GENDER-BASED CHALLENGES OF FEMALE TEACHERS IN THE TEACHING OF CIVIL TECHNOLOGY IN SELECTED SECONDARY SCHOOLS IN GAUTENG PROVINCE

by

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DECLARATION

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Dedication

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Abbreviations

4IR:	Fourth industrial revolution
CAPS:	Curriculum and Assessment Policy Statement
CGE:	Commission for Gender Equality
CPUT:	Cape Peninsula University of Technology
DBE:	Department of Basic Education
DIY:	Do-it-yourself
FET:	Further Education Training
IDMEC:	Investigate, design, make, evaluate, and communicate
ILO:	International Labour Organization
IPS:	Intelligentsia Publishing Service
IR:	Industrial revolution
MET:	Manufacturing, engineering and technology
NCS:	National Curriculum Statement
NDP:	National Development Plan
NSTF:	National Science and Technology Forum
PAT:	Practical assessment task
STEM:	Science, Technology, Engineering and Mathematics
UN:	United Nations Organization
UNESCO:	United Nations Educational Scientific and Cultural Organization
UNICEF:	United Nations International Children's Emergency Fund

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Abstract

Civil Technology is a specialised Technology subject in the Further Education and Training Band focusing on the concepts and principles in the built environment and on the technological process. The subject requires teachers and learners to be able to use hand tools in the workshop and operate the machines. There is however a belief that this subject should be reserved for male teachers only, thus raising gender-equality issues in the subject. Gender inequality in the workplace, specifically in this subject, that is informed by looking down on the abilities of females and referring to them as inferior is considered a gender issue. This issue emanates from the long-term impact of traditional gender role beliefs in society. It is for this reason that the aim of this study was to explore the gender-based challenges faced by female teachers in teaching the Civil Technology subject in selected technical high schools in Soweto in the Gauteng Province. Seven Civil Technology teachers (three males and four females) in the Johannesburg Central District were purposively selected from four schools, interviewed and observed during practical lessons. The findings showed that female teachers face numerous gender-based challenges when teaching Civil Technology. These include a lack of trust from some of their male counterparts and the shortage of tools and machines which led to them failing to plan the delivery of practical lessons. However, some male teachers believed that female teachers could teach the subject and needed to be encouraged. The study's significance lies in the fact that it highlights issues of the treatment of women in fields that are traditionally dominated by or reserved for men. Women's challenges should be addressed and effective solutions found to liberate them from stereotypes. By examining these issues, the study contributes to the broader discourse on gender equality, offering valuable insights and strategies to promote inclusivity and opportunities for women in technical education.

Keywords: Gender inequality, challenges, Civil Technology, female teachers, Technical Education.

Tshobokanyo

Thekenoloji e e dirisiwang mo Kagong ke serutwa sa Thekenoloji ya boitseanape mo Legatong la Thuto le Katiso ya Tlaleletso se se tsepamisang mo dikgopolong le melawanatheo ya mo kagong le mo mekgwatirisong ya thekenoloji. Serutwa se tlhoka gore barutabana le barutwana ba nne le bokgoni jwa go dirisa didiriswa tse di dirisiwang ka seatla mo bodirelong le go dirisa metšhini. Le fa go ntse jalo, go na le tumelo ya gore serutwa seno se tshwanetse go beelwa barutabana ba banna fela, ka jalo go tsosa mathata a a ka ga go lekalekana ga batho ba bong jo bo farologaneng mo serutweng. Go kgethololwa ka ntlha ya bong mo lefelotirong, segolo bogolo mo serutweng seno, go go bakilweng ke go nyenyefatsa bokgoni jwa basadi le go kaya gore ga ba dire tiro e e siameng go tsewa jaaka bothata jo ba bo itemogelang ka ntlha ya bong jwa bone. Bothata jono bo tswa mo ditlamoragong tsa pakatelele tsa ditumelo tsa setso le tse di tlwaelegileng tsa ditiro le maitsholo a a solofetsweng mo bathong ba bong jo bo rileng mo setšhabeng. Ka ntlha ya lebaka leno, maikaelelo a thutopatlisiso eno e nnile go sekaseka dikgwetlho tse di amanang le dikamano tsa banna le basadi tse di itemogelwang ke barutabana ba basadi mo go ruteng serutwa sa Thekenoloji e e dirisiwang mo Kagong mo dikolong tse dikgolo tse di tlhophilweng tse di neelang thuto e e amanang le tiro e e rileng tsa kwa Soweto mo Porofenseng ya Gauteng. Barutabana ba le supa ba Thekenoloji e e dirisiwang mo Kagong (banna ba le bararo le basadi ba le bane) mo Sedikeng sa Bogareng sa Johannesburg ba tlhophilwe ka lebaka mo dikolong di le nne, ba botsoloditswe le go lebelelwa ka kelotlhoko ka nako ya dikamuso tse go dirwang ditekeletso mo go tsone. Diphitlhelelo di bontshitse gore barutabana ba basadi ba itemogela dikgwetlho di le mmalwa ka ntlha ya bong jwa bone fa ba ruta Thekenoloji e e dirisiwang mo Kagong. Tsone di akaretsa go sa tshepiwe ke bangwe ba badirammogo ba bone ba banna le go tlhaela ga didiriswa le metšhini go go dirang gore ba palelwe ke go rulaganyetsa go ruta kamuso e go dirwang tekeletso mo go yone. Le fa go ntse jalo, barutabana bangwe ba banna ba ne ba dumela gore barutabana ba basadi ba kgona go ruta serutwa le gore ba tlhoka go rotloediwa. Botlhokwa le bokao jwa thutopatlisiso bo ikaegile ka ntlha ya gore e gatelela mathata a mokgwa o basadi ba tsholwang ka one mo maphateng a ka tlwaelo a laolwang ke banna kgotsa a a beetsweng banna. Go tshwanetse ga samaganwa le dikgwetlho tsa basadi go bo go fitlhelelwe ditharabololo tse di nonofileng tsa go ba golola mo ditumelong tse di rileng tsa karogantsho ya batho.

Ka go sekaseka mathata ano, thutopatlisiso e nna le seabe mo tshekatshekong e e anameng thata e e ka ga tekatekano ya batho ba bong jo bo farologaneng, e neela bokgoni jo bo mosola jwa go tlhaloganya le ditogamaano go rotloetsa go akarediwa ga batho botlhe kwa ntle ga kgetholololo le ditšhono tse di neelwang basadi mo thutong e e amanang le tiro e e rileng.

Mafoko a botlhokwa: Go kgetholololwa ka ntlha ya bong, dikgwetlho, Thekenoloji e e dirisiwang mo Kagong, barutabana ba basadi, Thuto ya Thekenoloji.

Isirhunyezo

I-Civil Technology kusifundo seThekhnoloji ekhethekileko eMkhakheni weFundo eRagela phambili kanye neBandulo (Further Education and Training Band) itjheja imiqondo neenkambisolawulo ebhodulukweni lokwakha begodu eenkambisweni yethekhnoloji. Isifundo sifuna abotitjhere nabafundi bakghone ukusebenzisa iinsetjenziswa zesandla kusifundobandulo bese kusetjenziswa imitjhini. Yeke, kunekolelo yokobana isifundwesi kufanele sibekelwe abotitjhere abaduna kwaphela, ngikho kuba neendatjana zokulingana kobulili esifundweni. Ukungalingani ngobulili emsebenzini, khulukhulu kilesisifundo, esifundwa ngokuqalela phasi amakghono wabantu bengubo begodu babathathe ngokuthi basezingeni eliphasi lokho kuthathwa njengendaba yobulili. Indaba le isukela esikhathini sakade esithinta ngokwendabuko iinkolelo zendima yobulili emphakathini. Kungesizathu lesi ekutheni umnqopho wesifundwesi kwabe kukuhlola iintjhijilo abotitjhere ababomma abaqalene nazobabantu ekufundiseni isifundo se-Civil Technology bengubo abaqalene nazo eenkolweni zamabanga aphakemeko eSoweto ngesiFundeni se-Gauteng. Abafundisi/Abotitjhere abalikhomba be-Civil Technology (abathathu abaduna nabane abasikazi) esiYingini se-Johannesburg Central District bakhethwa ngehloso eenkolweni ezine, bahlungwa begodu batjheja ngesikhathi seemfundo eziphrakthikhali. Imiphumela yaveza bona abotitjhere bengubo baqalene neentjhijilo ezinengi ezimayelana nobulili lokha nabafundisa i-Civil Technology. Lokhu kufaka hlangana ukungathembeki kwabanye babalingani babo abaduna begodu nokutjhoda kweensetjenziswa kanye nemitjhini eyenza bona babhalelwe kuplana ukwethulwa kweemfundo zamaphrakthikhali. Yeke, abanye babotitjhere abaduna bebakholwa bona abotitjhere bengubo bangakghona ukufundisa isifundo begodu batlhoga ukukhuthazwa. Ukuqakatheka kwesifundo kuphathelene nokuthi kuveza iindaba zokuphathwa kwabomma emkhakheni ngokwendabuko onabobaba abanengi namkha ebekelwe bona. Iintjhijilo abomma abaqalene nazo kufanele zilungiswe begodu kube neensombululo ezizwakalako okutholakele bona zibatjhaphulula abathatha bona vele kunjalo. Ngokuhlola iindabezi, isifundo senza umnikelo eenkulumeni ezinabileko ezimayelana nokulingana ngobulili, esinikela imibono eqakathekileko kanye namaqhinga wokuthuthukisa ukufakwa hlangana kwabomma kanye namathuba wabomma eemfundweni ezithekhnikhali.

Amagama aqakathekileko: Ukungalingani ngobulili, iintjhijilo, iThekhnoloji yoKwakha (Civil Technology), abotitjhere abasikazi, IFundo eThekhnoloji.

Chapter 1

Orientation to the Study

1.1 Introduction

Technology Education is a subject that provides an opportunity for learners to study the ever-changing advancements of society and provides a base for careers such as engineering (Kalka, 2010:2). It was introduced in the late nineteenth century as manual training to prepare males for the world of work (Kalka, 2010:9). Technology is not just the things that people create but includes the entire infrastructure needed to design, manufacture, operate, and repair technological artifacts. Learners and teachers should know how to use new technologies, understand how they are developed, and have the skills to analyse the ways that new technologies affect individuals, nations, and the world (Sneider, 2011:31). Technology Education engages learners in a wide variety of content and skills such as thinking critically to solve technological problems, engineering, and science concepts as well as communication technologies, so much so that it is crucial that learners become technologically literate (Kalka, 2010:9). Technological literacy is the ability to use, manage, understand, and assess technology.

Civil Technology, as a specialised technology subject in the Further Education and Training (FET) Band, focuses on the concepts and principles in the built environment and on the technological process. It embraces practical skills and the application of scientific principles (Department of Basic Education [DBE], 2014). Civil Technology aims to create and improve the built environment to enhance the quality of life of the individual and of society, and to ensure the sustainable use of the natural environment. The three main areas of the Civil Technology subject are civil services, construction, and woodwork (DBE, 2014).

Seemingly a stereotype still exists that this subject is only for males as per the above assertion by (Kalka, 2010). The existence of glaring gender disparities in the participation in science and technology based on gender is a global concern, hence, a need to engage in developing strategies to encourage females to intensify their interest and participation in these areas, while ensuring that boys and men stay on

(Kimani & Mwikamba, 2010). Master, Meltzoff and Cheryan (2021) emphasise that the prevalence of negative stereotypes about women's and girls' abilities contributes to the gender disparities in Science, Technology, Engineering and Mathematics (STEM). Even if women persist to become STEM faculty and working professionals, they tend to have lower visibility in their fields than male colleagues (Eddy & Brownell, 2016). I believe that to achieve technological and engineering literacy, it must start in the technical high school where learners are prepared for the engineering world after school. The Civil Technology subject requires that teachers must be fully prepared with all the knowledge and resources to prepare the learners. Specifically, and for the purposes of this proposed study, female teachers need the motivation to overcome their lack of self-confidence and the belief that technical subjects are for male teachers only.

There are nine technical high schools around Soweto and the Department of Technical Subjects in each school is dominated by male teachers. Since I began working at a technical high school as a Civil Technology teacher, I have observed that capable females in technical fields have less confidence than men and, as a result, they, as females, do not believe that they can be as successful as their male counterparts. The capability of female teachers can be discerned through the positive outcomes they consistently achieve in their schools. Researchers at Stanford University recently published new findings that female engineering students perform as well as men but are more likely than men to switch to a different major subject (Crawford, 2012). These women switch over to other subjects because they do not believe that their skills are good enough and they do not feel like they 'fit' in engineering (Crawford, 2012). The other reason could be that females suffer the stigma about STEM fields being paraded as male fields and opportunities are not being opened for them in the field. If women could be technical, why are they less confident that they will be successful compared to men? The reason is that the men that I have observed and worked with assume that they are better than women at technical things; for example, when we are in our practical training workshops, male teachers want to dominate and do all the tasks. Even when a female teacher asks for help, men usually take the project and do it themselves because they think female teachers are not capable enough.

Practical work is teaching and learning that involves the students observing or manipulating real objects and materials at some point. Civil Technology as a technical subject is intended to be more practically oriented, less theory should be taught (Maeko & Khoza, 2018). Civil Technology embraces practical skills and the application of scientific principles (DBE, 2014). As stated above, this subject is divided into three sections, i.e., woodwork, construction, and civil services. For each section, there is practical work that must be done. Some female teachers still have the misconception that all these sections are reserved for males only. I have observed that female teachers still think that men can do a better job than they can. Many female teachers will likely struggle to use some of the heavier machines and, as a result, they might avoid doing practical activities. This might be a problem because the Curriculum Assessment Policy Statement states clearly that 50 per cent of contact time must be for theory lessons and the other 50 per cent for practical lessons (DBE, 2014). Therefore, learners should not be limited to theory only, or have fewer practicals provided for them, to be able to enter a career pathway at a FET college or university immediately after obtaining their national certificate. Another factor contributing to female teachers not being able to operate the machines is the lack of resources in some schools whereby these female teachers believe that, if they were exposed to the necessary machines and tools, they would be able to practice using the machines and, thus, their skills and practice would improve.

This study aims to explore the views of female teachers regarding the gender-based challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng province and how these challenges affect their practice. The study would add to the body of knowledge in terms of helping to change the mindset of males and females about technical careers. As a female teaching Civil Technology, it is my wish to see my female learners being very confident and motivated to pursue a career in science and STEM-related fields. As a teacher, I need to show the same attributes that I want to see from my female learners. If I go into a workshop with less confidence, or ask for assistance from male counterparts unnecessarily, this would be proof that females are perceived to be less competent, and this mindset would continue to the next generation. Mentorship will play a central role in developing a new generation of talents that align with rapid advancements and developments in the field (De Swardt,

Zimri & Camara, 2021). Confident and motivated female teachers are the start of this change.

1.2 Rationale

There are nine technical high schools around Soweto and the Department of Technical Subjects in each school is dominated by male teachers. Despite the noticeable progress achieved in education, gender differences and inequalities persist (Statistics South Africa [StatsSA], 2004–2014:2). The picture of STEM subjects in South Africa presents a dominance of males who are qualified in these subjects, with a concomitant male dominance in the STEM-related occupations, such as teachers, engineers, and architects (StatsSA, 2004–2014:2). Women make up a minority of the world's workforce in STEM fields (De Swardt et al, 2021). Since I began working at a technical high school as a Civil Technology teacher, I have observed that capable women in technical fields have less confidence than men do and that, as a result, they, as women, do not believe that they could be as successful as their male counterparts. As a result, women seem to have some form of self-doubt that may inhibit them from pursuing STEM subjects or courses. This self-doubt may be enhanced by cultural perspectives that continue to perpetuate the notion that men are more competent than women are. The dominance referred to above plays a role in this self-undermining attitude in women. Also, women's doubt may be enhanced by some teachers or lecturers who continue to (either subconsciously or consciously) amplify the narrative that women may not be successful in pursuing science, adding to the perception that science is a man's field. This form of discrimination is prevalent at workplaces (De Swardt et al., 2021). Therefore, the motivation behind the study is to understand the challenges that female teachers deal with in a department that is male dominated.

1.3 Problem Statement

There are anecdotal observations of female teachers teaching Civil Technology facing challenges in respect of how to operate some machines in the technical workshop in some secondary schools in Gauteng. Female teachers face challenges in teaching the Civil Technology subject because of gender issues that are informed by perceptions that the subject is for males only and, therefore, they do not have confidence in themselves. Botella, Rueda, Lopez-Inesta and Marzal (2019) state that females

currently working in technological sectors find several barriers that prevent them from progressing in their professional careers. The barriers include a lack of female role models, a lack of mentors to support them during their professional careers, gender bias in the workplace, and the lack of a strong professional network support. Educational systems should have in mind the need to introduce the gender debate into different areas of education, from teacher training to subject knowledge definition, to change traditional gender roles and stereotypes (Esteves, 2018). Yet there has not been much research done on the challenges that female teachers face in teaching Civil Technology in the above-stated context, which is the reason why I became interested in conducting a study into this problem. This problem leads to the stated research question in 1.3.1 and its related sub-questions.

1.3.1 Research question

The main research question is:

What are the gender-based challenges faced by female teachers in teaching Civil Technology in secondary schools?

The main research question leads to the following sub-questions:

- What are female teachers' understanding of gender-based challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng?
- How do male teachers perceive the participation of female teachers as Civil Technology teachers in secondary schools?
- How do these challenges affect the female teachers' practice?
- How do these female teachers respond to the gender-based challenges?

1.4 Aim and Objectives

The aim of this study was to explore the challenges faced by female teachers in the teaching of Civil Technology in selected secondary schools in Gauteng. This aim was achieved through the following research objectives:

- To examine female teachers' understanding of the challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng.

- To assess male teachers' perceptions of the participation of female teachers as Civil Technology teachers in secondary schools.
- To understand the effect of these challenges on female teachers' practice.
- To establish the response of these female teachers to gender-based challenges.

1.5 Significance of the Study

This study contributes to the limited literature on the challenges faced by female teachers in the teaching of Civil Technology in technical high schools. The mentality of the technical department being male dominated should be discouraged by helping female teachers boldly venture into this subject field. As a former Civil Technology teacher and the only female who was teaching Civil Technology in my school, I have realised that I am not the only one who was having difficulties demonstrating the practicals to learners and being afraid to use some machines and tools, which explains why the department is dominated by males. This motivated me to embark on a study that aimed to explore the challenges that female Civil Technology teachers face in teaching Civil Technology. South Africa lacks female engineers because they are afraid of the challenges in the field. The counterargument is that technical subjects like Civil Technology can help to empower female teachers to inspire their female learners into taking technical subjects as their choice of career to be able to pursue engineering careers.

1.6 Overview of Research Methods

The critical theory paradigm was used for this study. Terhoeven (2009:45) defines a paradigm as a worldview that includes certain philosophical assumptions about the nature of knowledge. The critical theory seeks human emancipation in order to liberate human beings from the circumstances that enslave them. The study intends to contribute towards the emancipation of female Civil Technology educators from the perception of gender-based challenges faced in teaching the subject so that they can deliver practical lessons with confidence. It also challenges the status quo, which is the perception that Civil Technology subject is for male teachers only, and strives for a balanced and democratic society (Asghar, 2013:10) where female Civil Technology

teachers will be seen as equal to their male counterparts and will be confident to deliver the practical lessons in the classroom.

This study adopted a qualitative research approach. Qualitative research investigates people's experiences (Silverman, 2020:3) and emphasises gathering data on the naturally occurring phenomena (McMillan & Schumacher, 2014:31). People's experiences are examined in detail by using a specific set of methods such as interviews and observations. Therefore, this study used interviews to understand the experiences, views, and challenges faced by female teachers when teaching the Civil Technology practical lessons, and observations to see and hear how female teachers deliver practical lessons in the workshops. These approaches provided a clear description and understanding of their challenges.

As I wished to gather information on the unique, non-standardised, and personalised information about experiences and challenges, and how female teachers view the teaching of Civil Technology as a subject, a qualitative, structured interview was ideal for the study. "A structured interview is one in which the content and procedures are organized in advance" (Cohen, Manion & Morrison, 2011:414). My goal in using the structured interview was that, apart from it being less time-consuming, with less preparation needed for the interviewees, the structured interviews would be more credible because participants would be asked same questions in the same order, which would make it easier to compare the answers (George & Markum, 2022). The structured interview assisted in collecting useful information from the participants as the questions were set well in advance; therefore, the participants would not be able to deviate from the questions asked.

To get accurate data in an interview, it was imperative that I, the interviewer, do my job well (such as establishing rapport, and asking questions in an acceptable manner,) this means conducting interviews with honesty and clarity (Cohen et al., 2011:409). A trust relationship between the selected participants and me, as the interviewer, should be established. It is important that participants feel comfortable by having a fair conversation with them. My curiosity, desire to know, learn about people's views and facts, hear their stories, and discover their feelings encouraged me to tackle and overcome difficulties in setting up and conducting successful interviews.

As a participant observer, I conducted observation by taking part in the workshop activities as a regular member of the group on the day of the observation (McMillan & Schumacher, 2014). As a participant observer, I observed naturally occurring behaviour and facilitated a deep understanding of the context and participants' behaviour, allowing for the collection of data that reflects the significance of the context's effect.

The purpose of research design is to specify a plan for generating empirical evidence that will be used to answer the research questions of the study (McMillan & Schumacher, 2014:27). A phenomenological design was ideal for the study as it could facilitate the exploration of the lived experiences of female Civil Technology teachers during the teaching or demonstration of practical lessons and understand the meaning of those experiences. Blanche, Durrheim and Painter (2006: 36) explain research design as a strategic framework, a plan that guides the research activity to ensure that sound conclusions are reached regarding the aims and objectives of the study. The overall decision involves which design should be used for the study. Interviews were chosen as a method of data collection to allow female teachers to discuss their interpretations of delivering practical lessons in a Civil technology classroom and to express how they regard the situations they encounter from their point of view (Cohen, Manion & Morrison, 2011:409).

Purposive sampling is a sampling technique in which the rese archer relies on their own judgment when choosing members of the population to participate in a study (Survey Tips, 2021). Purposive sampling was appropriate for the study because of the limited number of subject teachers who were able to contribute to the study (Dudovskiy, 2016). It is also time- and cost-effective, and only focuses on the best fit participants to answer the research question (Survey Tips, 2021). The target population for this study was secondary school Civil Technology teachers in Gauteng. The sample consisted of a combination of female teachers who were still new in the field (less than five years' experience) of teaching the Civil Technology subject and both male and female teachers who had been teaching Civil Technology subject for more than five years. These participants were selected based on their experience because they were a close fit to the research context, and their qualitative responses

could lead to better insights and more precise results in order to achieve the research objectives (Ekwegh, 2017), to determine whether or not the challenges that female teachers face became easier with the experience, and also to understand how male teachers perceive the participation of females as Civil Technology teachers.

Thematic data analysis, which is a good approach to discovering people's views, opinions, knowledge, and experiences (Caulfield, 2019), suited this study. The views, opinions, knowledge, and experience of female teachers were discovered. Data analysis continued during and after the data collection process and was interpreted using following the steps: familiarisation; coding; generating, reviewing, defining, and naming themes; and writing up the findings to provide answers to the research questions of this study. Data were verified throughout the data-gathering process to ensure accuracy and reliability. The reporting of data should be fair and should be determined by the nature of data collected. Important things to report included the context of the study, methodology used, how the data were analysed, and the discussions of what the results mean.

1.7 Key Terms

Vocational Education

Vocational education is education with a curriculum that is tailored to the fields and expertise of students (Rosina, Virgintina, Ayyash, Dwiyanti & Boonsang, 2021). This curriculum begins in secondary schools with subjects such as Civil Technology. The participation of females in this curriculum is vital for the growth and development of society, as well as for gender justice. Vocational education can also enhance the quality of women in society and equip them to better participate in vocational programmes. Vocational programmes are designed to prepare young people for broad vocational areas and citizenship or, more narrowly, for specific jobs (Fuller, 2015). In a world where the wave of technological revolution is spreading, the fourth industrial revolution (4IR) is a new era that merges artificial intelligence with human life to undertake tasks and solve daily problems. Machines and technologies have become widely used tools to improve the quality of people's lives. Therefore, a proper education, which is known as vocational education, can produce graduates with high

vocational skills and equip them with technical knowledge (Hong, Ch''ng & Roslan, 2021). Those graduates should include women.

Technology Education

Gumbo (2016) defines Technology Education as a school subject that is taught to learners. Gumbo (2018) further explains that the intention of this subject is to promote technological literacy in learners and to qualify them as engineers, artisans, and technician. Learners learn about the processes and knowledge related to technology (Vikram, 2021). They are provided with learning experiences that prepare them for the ever-changing world of technology. These experiences are aimed at enhancing their quality of life, since they can acquire the skills necessary to solve real-life problems faced by both men and women in this modern world of technology.

Gender roles

Gender roles refers to the socially constructed roles, behaviours, activities, and attributes that a given society considers appropriate for women (Wikieducator, 2012). Esteves (2018) clarifies this statement by explaining that, back in history, both men and women had social roles shaped by culture and society. The roles and responsibilities assigned to women and men based on stereotypes have relegated female teachers to a subordinate status in the teaching of Civil Technology as a subject (Lefa, 2015). If women would be treated equally to their male counterparts, this would eradicate gender-based challenges and gender roles in society.

1.8 Chapter Outline

Chapter 1: Introduction

This chapter introduces the study and covers, among other things, the research problem, questions, aims, and motivation of the study.

Chapter 2: Scholarly Literature Review

This chapter discusses and presents a literature review pertaining to the problem being addressed by the study.

Chapter 3: Research Methods and Design

The chapter describes and justifies the research methods used in the study.

Chapter 4: Data Analysis and Presentation of Findings

This chapter presents the analysis, presentation, and interpretation of the findings.

Chapter 5: Conclusions and Recommendations

In this chapter, I conclude the study and make relevant recommendations.

1.9 Conclusion

This chapter provided an orientation into the study regarding the challenges that female teachers are faced with in TVET schools in Gauteng. In the chapter, a gap was identified within the existing literature, which led to the stating of the research problem, followed by the research problems and objectives. Based on the identified gap, the study is deemed significant, which is accounted for in the chapter. hence, the study unfolded, and the problem was thus investigated. The chapter briefly presents how the problem was investigated. The chapter ends by outlining the ensuing chapters. In the of this, the next Chapter 2 presents the literature review relevant to the problem.

Chapter 2

Literature Review

2.1 Introduction

This chapter presents a review of the literature that is relevant to understanding the development and depiction of the findings of this study. It provides the necessary background information on technology and technology education, as well as Civil Technology as a subject in secondary schools. The chapter also reviews the literature on the knowledge and skills of female teachers teaching Civil Technology in secondary schools. Most importantly, the chapter presents the surveyed literature on the understanding of gender-based challenges faced in the teaching of Civil Technology. The last section of this chapter describes, motivates, and accounts for the application of the theoretical framework underpinning this study.

2.2 Technology

Technology is the ability to provide practical solutions to everyday real-life situations or problems. The Technology subject in schools equips learners with knowledge and skills to be technologically literate. We live in a technological environment, expanding at an ever-increasing pace, where the natural world is shrinking (Ankiewicz, 2003:3). The world that people live in largely depends on technology, hence the importance of the Technology subject in schools. In South African schools, Technology is introduced from grades 7 to 9. The subject prepares learners with a better understanding of different careers and to be able to choose their stream of specialisation when they get to Grade 10.

Technology not only means the use of logical knowledge for purposes of practice but also for developments in computer abilities (Rootman & Krüger, 2020). Technology also denotes equipment and machinery that are developed from scientific knowledge. This means the knowledge that is focused on applied sciences or engineering (Visagie, Scheffler, Seymour & Mji, 2020). South Africa boasts in one of the largest communications and information technology markets in the world; the country shows leadership in technology, mainly in electronic banking services, and mobile and

security software (Aruleba, Jere & Matarirano, 2022). These are some of the key areas of technology that learners should be trained to venture into.

In an educational context, Technology can be defined as the 'use of knowledge, skills, values, and resources to meet people's needs and wants by developing practical solutions to technological problems, taking social and environmental factors into consideration' (DBE, 2011:8). The intention of the subject is to introduce learners to basics needed in Civil Technology, Electrical Technology, Mechanical Technology and Engineering Graphics and Design (DBE, 2011:8). Technology can also be seen as a tool to enhance teaching and learning, for example the use of media, gadgets, and internet.

Prior 1994, South Africa's government lacked transparency in terms of state support for technology and science. The national government focused heavily on the parastatal establishments and programmes that were designed for competency build-up (Jegede & Ncube, 2021). In 1995, the government and stakeholders developed a Green Paper to cover broader public participation and discussion on the development of policy strategies and objectives. The main outcome was the 1996 White Paper on technology and science titled *Preparing for the 21st Century* (Motala & Pampallis, 2020). The preparation of the 21st century begins at school with competent, trained, and confident teachers to offer the Technology subject.

Technology is one of the subjects taken by learners in grades 7 to 9 in preparation for the 21st century. Since the subject was introduced in 1998 and revised in 2002, most teachers are still battling with its implementation (Makgato, 2014). The science, STEM teacher education in the 21st century is most important and more challenging than it was a century ago (Ge, Ifenthaler & Spector, 2015); hence, the introduction of Technology as a school subject triggered an urgent need for in-service Technology teacher training as part of teachers' professional development (Makgato, 2014).

Despite the above-mentioned progressive policies, together with policies on gender equality and equity in the country, a gender bias still exists in the teaching and learning of technology. Starovoytova and Cherotich (2016) state that, when a group is underrepresented in a system, then that system is elitist. In this case, the elite group

has been, and continues to be, male; thus, females might feel 'out of place' in the system (Starovoytova & Cherotich, 2016). Women are sidelined in the STEM fields, despite existing evidence that they can excel in these fields. For example, Dr Anne-Marie Brennan loved science as a young girl but, instead of encouraging her, those who were around her tried to steer her in the direction of studying nursing, teaching, and secretarial courses (Intelligentsia Publishing Service [IPS], 2020). Today Brennan is the vice president of science engagement at the Foundation for Science, Technology and Civilisation in the United Kingdom (IPS, 2020).

Ankiewicz (2021) states that before 1998, only a few South African schools had Technology as a non-examination subject in their curriculum for Grades 10 to 12. In junior secondary schools, industrial arts (comprising of woodwork and metalwork) was a compulsory subject for boys and home economics was a compulsory subject for girls. Technical schools were boys-only schools at the time, which is the reason why attracting girls to engineering has been a problem since the inception of STEM education. However, technology investment in schools has increased in the last two decades to equip learners with a set of competencies to be competitive in the skills that are required in the 21st century (Lim, Zhao, Tondeur, Chai & Tsai, 2013).

Technology provides teachers and learners with access to a variety of educational resources that inspire creativity, critical thinking, communication, and collaboration (Knowing Technologies, 2015). It ultimately exposes students and teachers to new online global communities; this, in turn, promotes a global awareness, which is an essential component of a 21st century education (Knowing Technologies, 2015). The evolution of technology is always difficult for those who are unaccustomed to change, however, it is necessary to keep up with the needs of the 21st century (Gumede, 2020). South African teachers and learners have to prepare for changes in the curriculum so that it can fit well in the international space because the future of South African education in the fourth industrial revolution (4IR) anticipates something along the lines of having robots as teachers (Gumede, 2020). Teachers should be viewed as agents of change in 4IR, therefore their attitudes towards technology may either be developmental or destructive in terms of advancing a learner's progress in the 21st century. The question is why does the underrepresentation of women matter? Research shows that individuals from different genders, backgrounds, races, and

experiences bring different perspectives that can lead to innovative solutions (Stofan, 2017). Therefore, gender balance is important, and more women should be encouraged to participate and be confident in STEM education. STEM fields are key to reaping the rewards of 4IR. The following paragraph provides an insight into the purpose of technology education in schools.

2.3 Technology Education

The term Technology Education is commonly used in South Africa, though in the Curriculum and Assessment Policy Statement (CAPS), the term Technology is used. Other countries, such as China, use the term 'technical and vocational education'. Technology Education, as explained in the previous chapter, is the school subject that is taught to learners. It is intended to promote technological literacy in learners and to qualify them as engineers, artisans, and technicians. It is the education that provides learners with the knowledge and skills to tackle everyday life situations and to prepare them for the world of work after matric. The three main aspects of Technology Education are: a) technology as the discipline for learning and teaching; b) technology as learning; and c) technology as teaching (Vartiainen, Tedre, Salonen & Valtonen, 2020).

The focus of Technology Education is directed at skills provision to make learners employable or enable them to become self-employed (Mtshali & Ramaligela, 2019). Code, Ralph and Forde (2020) state that Technology Education means studying technology, wherein the scholars learn the knowledge and processes about technology. Gumbo (2016:14) shares the same sentiment by stating that it is a 'subject that provides learners with opportunities to learn the knowledge, skills and processes that pertain to technology and how they can apply these using different materials and techniques to effectively manipulate the environment while taking into account the issues of a sustainable environment'. Maeko and Makgato (2020) explain Technology Education as a formal type of education for providing suitable skills, practical skills, and scientific knowledge to prepare learners to join the labour market. It is also expected that Technology Education will provide learners with some experience to help them make career-oriented subject choices at the end of Grade 9 (DBE 2011:9). Hands-on skills, like problem-solving skills, the use of hand tools, do-it-yourself (DIY)

skills, and machinery use are found in many subject areas of Technology Education such as Electrical Technology, Mechanical Technology, and Civil Technology.

Buckley, Seery, Gumaelius, Canty, Doyle and Pears (2021) state that for grades 4 to 6 in South Africa, Technology Education comprises subjects like Natural Sciences and Technology for grades 7 to 9, while in the Further Education Training (FET) band (grades 10 to 12), Technology covers subjects like Civil Technology, Engineering Graphics and Communication, Mechanical Technology, and Electrical Technology. Technology Education involves the practical application and understanding of elementary mathematics and science principles, instead of attaining manual skill proficiencies (Cortés, Guix & Carbonell, 2021). Davies (2020) states that the South African government developed the National Development Plan (NDP) 2030 and created the Cape Peninsula University of Technology (CPUT) by merging the Peninsula and Cape technikons to embrace innovation and Technology Education so that students are transformed through access to world-class researchers, who inspire knowledge production and innovation that are cutting edge. The sustainable 2030 development goals are founded on the principle of ‘leaving no one behind’, which means that women play an important role in making innovation and technology work (United Nations [UN] Women, 2017). Therefore, in achieving the 2030 NDP, women should be encouraged to take advantage of STEM careers so that they are not left behind, and the gender inequality in the technology sector is eradicated (UN Women, 2017).

In addition, the provincial governments, businesses, and education institutions are improving awareness of STEM abilities among secondary and primary learners, mainly in computer and science laboratories (Abe & Chikoko, 2020). South Africa's National Science and Technology Forum (NSTF) has developed the 'STEMulator', a shared digital platform for stimulating learner curiosity, interaction, exploration, and knowledge of STEM (NSTF, 2021). Empowering girls and women to enter STEM fields of study and careers, and stay the course, is imperative (United Nations Educational Scientific and Cultural Organization [UNESCO], 2022), as they can contribute to the growth and development of the country (DigitalLearning Network, 2014). ‘Therefore, it is essential to take suitable measures for the expansion of vocational and Technical Education for women’ (DigitalLearning Network, 2014). However, too many girls and

women are held back by biases, social norms, and expectations influencing the quality of the education they receive and the subjects they study (UNESCO, 2022). They are particularly underrepresented in Technology Education and, consequently, in STEM careers (UNESCO, 2022). The National Policy for Women Empowerment formulated in 2001 aims to involve women in science and technology and vocational guidance and bring about social change in attitudes towards women and women empowerment (DigitalLearning Network, 2014). Vega (2016) opines that providing training in technology skills for women is vital to diminishing the gender division, and women should be introduced to technology at a younger age.

The next section focuses on the importance and background of Civil Technology as a Technology Education subject in secondary schools.

2.4 Civil Technology as a subject in secondary schools

Civil Technology is introduced as a subject of choice in secondary schools from Grade 10. The introduction of the 2006 National Curriculum Statement (NCS) and 2011 CAPS resulted in a change of subject names, and a reduction and combination of subjects. Part of this process was the development of Civil Technology as a subject. Civil Technology emanated from combining manufacturing, engineering, and technology (MET) or NATED 550 subjects, that is, plumbing civil technika; plastering and building; and woodworking and woodwork (DBE, 2011:3). According to the DBE's 2014 NCS, the focus of Civil Technology is the development of higher levels of learner skills and knowledge, mainly in civil services, construction, and woodworking. The subject sets very high employment prospects for all learners in South Africa (DBE, 2014). Civil Technology specifies the minimum skills and knowledge standards each learner must achieve in every grade and field. This includes explaining the functions, use, and care of specialised tools and equipment; evaluating the different manufacturing processes or construction methods; and defining and applying with comprehension the terminology used in Civil Technology (DBE, 2005). There is an emphasis on the application and use of new technologies to guarantee high skills and knowledge levels in learners (Isaac & Manto, 2019).

According to the DBE (2014: 10), as well as CAPS on Specialisation, Civil Technology concentrates on built environment principles and concepts as well as on the process of technology to embrace the use of scientific ideologies and practical abilities. The subject integrates both theory and practice. The (theory) content knowledge provides the basis for the acquisition of practical skills (Mtshali & Ramaligela, 2019). Civil Technology focuses on the creation and improvement of built environments to improve people's quality of life and to guarantee the sustainable application of natural environments (Mokhothu, 2020). The ultimate goal of the Civil Technology subject is to advance skill levels for learners in grades 10 to 12 and enable them to enter a professional path at a university or FET college immediately after attaining the National Senior Certificate (Albert & Makgato, 2020). The learners are ready to assume apprenticeships or learnerships, which prepare them for the trade test.

Civil Technology covers the following topics in secondary schools: safety, equipment, materials, terminology, construction, quantities, applied mechanics, civil services, joining, graphics and communications (Mtshali & Ramaligela, 2020). Mtshali and Ramaligela (2020) insist that in this 4IR era, the value of the Civil Technology subject to secondary school learners depends on the successful installation of employability skills in learners. The subject has an important role to play in making 4IR a reality by ensuring that learners can demonstrate an understanding of the industry; enhance their knowledge, skills, values, and reasoning abilities; establish connections with life outside the classroom; and address real-world challenges (Mtshali & Ramaligela, 2020). Therefore, the leading objective of Civil Technology is to guarantee that learners can demonstrate a clear understanding of the chosen industry, and demonstrate improved knowledge, reasoning abilities, skills, and values (Mtshali, Ramaligela & Makgato, 2020). Learners should establish relations with life beyond the classroom setting to resolve the actual challenges of real-life situations (DBE, 2019). As a subject, Civil Technology should enable learners to respond to the needs of the chosen industry and 4IR.

However, research by Maeko and Makgato (2020) has shown that what is available in schools for technology skills training is a situation of inadequate training facilities in the form of materials, tools, equipment, workshops, and inappropriate delivery method. This has a major bearing in how teachers prepare to teach practical lessons. The

teaching and learning of Civil Technology in some South African schools is currently of serious concern because learners graduate from Grade 12 without the requisite basic hands-on skills, which is why there is a growing need for teachers to prepare learners with efficient hands-on skills. This requires a more resourceful and enabling learning environment (Mtshali & Ramaligela, 2019). Teachers' knowledge for Civil Technology includes content knowledge, practical skills, instructional knowledge, environmental knowledge, content-related practical knowledge, and assessment knowledge (Mtshali & Ramaligela, 2019). Civil Technology teachers are required to have the required knowledge to teach the subject with confidence and flair, conduct practical sessions, produce working practical assessment task (PAT) projects (artifacts) in cooperation with learners, and regularly attend skills training workshops (DBE, 2014). Attending skills training workshops ensures that teachers are well equipped with the knowledge and skills to operate machines, and that they can complete projects on their own, so that they can deliver the practical lessons as they are required to, with confidence and flair (DBE, 2014)

The next section provides literature review on the history of gender issues and how they contributed to the study.

2.5 Gender Issues and Policies Related to the Treatment of Women

Gender inequality in the workplace, looking down on the abilities of another gender, referring to another gender as inferior, or any issue that results in gender/sex stereotypes are considered gender issues. These issues emanate from the long-term impact of traditional gender role beliefs on society (Dicke, Safavian & Eccles, 2019). The social roles of men and women have been influenced by the nature of the patriarchal society that has been dominant for many centuries in the Western world (Esteves, 2018).

Many indigenous cultures often promote patriarchy and sexism (Akala, 2018). Historically, gender roles – the socially constructed roles of men and women – have been ordered hierarchically with men exercising power over women (Wood, 2019:3). Akala (2018:234) opines that, in medieval times in Western communities, patriarchy was a noble duty, where men prided themselves in taking headship and protection

roles in their families. Patriarchy conceptualises women as inferior intellectually and physically (Akala, 2018:235).

On the other hand, Gumbo and Mapotse (2020), in their study titles *Indigenous Mining and its Criminalization*, alluded to the fact that one aspect of prehistoric mining in Africa is that it did not genderise the mining activities. Mining was approached as a family or communal activity, and women were engaged in the alluvial mining activities (Gumbo & Mapotse, 2020). 'However, with the industrialization and mechanization of mining at the end of the eighteenth century, women were gradually excluded from mining in part because of the emergence of the male breadwinner model and "laws" to protect women and children' (International Labour Organization [ILO], 2021). Although the lived experiences of women vary throughout the stages of their lives, traditional gender roles have often defined and limited women's activities and opportunities (ILO, 2021).

Considering the above-mentioned, Esteves (2018) thinks that, through education, it is possible to change social stereotypes and promote greater equality between the sexes, and so change dualistic and stereotypic norms. Promoting gender equality in science and technology education is now globally accepted as a developmental strategy for poverty alleviation, and for improving the health and living standards of both women and men for the socioeconomic development of a nation (Okoli, 2012). Considering that women and girls represent half of the world's population, providing them with equal access to education, health care, decent work, and representation in political and economic decision-making processes, will fuel sustainable economies and benefit societies and humanity at large (Esteves, 2018).

According to the European Institute for Gender Equality (2016), gender issues mean all interrelated concerns and aspects related to the lives of men and women, as well as societal situations, including differences in the use of and access to resources and activities, and reactions to changes, policies, and interventions. Therefore, the gender issue is any concern emanating from gender and/or sex differences between men and women. The main gender issue in the world, and in South Africa, is inequality in access to resources and treatment, autonomy, and opportunities (United Nations International Children's Emergency Fund [UNICEF], 2022). As the increase in gender inequality forms more obstructions for men and women, South Africa is embracing gender-

equitable programmes such as the women empowerment and gender equality bill, gender equity through the Department of Basic Education. Despite these efforts, women still experience gender bias and are underrepresented in the job market. Women accounted for 43.4 per cent of total employment in South Africa in the second quarter of 2021, dominating the domestic worker, clerk, and technician sectors, while men dominated the other sectors (StatsSA, 2021). In South Africa, gender issues arise out of the failure to fulfil Section 9 of the country's Constitution, which refers to equality with respect to unfair discrimination based solely on the grounds of race, colour ethnic or social origin, sex, religion, or language (Constitution of the Republic of South Africa, Act 108 of
1996).

Regarding Section 27(1) of the Constitution, gender issues arise when government, citizens, and other players in the private sector fail to offer everyone their right to access health care services; sufficient water, food and social security; protection of peoples' rights; promotion of equal protection; and unfair discrimination regardless of sex, gender, marital status, and pregnancy (Heywood, 2020). South Africa established the Commission for Gender Equality (CGE) to promote respect for gender, as well as gender protection, equality, development, and achievement. The CGE resolves gender issues in South Africa by protecting and promoting gender equality, undertaking needed research, policy development, public education, legislation, effective litigation, and monitoring (CGE, 2022). The appreciation and response to gender issues with gender equality programmes remains essential to the effective resolution of gender issues (CGE, 2022).

There is extensive research about gender equality in education as this has been a concern in many countries. Gender equality in education systems means equal educational policies for all girls and boys, as well as gender equality for teachers and administrators, but it cannot be achieved without a gender-responsive curriculum, and teaching and learning materials (Esteves, 2018). An analysis of how education can foster gender equality can be based on boys and girls receiving equitable treatment and attention, equal opportunities to learn, and exposure to the same curricula (not gendered). It also means that learners are exposed to teaching methods and materials that are free of stereotypes and gender bias (Esteves, 2018). This means having

female teachers who are seen as equal to male teachers and who are as confident as male teachers are to deliver the Civil Technology subject to learners. This takes us to the next section which elaborates on the low numbers of women participating in the Civil Technology subject in secondary schools, and the importance of having more women teaching the subject and more learners taking the subject.

2.6 Women Participation in Civil Technology

An observation I made while attending the subject meetings and workshops in the province is that there is a low number of female teachers teaching the Civil Technology subject in secondary schools. The male teachers always outnumber the female teachers. For example, Sedutla (2022), a senior education specialist (SES) in the Ekurhuleni South district in Gauteng indicated that there are four female and nine male Civil Technology teachers in the district. This raised a concern that led to the realisation that female teachers are experiencing the challenge of being underrepresented in the subject.

While more women are entering the STEM fields than ever before, there is still a large gap between the number of women and men enrolled in STEM fields as undergraduates (Dzombak, Moukkad & Mehta, 2016). A study by Veelen, Derks and Endedijk (2019) suggests that women working in male-dominated work contexts experience gender identity threats. In contrast to men, who hold 81 per cent, women hold 19 per cent of the technology-linked jobs in the top 10 international technology businesses today (Jacobs, 2021). StatsSA indicates an imbalanced proportion of males to females graduating with STEM degrees (Jacobs, 2021). Women remain under-represented in statistics and maths (5:4), as well as in technology and information and communications technology (5:2) (Jacobs, 2021). Statistics show a lower number of women in the STEM field. Popescu (2020) stated that, when there are new STEM opportunities, women gain only one STEM job while men gain five. As a result, there is a small pool of female participants in technology (Jacobs, 2021).

The WomeninTechZA's (2022) initiative suggests that women hold only twenty-three per cent of technology jobs in South Africa, covering only 56,000 of the 236,000 technology jobs in South Africa. There is a need to align the future workforce with

population realities because women constitute over half of South Africa's population (Asongu, Amankwah-Amoah, Nting & Afrifa, 2021). However, the technology sector is generally struggling to attract young females, regardless of the need to advance diversity in the workplace. Perry (2022) opines that the reason young women are not attracted to the sector is that, when they look at conferences in the media and inside technology companies, they see mostly men (who they cannot relate to) doing what they perceive to be boring jobs. A lack of female role models, gender stereotyping, and less family-friendly flexibility in STEM fields (Beede, Julian, Langdon, McKittrick, Khan & Doms, 2011) also contributes to little interest in the field by young women. In 2019 alone, girls made up over two-thirds of the learners in Itec Tiyende's Numeric Programme and improved in maths by about 15 per cent (Itec Tiyende, 2022).

The imbalance between women and men in South Africa's technology sector is not remediable unless universities, organisations, and schools collaborate to alter entrenched prejudices about the technology industry and educate youth in Civil Technology dynamics and career ranges in the world of technology (Kamberidou, 2020). Diversity prevails as vital to the future of applicable technology and society because South Africa cannot embrace technology for everybody if there is limited involvement in the production of technology (Akpey-Mensah & Muchie, 2021). There is a low number of female learners pursuing STEM subjects, as well as behavioural and cultural barriers that inhibit Civil Technology adoption. Family influence, self-efficacy, values, a sense of belonging, apparent difficulty, values, and gender are some of the factors influencing career decisions (Abe & Chikoko, 2020:2). The main barrier to the necessary gender equality in South Africa is the shortage of women representation in the workplace, especially in the positions of leadership (Smidt, 2021).

In education, particularly the teaching of Civil Technology, teachers should ensure that, while teaching, they promote active learning where learners gain practical skills that prepare them for artisanship after they complete their secondary schooling life, among other things (DBE, 2011). Mtshali and Ramaligela (2019) noted that hands-on skills training in schools offering Civil Technology is not functional. However, women being underrepresented in this subject is not an issue of inability. Stofan (2017) thinks that the reasons why the representation of women and girls in STEM is low are lack of encouragement, active discouragement, lack of role models, negative peer

pressure, and harassment. Women from underrepresented groups face prejudice, for example gender discrimination, favouritism of males over females in some jobs, and unequal treatment in society (Stofan, 2017). However, it is evident that women want to make a difference in the jobs that were originally meant for men only. For example, Molebogeng Pitso, a female carpenter in Kutloanong, owns a carpentry workshop. Molebogeng also teaches carpentry to other females who are interested in carpentry (Mbhele, 2022). Being a carpenter is one of the skills that learners can acquire in the Civil Technology subject, specialising in woodwork.

Women are embracing technology because enormous financial opportunities exist in equality and gender employee promotions (Adeleken & Bussin, 2022). The cultivation of women's interest in the STEM sector starts with leaders in the STEM sector who are champions of diversity (Ravanera, 2019). Designing early-age behaviour, change in Civil Technology teaching approaches, and role model celebration to counter stereotyping could help females to counteract bias in learner spaces (Nhamo & Mukonza, 2020). Furthermore, Nhamo and Mukonza (2020) reckon that the closure of the prevailing gap in Civil Technology participation needs early-age girl mentorship and education. It also requires the creation of safe and welcoming learner environments that allow smooth transitions from the classrooms to the office boardroom (Nhamo & Mukonza, 2020). Civil Technology education remains vital at 12 to 14 years of age because it is at this time that young females are most inclined to avoid STEM subjects (Babalola, Du Plessis & Babalola, 2021). The mentorship of females in Civil Technology would help them feel confident and supported to accomplish set dreams. The significant reskilling and upskilling (Tsusaka, 2020) of females in workplaces is vital to the promotion of Civil Technology because it provides them with an opportunity to advance their Civil Technology careers.

The following section discusses the knowledge and skills needed to teach the Civil Technology subject by female teachers.

2.7 Knowledge and Skills

Knowledge and skills in the teaching of Civil Technology refers to the theoretical and practical information that the teacher must pass on to the learners. In the teaching of

Civil Technology, the female teacher should be able to infuse practical skills into the theory taught in classrooms, and the teacher should equip learners with necessary skills to carry out practical projects in the subject.

The required Civil Technology knowledge and skills comprise equipping learners with theory on the design process, civil services, woodworking, and construction (Mtshali & Ramaligela, 2020). DBE (2014) states that the design process comprises skills, such as investigate, design, make, evaluate, and communicate (IDMEC). It is not so easy to become a true professional in the STEM fields and master all the necessary skills to implement these skills (Teramond, 2022). Unfortunately, gender discrimination takes place in STEM fields and plays a huge role in reducing the possibility for women to develop in STEM (Teramond, 2022).

However, IDMEC offers learners appropriate skills in practical planning. In the practical lessons, learners should develop skills in the PAT form (Makhubele, Simelane-Mnisi & Makgato, 2019). Therefore, teachers' Civil Technology knowledge comprises content knowledge, instructional knowledge, practical skills, content-related-practical knowledge, assessment, and environmental knowledge. While environmental knowledge is the teachers' ability to effectively operate and prepare equipment for the practical demonstration, preparing knowledge will, in the Civil Technology context, be based on their capacity to prepare tools and equipment that the learners employ for skills attainment (Isaac & Manto, 2019). Operational knowledge is the ability of the teacher to demonstrate the application of workshop tools and equipment.

Female teachers are qualified to transfer the IDMEC skills to learners. They know and understand the knowledge that is required to produce learners who will be ready to enter the world of work after matric. However, there is a need to motivate and encourage the female teachers who are teaching the subject so that they demonstrate these skills with confidence and pride. A study by Mtshali and Ramaligela (2019) revealed that teachers experience challenges with teaching large classes in the workshop, such as fixing and maintaining tools; limited knowledge in operating old manual tools and old machines that are not maintained or used; limited resources; as well as using machines and tools correctly. The exposure to the well-maintained machines and available resources in the Civil Technology workshop might be a good

thing to ensure that female teachers get sufficient practice in practical lessons, which would give them more confidence.

DBE (2014) indicates that the main skills required for the integrated accomplishment of Civil Technology's theory and PAT include practices of safe work, decent housekeeping, practices of first aid, interpretation of work drawings, structural erection, working to correct measurements, as well as workshop practice. Clear knowledge of and acquaintance with the practical skills and subject philosophies equips the Civil Technology learners with a unique skill set, placing them apart from the other learners, desired in industry, entrepreneurship, and tertiary institutions (DBE 2014). Balancing the numbers of female and male teachers in demonstrating the above-mentioned skills is of great importance to attract female learners to the subject, and to eliminate the stereotypes that threaten their confidence in STEM careers.

2.8 Theoretical Framework for the Study

Critical theory, which is a social theory oriented toward critiquing and changing society as a whole (Crossman, 2019), guided this study. Societal change in this study refers to changing attitudes towards female teachers related to their challenges with teaching a subject where they are underrepresented, because it is perceived to be suitable for males. Female teachers should be encouraged to look past their fear of male-dominated fields. Promoting gender diversity from the top down is one of the best ways to encourage more women to enter the STEM fields and strengthen those who are already in the industry (Unwritten, 2019). Another way to encourage women in STEM and eliminate biased perceptions of their male counterparts is to look up to women who are doing well in the industry. Successful women, like Senamile Masango, the founder and chairperson of Women in Science and Engineering in Africa (Wise Africa), which serves to promote leadership and role models for young people wishing to enter the fields of science and technology (Mamacos, 2018), are good examples of women who are capable of succeeding in STEM.

Teramond (2022) thinks that it is important to contribute to eliminating narrow thinking in schools and universities because this will help to develop a world free of prejudices.

She adds that any STEM organisation needs to be guided by the qualifications and roles of women in the hiring process because this represents true fairness.

Critical theory is historically related to three leading critical theorists of the original Frankfurt School, namely Horkheimer, Adorno and Macuse (Asghar, 2013). One of the founders, Horkheimer, stated that critical theory seeks human emancipation to liberate human beings from circumstances that enslaves them (Asghar, 2013). This study adopted critical theory to bring to the fore the gender-related issues that female teachers experience in teaching the Civil Technology subject, the results of which will ultimately contribute towards their emancipation. For this study, critical theory is devoted to informing society about the potentialities (female teachers teaching the subject with confidence). The identification of potentialities involves an examination of what technology is; the increasing struggles of and problems faced by females teaching the subject, namely that society feels Civil Technology should be taught by men only; and being underrepresented in the technical field. The confident delivery of practical Civil Technology lessons challenges the prevailing status quo and patriarchal perceptions and offers a democratic and balanced society in which Civil Technology female teachers achieve gender equality and the confidence to deliver theory and practical lessons.

2.9 Conclusion

The chapter established that, in South Africa, Technology Education involves engaging learners in critical thinking, varied skills, and content to practically resolve societal problems, communication and engineering technologies. Civil Technology is a specialised subject in South Africa's FET phase, focused on built environment principles and concepts, as well as on technological processes. Learners pursuing Civil Technology education are embracing theory and practical skills in the application of technical principles. Civil Technology education focuses on creating and improving societies, enhancing the quality of peoples' lives, and guaranteeing the sustainable application of natural environments. The chapter indicates that there is a low number of female participants in teaching the subject. Gender issues have a huge impact on how female teachers teaching the subject perceive themselves, and on the quality of lessons they deliver to learners in the classroom, therefore, female Civil Technology

teachers struggle with the skills and knowledge required to deliver the subject to meet the requirements of producing learners who are ready for the world of work after school. The theory underpinning this study focused on liberating female teachers from gender-based issues so that they can deliver quality lessons and produce learners who are ready to enter the world of work after matric or pursue their engineering careers at higher institutions of learning.

The following chapter presents the research methodology adopted in the study.

Chapter 3

Research Methodology

3.1 Introduction

In Chapter 1, I introduced the study and identified a gap in the literature. The aim of this study, which was to explore the challenges faced by female teachers in the teaching of Civil Technology in selected secondary schools in Gauteng, was stated in Chapter 1. The research methodology of the study was also briefly outlined to orientate the reader in Chapter 1. In Chapter 2, I presented a review of literature on the challenges faced by female teachers teaching Civil Technology in secondary schools in Gauteng.

In this chapter, Chapter 3, I present details of the research methodology that was chosen for the study and describe and motivate the methods and techniques used for gathering and analysing the data. I, therefore, cover the different stages of research, including the selection of participants, data collection processes, and analysis, in this chapter.

3.2 Research Paradigm

A paradigm provides the world with views that define the nature of the world, as well as the range of possibilities for its holders in relation to reality (Asghar, 2013). Cohen, Manion and Morrison (2011:31) explain the critical theory paradigm as 'explicitly prescriptive and normative, entailing a view of what behaviour in a social democracy should entail'. The concept originates from the works of a group of 20th century authors who were affiliated to the Institute of Social Research at the University of Frankfurt, hence, the name the 'Frankfurt School'. The researchers include Herbert Marcuse, Theodor Adorno, Max Horkheimer, Erich Fromm, and, later, Jürgen Habermas (Rehman & Alharthi, 2016). For this study, critical theory has been used to seek emancipation from prejudice in order to liberate female teachers from the gender-based circumstances that enslave them in the delivery of Civil Technology lessons in the classroom (Cohen et al., 2011). According to Asghar (2013), Horkheimer's definition of critical theory suggests three criteria for an adequate critical theory:

- It must explain what is wrong with the current social reality: The reality is that inequality is the main gender issue in the world (UNICEF, 2020). The social roles of men and women have been influenced by the nature of a patriarchal society that has been dominant for many centuries in Western society (Esteves, 2018). For this reason, there are still some misconceptions among female teachers that the Civil Technology subject is reserved for male teachers, which leads them to have difficulties delivering the practical lessons of the subject.
- It must identify the action to change the reality: Females must be given lots of opportunities to succeed at technical tasks and be made to believe that they can become great engineers. This can be achieved by improving their confidence, attracting more females into the technical fields, and eradicating the stereotypes that technical subjects are reserved for male teachers only. The study focused on identifying the challenges faced by the female teachers currently teaching Civil Technology to come up with a workable solution to the challenge.
- It must provide both clear norms for criticism and transformation: The intention of the theory is not merely to give an account of society and behaviour that is based on equality and democracy for all its members, its purpose is not merely to understand the teachers' situations and phenomena but to change them and promote individual freedom within a democratic workplace (Cohen et al., 2011). It seeks to uncover their interests at work, when delivering practical lessons in the classroom, and identify the extent to which they are legitimate in their service of equality and democracy (Cohen et al., 2011). It is a transformative agenda.

'The ontological position of critical theorists is that of historical realism' (Rehman & Alharthi, 2016). Ontology assumes that reality exists, but it has been shaped by cultural, political, ethnic, gender, and religious factors interacting with each other to create a social system (Rehman & Alharthi, 2016). 'Throughout human history, traditional gender roles have often defined and limited women's activities and opportunities' (ILO, 2021: 17). Women's lived experiences vary throughout the stages of their lives, and are shaped by their cultures, ethnic groups, countries, societies classes or families they come from, move to, reinforce and change (ILO, 2021:17). This is where the gender-related issues and underrepresentation of women in STEM come from. Data collected from participants in the study was used to determine their

beliefs in terms of gender-related issues, and to understand the role that the history of gender bias in the society, and the stereotypes that exist when it comes to gender roles, has played in shaping their thinking in STEM careers.

'Critical theory is subjective in that it is assumed that no object can be researched without being affected by the researcher' (Rehman & Alharthi, 2016). The aim of critical educational research is not merely to explain or understand society, but to change it; critical researchers endeavour to bring to light the beliefs and actions that limit human freedom with the aim of transforming the situation. The task of critical educational researchers is to confront those in positions of power and expose the oppressive structures that subjugate people and create inequality (Rehman & Alharthi, 2016).

Critical theory does not intend only to highlight and explain these social factors that cause oppressive and powerful groups to dominate the suppressed and repressed sections of society, but also strives for a social setup based on equality for all the members of society (Asghar, 2013). An analysis of the data collected will contribute to emancipating female teachers and changing the stereotypes that still exist with respect to gender roles. The transformation of the situation will depend on the data collected, to be utilised to guarantee that sufficient measures are put in place to liberate women from gender-based circumstances.

Critical methodology is dialogic and dialectical (Rehman & Alharthi, 2016), in the sense that it requires the investigator to engage the subjects in dialogue with the aim of bringing about a change in their outlook on social systems that keep them deprived of their intellectual and social needs (Rehman & Alharthi, 2016). Critical research is more inclined towards qualitative research designs. The data from the participants' subjective experiences were collected by means of open-ended unstructured interviews. This falls in well with critical theory as unstructured interviews allowed participants ample opportunity to freely contribute their views. Another criterion for quality critical research is the degree to which the subjects' misapprehensions about gender challenges in the teaching of Civil Technology and status quo are exposed and the degree to which such exposure facilitates action designed to redress the unequal and oppressive gender-related structures that have now been exposed (Rehman &

Alharthi, 2016). Critical ethnography, which is explained by Ross, Rogers and Duff (2016) as ‘a research method that endeavours to explore and understand dominant discourses that are seen as the right way to think, see, talk about or enact a particular situation in society and recommend ways to redress social power inequalities’, aims to probe and criticise the taken-for-granted assumptions of gender in order to change awareness (Rehman & Alharthi, 2016). Critical theory and critical ethnography in the study are meant to redress the gender inequalities in society.

Dudovsky (2020) explains axiology as ‘a branch of philosophy that studies judgments about the value’. It refers to the aims of the research and what is valued in research. The aim of my study was to explore the challenges faced by women in STEM education, particularly in the teaching of Civil Technology in secondary schools. The value of the study is based on equality, seeing females treated equally to men in the teaching of the subject, motivating girls to join STEM careers, and the women who are already in the field to be confident. Women are as equally qualified as males to teach the subject; therefore, they should be valued equally.

The axiology of this study is value-laden; therefore, it is concerned with what makes a researcher good (Basti Consultores, 2021). During data collection, it was very important that I listen attentively to the participants, be unbiased with the questions I asked and be diligent (Basti Consultores, 2021). The formation of the research questions was carefully considered, considering that participants should answer the questions truthfully to give the study the necessary value.

Thus, the chosen research paradigm informed the method of research; data collection procedures and strategies; participant selection and data analysis; and trustworthiness of research methods.

3.3 Research Approach

In order to satisfy the objectives of the study, a qualitative research approach was followed to conduct an in-depth investigation of the challenges that female teachers are experiencing in teaching Civil Technology. The study explored the teachers’ experiences (Silverman, 2020:3) in a Civil Technology workshop. Creswell (2009)

defines qualitative research as a means of exploring and understanding the meaning individuals or groups ascribe to a human or social problem, in this case the problem of gender issues in a workplace. The objective for using a qualitative research approach was to look for answers to questions about the way female teachers create and interpret their experiences in the classroom. I obtained an idea of how they feel and think about their situation, what sort of limitations they experience, how they deal with conflicts, the rules they must deal with, and their strengths and weaknesses in teaching the subject. The nature of a qualitative research and the problem being researched determined the suitable methods to be engaged. The qualitative approach in this study suggested the use of interview and participant observation.

The method that best assisted me to get answers from the female teachers was through interviews. 'Interviews are a widely used tool to access people's experiences and inner perceptions, attitudes, and feelings of reality' (Zhang & Wildemuth, 2017: 1). Interviews can be divided into three categories, namely structured interviews, semi-structured interviews, and unstructured interviews. For this study, data was collected using structured interviews. Structured interviews rely on asking questions in a set order to collect data (George & Merkun, 2022). As stated above, my goal in using the structured interview was to get responses that can be easily compared and aggregated, while being a participant observer would assist me to get a deep understanding of female teachers' views and the challenges that they face during practical lessons.

3.4 Research Design

The selection of a research design is based on the nature of the research problem, and the audience for this study (Creswell, 2009:21). Qualitative research design as a design choice for this study was based on the means for exploring and understanding the meaning that female teachers ascribe to a social or human problem (Creswell, 2009:22). It was also chosen to emphasise gathering data on naturally occurring phenomena (McMillan & Schumacher, 2014:31). The study followed a phenomenological qualitative design to describe the meanings of the lived experiences (McMillan & Schumacher, 2014: 32) of the female teachers. The aim was to transform the female teachers' experiences into a description of essence to allow

for reflection and analysis by using interviews towards understanding their perspectives and everyday lived experiences (McMillan & Schumacher, 2014: 32).

3.5 Research Site

The study was conducted at technical high schools offering Civil Technology as a subject in the Soweto township the province of Gauteng. The schools were selected from the Gauteng Central District (D14).

3.6 Selection of Participants

The method of selecting participants for the study, purposive sampling, was explained in Chapter 1. This method of sampling in qualitative research is essentially strategic to the sampling of cases based on the interviews, with an attempt to establish a good correspondence between research questions and sampling, where the researcher samples because of wanting to interview people (female teachers) who are relevant to the research question. Purposive sampling is time- and cost-effective and only focuses on the best-fit participants to answer the research question (Survey Tips, 2021). Participant selection depended on their availability in schools. Some schools, such as Jabulani Technical High School (School A), did not have female teachers teaching Civil Technology. The selection was done as follows: Jabulani Technical High School (two male teachers), Curtis Nkondo School of Specialisation (School B) (two female teachers), Tetelo Secondary School (School C) (one female teacher), Altmont Technical Secondary School (School D) (one male and one female teacher). Seven participants in total were selected (three males and four females). The following were the criteria used for choosing the participants:

- The participants must be qualified Civil Technology teachers, currently teaching Civil Technology at a technical high school in Gauteng.
- Participants should be of all ages, there is no age limit. This would allow different views from all ages.
- Participants should have experience in conducting practical lessons in the workshop. This would be beneficial to finding out about their lived experiences in teaching the practical lessons.

3.7 Research Instruments

A research instrument is a tool used to collect, measure, and analyse data related to research (Bradley, 2021). Research tools identified for this study were observation forms and structured interview guides. An observation tool was developed to explore the female teachers' challenges in respect of delivering the practical lessons and the attitude of male teachers towards them. The schedule was intended to be used during one practical lesson for every participant. It focused on the behaviour of the teacher and learners in the workshop, how the teacher demonstrates the practical lesson, and how they interact with learners, according to their gender. It also focused on events/ activities that took place during the lesson presentation, and activities that learners had to do after the lesson.

The structured interviews were developed to gather the views of the female teachers regarding the challenges that they faced and how they dealt with them. The questions focused on their lived experiences. The questions also focused on what male teachers thought about female teachers teaching the subject and understanding their attitude towards female teachers and learners. Table 3.1 below shows the relationship between the research questions, theory, and methods.

Table 3.1: Relationship between research questions, theory, and methods

Research questions	**Theoretical framework**	**Research method**	**Information in research instruments**
What is the understanding of female teachers of gender-based challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng?	Societal change, emancipation	Interviews, observation	Female teachers' understanding of and reaction to gender-based challenges; male teachers' attitudes towards female teachers

Research questions	Theoretical framework	Research method	Information in research instruments
How do male teachers perceive the participation of female teachers as Civil Technology teachers in secondary schools?	Male/patriarchal gender perceptions (of women)	Interviews, observation	Understanding gender related attitudes
How do these challenges affect female teachers' practice?	Gender-based perceptions; challenges of female teachers; gender diversity	Interviews, observation	Female teachers' venturing in STEM careers
How do these female teachers respond to the gender-based challenges?	Gender diversity, liberty, democracy, emancipation	Interview, observation	Gender diversity and balance in the technology subjects

3.8 Research Methods and Data Collection Procedures

For the purposes of this study, data was collected using qualitative research methods. According to Langkos (2014:4), 'qualitative research is mostly appropriate for small samples and its outcomes are not measurable or quantifiable'. Qualitative research methods were used to answer questions, meaning, and perspectives about female teachers' experiences in a workshop, from their own standpoint (Hammarberg, Kirkman & de Lacey, 2016).

Structured interviews and participant observation were chosen as data collection methods for the study. Structured interviews were chosen for their credibility in terms of posing the same questions to participants in the same order, making data analysis easier, while observation was chosen to get a deeper insight into female teachers'

lives, and the attitudes of their male counterparts towards them. Participants should be free to provide details about the challenges and experiences that they are facing in teaching Civil Technology. Structured interviews assisted me to understand the participants' experiences and challenges better because the questions were straightforward.

Structured interviews, as explained in Chapter 1, assisted me to gain comparable data from all the female teachers and their male counterparts (Cohen et al., 2011). They helped me to get a better understanding of the participants and the depths of their subject knowledge (Reddy, 2016). Furthermore, they helped me to get useful information about the participants' experiences and challenges because the questions were set well in advance of the interviews and the participants did not deviate from the questions asked. Although structured interview questions were set in advance, the participants were allowed to respond in an open-ended manner to offer more detailed information or to elaborate on their responses (Denomme, 2022).

Observing how female and male teachers deliver practical lessons in the workshop gave me an opportunity to see and hear what was occurring naturally at the research site (Mcmillan & Schumacher, 2014), which, in this study, was the practical workshops. As a participant observer, I interacted with teachers and learners when it was the right time to do so, ensuring that I did not disrupt the lesson. I had to be in touch with the social realities of teaching learners the Civil Technology subject as a female or male teacher. This included active involvement in the teaching and learning activities; talking to teachers and learners about their activities when the opportunity arose. The reason for interacting with teachers and learners was to deepen my understanding of gender issues that could come up. Over the years as a Civil Technology teacher, I have been troubled by the gender perceptions and attitudes that confront female teachers. This research helped me understand the attitudes of male teachers towards their female counterparts and female teachers' views regarding this issue. The research also helped me get a rich understanding about how the environment accommodates female teachers, which tools or machines they are comfortable using, and which ones they struggle to use. Being a participant observer in the study, I also understood how male teachers relate to girls during the practical lessons.

Structured interviews have their own disadvantages. They may distort what participants really mean or experience by so completely limiting their response choices. I followed the data collection procedure according to Creswell (2009): the setting, which is the schools identified above; the participants, according to the criteria specified above; and the events. Observations were carried out in the specified schools during the practical lessons, and structured interviews were scheduled on a day that was chosen by the participant concerned. The place to conduct the interviews also depended on the participants' choice; they chose an environment where they would be most comfortable. All the participants chose their schools as the place to conduct the interviews. Field notes were recorded during the observations of practical lessons at the schools, whereas audio tapes were used to record the interviews. I managed to collect the data within the specified time that I had set for myself. The process that comes after data collection was the data analysis, which is explained in the next section.

3.9 Data Analysis

Audio tapes were the main sources of data collection. After the data was collected, it was organised and analysed. To make sense of the data collected, I had to organise and separate data into a few workable units (McMillan & Schumacher, 2014). Data was organised according to the questions and sub-questions asked throughout the interviews to make the analysis process easier. This was done because of the flexibility of using thematic data analysis as it allows for data to be focused on in numerous ways; for example, to analyse meaning across the entire data set or one certain aspect of the phenomenon in depth (Braun & Clarke, 2012:57).

Thematic analysis was used to analyse data that was gathered from the personal interviews. According to Ibrahim (2012:40), "thematic analysis is considered the most appropriate analysis for any study that seeks to discover using interpretations". Ibrahim (2012) alludes to the fact that thematic analysis allows the researcher to precisely determine the relationships between the concepts of gender challenges and compare them to the replicated data. Using thematic analysis, I was able to link the opinions of the female teachers and compare them to the data gathered. I followed Braun and Clarke (2012:60–63) to analyse the data as follows:

- Familiarising myself with data – this means reading through the data collected, listening to the voice recordings of the interviews, and making notes of the data.
- Generating codes – data was coded according to the developed categories and related concepts were grouped together to facilitate the coding process.
- Generating themes – a theme captures something important about the data in relation to the research question and represents some level of patterned responses or meaning within the data set. Themes and sub-themes were identified from the data.

The findings are ultimately presented and discussed in Chapter 5.

3.10 Trustworthiness of Methods

Nowell, Norris, White and Moules (2017) explain trustworthiness as 'one way a researcher can persuade themselves and readers that their research findings are worthy of attention'. To demonstrate trustworthiness in my study, I used the original widely accepted and easily recognised criteria by Lincoln and Guba (Nowell et al., 2017). Lincoln and Guba posit that the trustworthiness of a research study is important towards valuating its worth; it involves establishing credibility, transferability, dependability, and confirmability.

Credibility asks how congruent the findings are with the study (Norman & King, 2020). This means whether the researcher is confident about the truth of the findings and the context in which the study was undertaken, and the study was conducted using the standard procedures used in a qualitative approach or an adequate justification provided for variations (Connelly, 2016). The purpose of the study was explained to participants and their cooperation was solicited. I established a relationship of mutual respect with the participants and created a climate in which the participants could feel free to express their experiences and opinions. Peer debriefing was used to further establish the credibility of the study. Peer debriefing means involving co-researchers and colleagues (Norman & King, 2020) to listen to, and analyse, participants' challenges and concerns. For this study, I involved colleagues at the University of South Africa (Unisa) in the Department of Science and Technology Education who are subject specialists and who also do research in the same field.

Norman and King (2020) interpret transferability in a qualitative inquiry as seeking to expand understanding by transferring the findings from one context to another. However, the qualitative research findings are not transferrable because they are highly context bound, considering the uniqueness of the research situation and site. Having said this, however, other researchers and practitioners may find the findings useful in their situations. It is to this effect that data collected for the study was detailed to permit comparison and to enable researchers to decide on its transferability. 'This cannot be apportioned by myself; however, it should be imputed by those who wish to compare the research with their personal contexts as in lessons from somewhere else' (Norman & King, 2020: 27). Locating transferability remains the responsibility of those who want to transfer findings to another situation.

Dependability establishes the research study's findings as consistent and repeatable (Statistics Solution, 2022). This means the stability of data. It ensures that nothing was missed in the study, or that I was not sloppy or misguided in my final report (Statistics, Solution, 2022). I ensured stability by using external audits regularly as the research process unfolded. An external audit refers to data being scrutinised by external reviewers (Universal Teacher, 2016). The external reviewers used for the study were independent reviewers who are qualified researchers. The reviewer's services were paid by me from my own pocket.

Confirmability is the neutrality or the degree to which findings are consistent and can be repeated (Connelly, 2016). An audit trail, a technique where I detailed the process of data collection, data analysis, and interpretation of the study, was used for confirmability of the study (Statistics Solution, 2022). I also ensured confirmability by giving participants the transcribed data to confirm that their words were not misconstrued.

3.11 Ethics

Ethical considerations are important in a study, and this study was subject to ethical issues. Conducting research requires honesty and integrity to recognise and protect

the rights of the participants involved in a study. As a researcher, I am obligated to respect the rights, needs, values, and desires of the participants (Creswell, 2009:183).

Before conducting the interviews, I applied for ethical clearance from the Unisa (Appendix A), obtained permission from the Department of Basic Education to conduct this study and, upon identifying the possible schools for data collection, I contacted the principals of the schools to gain their permission to access the setting and the participants (McMillan & Schumacher, 2014: 377). After getting the permission to conduct the study, I asked the participants to consent to their participation in the study. No participant was forced to participate in the interview without agreeing to do so. Participants were informed of the data collection devices and activities (Creswell, 2009:183), that the interview was strictly confidential, and that there was no third party involved in the research. Participants would remain anonymous. To protect their identity, I used the pseudonyms to identify them as teacher A, teacher B, teacher C, and so on. If they did not want their data to be published, they were allowed to withdraw from the study. I also informed the participants of the purpose of the study, so that they fully understood what would happen to the data that they provided during the interviews.

3.12 Conclusion

In this chapter, I discussed the research methodology and design of the study. The research paradigm and the research approach were also discussed, together with the data collection methods, namely the open-ended unstructured interviews and participant observation. The issues that gave the study legitimacy, such as ethical considerations, site selection, trustworthiness, and ways of ensuring the consistency and integrity of data, were discussed. In this chapter, I provided an overview of how the research was planned and how it unfolded on the ground to help answer the research questions of the study on the challenges that female teachers are facing in teaching Civil Technology in secondary schools in Gauteng. In the next chapter, I discuss data analysis and interpretation of the findings.

Chapter 4

Data Presentation and Findings

4.1 Introduction

In this chapter, I present the data analysis and findings from the interviews with seven teachers who teach Civil Technology in secondary schools in Gauteng District D14. The findings are a response to the purpose of the study, which was to explore the views of female teachers regarding the gender-based challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng. I present the findings from the structured interviews, followed by findings from participant observation.

The objectives of the study were:

- To examine female teachers' understanding of the challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng.
- To assess male teachers' perceptions of the participation of female teachers as Civil Technology teachers in secondary schools.
- To understand the effect of these challenges on female teachers' practice.
- To establish the response of these female teachers to gender-based challenges.

4.2 Participant Demographics

A summary of each participant is provided below. The real names of the participants are omitted to ensure confidentiality.

Table 4.1: Participant demographics

School	**Participants**
School A: A fully technical high school that specialises in Civil, Electrical and Mechanical Technology technical subjects. For Civil Technology, the	Teacher A is a male teacher who specialises in Bricklaying. He has been teaching the subject for more than ten years.

School	Participants
school specialises in Woodworking and Construction.	Teacher B is a male teacher who specialises in Woodworking. He has been teaching the subject for more than ten years.
School B: The school specialises in Civil, Electrical and Mechanical Technology technical subjects. For Civil Technology, the school specialises in Woodworking and Construction.	Teacher C is a female teacher who specialises in Bricklaying. She has four years' teaching experience and teaching the subject.
	Teacher D is a female teacher who specialises in Woodworking. She has been teaching the subject for four years.
School C: The school specialises in Civil, Electrical and Mechanical Technology subjects. For Civil Technology, the school specialises in Woodworking only.	Teacher E is a female teacher who specialises in Woodworking. She has been teaching the subject for more than twenty years.
School D: The school specialises in Civil, Electrical and Mechanical Technology technical subjects. For Civil Technology, the school specialises in Woodworking and Construction.	Teacher F is a male teacher who specialises in mathematics and Woodworking. He has been teaching the subject for more than ten years.
	Teacher G is a female teacher with more than ten years' experience in teaching Woodworking subject.

It can be noticed from Table 4.1 that seven teachers were interviewed. These are four (4) female and three (3) male teachers. Three teachers, (teacher B, teacher C and teacher E) were also observed.

4.3 Data Presentation from the Interviews

Firstly, an Otter was used to transcribe the recorded audios. An otter listens to, analyses, and transcribes the words into text. This web-based application and a mobile application allowed the audio to be transcribed in real time. Secondly, data was coded using the developed categories and related concepts that were grouped together to make coding easier. The information segments relevant to the research objectives were coded with categories, concepts, and labels. The patterned responses in the collected data were used to identify the themes.

4.4 Identification of Themes

Several themes emerged from the data. The major themes that arose when female teachers were asked about their understanding of the challenges faced in teaching Civil Technology are identified in the Table 4.2.

Table 4.2: Identification of themes

Objective	**Theme**
To examine female teachers' understanding of the challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng Province.	• Perception
To assess male teachers' perceptions of the participation of female teachers as Civil Technology teachers in secondary schools.	• Equals • Motivation
To understand the effect of these challenges on female teachers' practice.	• Lack of tools and machines • Lack of trust
To establish the response of these female teachers to the gender-based challenges.	• Adequate training • Empowerment

The main themes on male teachers' perceptions about the participation of female teachers as Civil Technology teachers in secondary schools are 'equals' and 'motivation'.

4.4.1 Theme 1: Perception

Civil Technology as a male dominated subject came through strongly from the views of the participants. These views were expressed by teacher E, teacher G and teacher C, who are females. They indicated that some males perceive Civil Technology as a subject for male teachers. Teacher E, who has been teaching Woodworking for more than 20 years confirmed this when she indicated:

> *from when I was at college, I was asked: 'Why are you doing civil technology subjects because they are perceived as male subjects?' …*

Teacher G, who also specialises in Woodworking, concurred with this statement by saying that:

> *Some male educators are of the mentality that as a female teacher teaching this subject, you are unable to do certain things when it comes to the subject, especially the practical part.*

Teacher C, a Construction teacher for four years, said:

> *I think construction is for men, therefore the men in construction treat us women like eggs as if we cannot do anything or some of the things.*

4.4.2 Theme 2: Adequate training

Continuous training in the subject is critical to staying abreast with the knowledge and skills that one should acquire in the field. All the participants indicated that there is adequate training received from the DBE. The training is usually a weeklong and takes place during the winter school holidays. Teacher D emphasised that, every year during June holidays, they receive training that assists them with practical work:

> *The department do assist us with practicality specially during the winter holidays they do assist us can be for one week but they are helpful to us because we learn a lot especially for the practical of that year on what you're supposed to do or how to use the material or the tools that we offer or the work that you're supposed to do in a workshop because it's about workshop so it is helpful.*

Teacher G added to this by indicating that they learn to do practical objects and use tools and machines during this training. She stated that:

From the department we do get trainings very often, every year there is a training where we have to personally do projects using the machines and tools.

4.4.3 Theme 3: Lack of tools and machines

Participants indicated that schools have tools and machines, but they are insufficient. They further indicated that they could work with what they must in order to complete projects with learners, *'*not all, but we have most of the required tools and machines needed*'* (teacher G). Teacher C indicated that they just learn about some tools from the textbook, but they do not have the tools at school, meaning they do not use them in class.

Meanwhile, at teacher D's school, the situation is different. The situation is detailed in teacher D's views as follows:

My school is suffering with some of the tools some of them I do not have you find that some were broken long long time ago because remember this is a new not per say but it is a new school but it's less than 10 years so some of the tools we found them broken because of the history of the previous school so even though they are broken but we still use them because we cannot throw them away so we still use them and try our level best also to maintain them carry out even though not the real standard of it but we try our best to use and not to waste them not to throw them away because they are still useful for us but you do not have some of the tools. The school is also complaining about buying some of the tools they are saying technical is using a lot of money then they're forgetting that obviously there's a lot of practicality and they cannot compare it with others it's not theoretical subject so they complain about using a lot of money if you have to buy practical material.

Teacher C, a Construction teacher, stated that many of the materials they use are heavy materials, such as bags of cement, bricks, and soil, and that it would be easier to lift those materials if there were power tools available in the workshop, such as lifting machines. She stated that:

Just to be realistic some of the activities are difficult to be carried out by females, for instance, when you need to move a bag of cement from one place to another, it's difficult because you need manpower and obviously at school, we

don't have enough power tools to carry out the work to make it easy for both gender, sometimes you need manpower.

4.4.4 Theme 4: Lack of trust

Data analysis revealed that there is lack of trust of the female teachers by the male teachers. Male teachers do not trust female teachers to carry out practical activities as they should. Teacher G, who works with her male head of department directly, alluded to this challenge as follows:

The lack of trust from my colleague, who is my HoD also, my colleague does not give me the freedom to show my knowledge and skills when it comes to doing practical subjects, he always takes over my practical lessons, then I have to observe like the learners, when I use the machine he is always quick to come and assist or just be there to check if I am using it correctly.

Although teacher E's issue was different, she also expressed the same concern about a lack of trust from her male counterparts by indicating that:

I remember in my early years when I started teaching when I got qualified to teach, I would go to workshops and I would meet male counterparts there, I remember some of them would make jokes like, "when you are actually teaching, I wish to attend your class as you teach and see how you are doing it, it was also negative, they will be laughing at me, why will they think I have to fail, like why would I be here if I am failing, yeah I had those challenges, these showed that they do not trust or believe that I can do this.

4.4.5 Assistance seeking

Teachers C and D, who are the only female teachers in their school teaching the subject, indicated that some tasks were not easy to carry, therefore, they had to seek assistance from their male colleagues or from male learners. Teacher D said that 'the males treat us like eggs, therefore they are always open to assisting us', while teacher C reckoned that it would be easier for them if they had power tools that could lift materials such as bags of cement.

4.4.6 Empowerment

All four female participants believe in more empowerment in terms of training, career days, and bursaries for both female learners and female teachers. Teacher C said:

> *I think it starts by if the subject is being taught by a female teacher, it motivates them, seeing a woman in construction, I think that's why in my case I have more females than boys, I think if a teacher can encourage more females to take on teaching the subject.*

She added to this statement by saying that:

> *I think maybe we can have female empowerment bursaries, that can motivate females to teach the subject in turn female learners would also be encouraged to do it.*

Teacher E believed that female teachers become more encouraged when they attend the training. When they see how confident experienced teachers are and that they can do their projects with ease, they also become interested, they ask questions and want to know more.

Teacher G shared the same sentiments as teacher C, 'I think female teachers should be recognized and given more opportunities, maybe in a form of bursaries or programmes that would encourage them to boost their confidence and also grow their interest in the subject'.

4.4.7 Equals

All male participants said that they do not believe that this is a subject to be taught by males only; they believe that the subject is for anyone, male or female. Teacher B stated the following in this regard:

> *Honestly I think that Civil Technology can be taught by all the genders and not only males only, no I don't believe that a gender can teach a subject, the subject can be taught by anyone irrespective of their gender as long as they are interested.*

Teacher A concurred, *'*no because if it was to be taught by males only why there are female students doing the subject ,..'

4.4.8 Motivation

The male participants believed in motivating females more so that they would stay in the subject. Teacher F, who indicated that he is a father of girls, only believed that girls can do anything as he also teaches them to do some projects at home. He stated that money would motivate females to be confident in the subject, 'at this time I think money can motivate them, if they know that there is money, they can learn a lot and they will be able to do some projects and sell them, basically money will motivate them'.

Teacher A believed that supporting and encouraging females would make them more confident:

> *Just giving them support material and making them feel free within the subject itself, it's not male based and they should know that it's like any other subject, it's just them taking the opportunity and teaching the learners, and not looking at the surroundings because of certain tools being used seen as male tools and so on, it's supposed to be just tools whereby everyone is confident to touch them, work with them, I think more or less workshops just to encourage them to understand that they can do this.*

Teacher B shared the same sentiments about motivation and encouragement. He believed that women do flourish in the subject if they are given space to do so. He said that:

> *Schools should allow them to go for training so that they get development that is needed mainly to allow them to work in those subjects, that is what teaching is, I was in a district were at some point a female teacher was confident in class when it comes to Civil Technology because she was the only one teaching the subject, when females are given space to do their work they flourish, give them space so that they can boost their confidence.*

The findings this far reveal that the major challenges that female teachers of Civil Technology face in teaching at selected secondary schools in Gauteng include the perceptions, shortage of tools, and the lack of trust of their male counterparts.

4.5 Data presentation from Participant Observations

This section presents findings from the observations. The main observation objectives were:

- To understand how practical lessons are delivered by male and female Civil Technology teachers in a classroom.
- To see how learners are treated by male and female Civil Technology teachers in the classroom based on their gender.
- To see first-hand the challenges that females face in teaching the subject.

Data from observations was coded manually using deductive coding to seek patterns related to the observation objectives. The following patterns were discovered from the observations: interaction, lesson demonstration, learner involvement, and lesson monitoring.

4.5.1 Interaction

During practical lessons, learners were not restricted from talking or interacting with each other. They were free to talk to each other. Learners asked assistance from each other. They were comfortable when interacting with each other. The female learners asked for assistance from their male classmates about which tools to use for certain tasks and about operating the machines. They waited for their male classmates to finish their projects so that they could assist them with their tasks. They also interacted with their teachers, asking for assistance. but they mostly asked for assistance from their male classmates. During my interaction with teachers and learners, I realised that teachers do not have much faith in female learners, they do not believe that female learners can finish their projects on time or do them correctly; however, they still assisted them when assistance was requested. Female learners rely more on their male classmates than on their teachers for assistance with their projects.

4.5.2 Lesson demonstration

The teachers gathered learners around to explain the project of the day. In Woodworking, the materials were pre-cut, or a teacher has a project that is ready-made. When a project is ready-made, the teacher just explained it theoretically and

did not demonstrate practically how she achieved the project, handled the tools, or operated the machines used. The teachers showed the learners which tools to use and the personal protective equipment that they must wear and told them how to do the whole project before they let them do it on their own.

4.5.3 Learner involvement

Two teachers teaching Woodworking (teachers C and E) always called on male learners to assist with the cutting of timber for all the learners in class. They also sent male learners to fetch the tools from the storeroom for everyone. Male learners were mostly asked to assist, such as holding timber or to mixing cement and dagga in the construction workshop, while female learners were observing the demonstration.

4.5.4 Lesson monitoring

Teachers were always in the workshop. They did not leave the learners alone. They walked around to check whether learners were doing their projects correctly. They also availed themselves to learners who needed assistance. However, learners were helping each other most of the time. Teachers attended to the learners fairly in terms of ensuring that they all did their projects correctly.

The findings from observations reveal that teachers involve male learners more in the preparation and demonstration of the lessons, due to the perception that this subject is for males. Female teachers demonstrated theoretical knowledge more than practical skills while presenting the lessons because the materials they were using were pre-cut and, therefore, they explained to learners the process and tools to be used to assemble the materials into a final project.

4.6 Discussion of Findings

The section above dealt with the presentation of the findings, while, in this section, I will discuss these findings. This section also contains an evaluation of the objectives and aims based on the research questions.

Regarding the teachers' gender, the female participants' views are that male teachers dominate the Civil Technology subject in Gauteng. The implication is that female

teachers lack interest in technical education because they find it a hard labour meant for males. This finding concurs with Hoffmann-Barthes et al.'s (2000) findings that there is an incorrect perception of vocational and technical education. These authors use vocational training when referring to girls and technical training when referring to boys. The tendency in secondary schools of Gauteng is that boys with poor parents, or those who fail to attain admission to traditional secondary schools because of their poor grades, are enrolled in technical schools, while girls enrol in vocational schools (Maeko & Makgato 2014).

In terms of age, experience, and speciality, there is a promising greater percentage of youthful teachers. Mtshali, Ramaligela and Makgato (2020) agree that female teachers in Civil Technology maintain a positive percentage, with new, significantly high skills and knowledge.

Positive teaching support and cultures, backed up by experienced female teachers, demonstrate how newly qualified female teachers focus on teaching quality and learners needs over time. Ankiewicz (2021) agrees that the teaching experience of female teachers is important to their professional development. However, according to the findings of this study, the everyday experience of teaching Civil Technology is challenging, which can lead to professional growth if female teachers take that stance that challenges the existing perspectives. Furthermore, experience has motivated and given female teachers more confidence to teach Civil Technology. This shows that female teachers can teach the subject, are familiar with the tools and machines used, and are eager to learn and improve their teaching skills.

The findings above collate with Flores' (2003) conclusions that many female teachers of STEM subjects experience enormous idealism in the first two years of professional teaching. According to the findings of the current study, while female teachers become positive and self-satisfied with their progress and achievements in the subject, their male counterparts are eager, dedicated, open to assist them, and respect them when they see that they are doing well in the subject. Teacher B (male) acknowledged that he had a female colleague who was very confident in teaching Civil Technology, and she was flourishing. Teacher E expressed her confidence in teaching the subject by stating that her results spoke for themselves, and that male teachers stopped looking

down on her after learning that she teaches in one of the top three best performing schools in the subject. The differences between male and female teachers of Civil Technology in Gauteng emanate from a personal disposition towards teaching Civil Technology, the nature of their teaching experiences, and the personal and professional support that teachers receive.

The study found that female Civil Technology teachers experienced challenges, such as tool maintenance and fixing, as well as the correct use of machines and tools. According to Davids and Waghid (2020), teachers' preparing knowledge to convey practical knowledge remains a key missing piece in the mystery of professional development and higher quality teacher education in South Africa. The challenge is evident in both female and male Civil Technology teachers. Other challenges for female teachers were the preparation of equipment and tools, as well as properly employing the machinery. For instance, teacher C indicated that she had inadequate knowledge of operating the old physical tools that were in the school workshop. Umar and Ma'aji (2010) agree that female teachers need clear development in maintenance and fixing of the equipment and tools because they cannot just select a machine, which can aid in enhancing the learners' appreciation of the practical skills. Teachers are often reliant on the skills and knowledge acquired from the teacher training bodies, yet some bodies focus on the design skills minus the end product, which illustrates the process of manufacturing. Albert and Makgato (2020) insist that there is a need for institutions to focus on workshop organisation and planning, skills for handling vast tools, and increased knowledge of Civil Technology processing and materials.

The challenges faced by female teachers of Civil Technology create a huge gap in the technical field, which teachers are unaware of and thereby compromise their quality of skills. Pool, Reitsma and Mentz (2013:455) aver that Technology teachers should possess deep knowledge that will enable learners to perform appropriately, explain, introduce, and interpret modern concepts and practical skills as gauged against the economic demands. A perusal of the responses concerning and observations about the challenges that female teachers of Civil Technology experience indicate an increased burden among teachers in the form of teaching more learners with very limited resources. For instance, teacher A stated that their challenge is controlling the large numbers of learners in a single practical workshop.

Teacher E also stated that there are many learners to teach in practical lessons. Teacher A similarly highlighted challenges with the repair and maintenance of machines. Teacher D indicated the challenge of correct application and servicing of machines and tools to keep functioning, and the quality of the machines and/or repair broken machines. The findings collate with Zhang's (2009:113) findings that, besides teachers being the most significant resource for South Africa's technical schools, their practical abilities are crucial for training the future keepers of the national economy. Therefore, the environmental knowledge of Civil Technology teachers is important to a learner's acquisition of practical skills necessary for industrial demands. The findings of the study indicate that Civil Technology teachers still face challenges with executing their environmental knowledge.

The preparation knowledge of the teachers is systemic since two teachers could not communicate the lesson goals with learners during task commencement. Teachers did not offer learners sufficient time to appreciate the given tasks for the observed lessons. Johannsen, Bolander-Laksov, Bjurshammar, Nordgren, Fridén and Hagströmer (2012) found that the failure to transfer skills emanates from ignoring the knowledge of processes, methods, techniques, and procedures for undertaking specialised tasks, and the capability to run equipment and tools linked to such tasks. Regarding their operational knowledge, female teachers had the challenge of being incapacitated to operate the machines for the intended purpose. Teacher C indicated that she had the challenge of lifting, correctly using machines and tools, servicing, and maintenance of quality.

The finding above collates Amyotte and Eckhoff's (2010) finding that many technical teachers fidget when practical teaching emerged because they have more theoretical knowledge compared to practical knowledge. As a result, there is a tarnishing of learner participation in skills acquisition. The findings by Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt and Wenderoth (2014) indicate that the process of technological design is the backbone of Civil Technology and if teachers apply it correctly, it offers maximum opportunities for learner engagement. Only two female teachers (E and C) in this study indicated a deep understanding of the process of practically teaching Civil Technology. The study establishes a shortage in

environmental knowledge among teachers of Civil Technology, yet it is essential to advancing active learning in practical lessons.

From the observations and findings of the study herein, teachers of Civil Technology in Gauteng have various environmental knowledge challenges, which hinder their preferment for active learning among secondary school learners. For example, during the observation, teachers B and E were not able to prepare learners for the practical responsibilities. Isaac and Manto (2019) provide the base for this finding when they state that professional development and high-quality teacher education lacks teacher planning to offer practical knowledge. From the interviews and observations of the current study, teachers did not often have lesson planning and/or rarely checked the lesson plans offered by the DBE. Such practices hamper the advancement of active learning since teachers lack knowledge of the extent of learner engagement in the practical tasks, minus consumables, and time wastage. According to Kihwele (2020) and Ono and Ferreira (2010), lesson planning ensures that every envisaged outcome is tracked and accomplished in the time stipulated.

The teachers of Civil Technology in Gauteng's secondary schools do not practice tracking their learners' practical skills. In the observations, all three teachers cited challenges that hamper the implementation and planning of practical content, equipment, and tools preparation because of the large numbers of students, as well as correct use of the civil technology machinery. The cited challenges result in the ongoing inability to produce students with the necessary practical skills for the quickly emerging workplace.

4.7 Conclusion

In this chapter, I presented evidence that female teachers face numerous gender-based challenges when teaching Civil Technology in selected secondary schools in Gauteng. These challenges hinder the advancement of active learning among learners. The teachers also fail to plan the delivery of practical knowledge, thereby defeating professional development and high-quality teacher education. Female teachers have failed to practice the tracking of the needed practical abilities of their learners. The study observations indicate that there is many learners in Gauteng's

secondary schools and the teachers' inability to correctly use the machinery constrains the implementation and planning of teachers' practical content, mainly equipment and tool preparation. In the following chapter, I present the summary, conclusions, and recommendations for the study.

Chapter 5

Conclusion and Recommendations

5.1 Introduction

I conclude the study in this chapter by providing a summary, including the key research findings in relation to the research objectives and questions, as well as discussing their value and contribution. I also examine the study's limitations and make relevant recommendations.

5.2. Summary of the study

In Chapter 1 I introduced the study. This covered the introduction of the research problem and related research questions and objectives. I also accounted for the significance of the study and gave an overview of the research methodology.

The literature review pertaining to the problem that was addressed in the study was discussed in Chapter 2.

In Chapter 3, I described and justified the research methods used in the study, including their execution.

The key research findings can be found in Chapter 4. This study aimed to explore the challenges faced by female teachers in the teaching of Civil Technology in selected secondary schools in Gauteng. This aim was achieved by responding to the following research objectives:

- To examine female teachers' understanding of the challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng.
- To assess male teachers' perceptions of the participation of female teachers as Civil Technology teachers in secondary schools.
- To understand the effect of these challenges on female teachers' practice.
- To establish the response of these female teachers to the gender-based challenges.

These objectives were thus addressed by the research findings as follows:

5.2.1 Objective 1: To examine female teachers' understanding of the challenges that they face in the teaching of Civil Technology in selected secondary schools in Gauteng Province

Female teachers held views about their practice and how they were viewed by their male counterparts. The findings indicated that female teachers would seek assistance from male teachers when necessary. The findings revealed that female teachers had challenges performing certain tasks, so they sought assistance from their male counterparts and male learners. When they sought assistance from their male counterparts, they thought that male teachers interpreted this as that they were incapable of teaching the subject.

5.2.2 Objective 2: To assess male teachers' perceptions of the participation of female teachers as Civil Technology teachers in secondary schools

The findings showed that, despite male teachers' perceptions that Civil Technology is a male-dominated subject, female teachers can teach it; it can be taught by anyone who is interested to do so and, if it were a subject that should only be taught by men, there would be any female learners taking it. The male teachers indicated that females needed to be encouraged to be confident, and they needed relevant materials for support. Furthermore, male teachers believed that, if given the opportunity, female teachers could thrive in the subject, and that some do, indeed, excel in the subject.

5.2.3 Objective 3: To understand the effect of these challenges on female teachers' practice

The findings indicated that a lack of tools and machines in the schools continues to be a major challenge. While some teachers stated that they had most of the tools and machines needed to complete the projects, there were some tools and machines that they only learn about theoretically because the schools did not have them. Some contact time for practical lessons was affected by the lack of tools and machines and so learners could not gain experience with those tools and machines.

The research findings also showed that a lack of tools and machines is not the only challenge that female teachers faced in the classroom, however, as some male teachers showed a lack of trust of female teachers. Teacher G shared her experience working with a male teacher who was constantly following her around during her practical lessons. Teacher E encountered a lack of trust on the part of male teachers, who made jokes and remarks that they wished to go to her class to see how she was doing in teaching the subject, meanwhile they did not know that she was in one of the top three performing schools in the subject.

5.2.4 Objective 4: To establish the response of these female teachers to the gender-based challenges

According to the findings, all female teachers believed that female empowerment in the subject would significantly attract female learners into the field. Learners would be encouraged to take the subject if they saw female teachers teach it with confidence. According to the findings, empowerment bursaries, among other things, could attract more women to the field. The effect of challenges affecting female teachers is low self-esteem in some and motivation in others. Some teachers, such as teacher E, proved that she could do well in the subject and her results spoke for themselves, while teacher G, who could not do anything without her male colleague being around, showed signs of low self-esteem.

5.3 Recommendations

Based on the findings of the study, it is recommended that female teachers who teach male-dominated subjects such as Civil Technology be recognised by their male counterparts to dispel the perception that these subjects are only for men, especially since female teachers can thrive in the subject with experience and support. Support for women empowerment should be intensified through bursaries to boost their numbers in the subject. These recommendations will serve as an inspiration to female learners to develop the confidence to take the subject and for male teachers to be more trusting of their female counterparts.

It is also recommended that the DBE provides all the tools and machines that learners are supposed to learn about, as per the curriculum. This recommendation will ensure

that teachers meet their pedagogical obligation of ensuring that the specified minimum skills and knowledge each learner must achieve in every grade and field are met. This will also boost the confidence of both female teachers and learners as they prove themselves in operating the machines.

Male teachers who are teaching Civil Technology alongside female teachers should treat them as their equals and be trustful of them. Some positive views that the male teachers held could help dismantle the notion that Civil Technology is the male-only subject field. The numbers of female teachers should be increased to boost their morale. Males should note that helping female teachers to lift heavy materials does not signify that the subject is not appropriate for them.

5.4 Limitations to the study

This study concentrated on Civil Technology teachers in the Johannesburg Central District of the Gauteng province, and I make no claim that it is applicable to other provinces. Other areas of research on this topic may yield different findings and, because this study used a qualitative approach with a smaller sample size, the findings may not be generalised beyond the studied context. With other research questions on the topic, the scope of the interviews could cover aspects such as the involvement of female trainers for teachers during their annual trainings. The interviews and observations could also probe into the teacher training to understand the dynamics of gender treatment.

5.5 Conclusion

The objectives of the study were identified, and the findings of data collected were discussed. Despite having female teachers who excel in the subject, the study discovered that there are perceptions of Civil Technology as a male subject. The study found that the support of teachers and the provision of annual training by the DBE play a significant role in empowering women, giving them the confidence to use tools and machines in their workshops. Although most schools experience a shortage of tools and machines, teachers managed to complete projects with learners. Female teachers are committed to teaching Civil Technology. With the necessary support and change of perception in their male counterparts, they can thrive in the subject.

Personal reflection

I knew from the start of this master's study journey in 2015 that it would not be easy; it would require hard work, dedication, commitment, and time. When my application was accepted, I realised that I needed to make some changes in my life. The first change was that I asked my mother to look after my newborn baby because I could not study, work, and care for a newborn at the same time. It was difficult to leave him behind. This was compounded by the financial constraints that caused me to discontinue my study in 2017.

For five years, I was unable to register, and I had given up on my dream of completing the study until I was offered a position as an academic at the University of South Africa. One of the conditions of this position clearly states that I should complete my master's and doctoral degrees. I then reapplied for a master's degree to continue with the topic that I registered in 2015.

Much has happened in the five years that I had been unable to register, which meant that the challenges were now different. As a single parent with three children, and as an academic, I knew I had to work extra hard; giving up was not an option. This meant juggling time between my kids, work, and my study. This meant staying up until late in the night and getting up early to find balance. Coming this far means a lot because the journey was not easy.

I am grateful to my supervisor, Prof Mishack T Gumbo for making the journey bearable through his kindness, understanding, consistency, and professionalism. As a mentor, he provided a haven for me to persevere. His supervision is very developing, and he is focused on academic growth as a researcher. If I needed anything related to my study, his door was always open. I look forward to registering for my PhD journey with him still.

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APPENDICES

Appendix A: Ethical clearance certificate

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2022/11/09

Ref: **2022/11/09/55442366/26/AM**
Name: Ms HM Ngakane
Student No.:55442366

Dear Ms HM Ngakane

Decision: Ethics Approval from 2022/11/09 to 2025/11/09

Researcher(s): Name: Ms HM Ngakane
E-mail address: 55442366@mylife.unisa.ac.za
Telephone: 0617948923

Supervisor(s): Name: Prof. M.T. Gumbo
E-mail address: gumbomt@unisa.ac.za
Telephone: 0124293339

Title of research:

Gender-based challenges of female teachers in the teaching of Civil Technology in selected secondary schools in Gauteng Province

Qualification: MEd Technology Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2022/11/09 to 2025/11/09.

*The **medium risk** application was reviewed by the Ethics Review Committee on 2022/11/09 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

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3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. 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. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2025/11/09**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2022/11/09/55442366/26/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
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Appendix B: Interview Guide for Female Teachers

Area of Specialisation in the subject:_____

Years of experience as a subject teacher: _____

1. Tell me about yourself as a Civil Technology teacher.
2. Why did you choose teaching as a career, especially teaching Civil Technology subject?
3. How do male teachers perceive you as a female Civil Technology teacher? Why do you think so?
4. Based on your experience in teaching the subject, would you say this is a subject that must be taught by males only and why?
5. What are your working relationships with your male colleagues in this subject?
6. What are the gender-related challenges that you face in teaching the subject?
7. How do you respond to these challenges?
8. What are the hand and power tools as well as machines that are available in your workshop?
9. How well are you able to use these hand and power tools and machines?
10. How well can you do basic maintenance on the tools and machines?
11. How do you demonstrate to the learners the project that they are supposed to do?
12. Does your school have all the required resources, tools and machines to carry out practical work? Why?
13. How often do you receive training from the Gauteng Department of Basic Education?
14. Do female teachers receive more attention as male teachers during the trainings? Explain.
15. In your classrooms, are there more males or female learners or vice versa? Why?

16. What do you think should be done to encourage female learners to take Civil Technology as a subject?
17. What do you think can be done to motivate female teachers, teaching Civil Technology to be confident in teaching the subject?

Appendix C: Interview Guide for Male Teachers

Area of Specialisation in the subject: _____
Years of experience as a subject teacher: _____

1. What is your understanding of gender-based challenges in a workplace?
2. Do you consider civil technology subject as a subject that must be taught by males only? Why?
3. Have you ever worked with a female teacher before?
4. What was your experience like, working with a female teacher?
5. During practical lessons, who do you mostly prefer working with between male and female learners?
6. How often do you attend trainings offered by the Department?
7. Do you think female teachers are given same attention as males during the trainings? Why?
8. Have you ever offered to do or assist a female teacher with her project during trainings?
9. In your classrooms, are there more males or female learners and why is it so?
10. What do you think should be done to encourage female learners to take Civil Technology as a subject?
11. What do you think can be done to motivate female teachers, teaching Civil Technology to be confident in teaching the subject?
12. Do you think being a male teacher of the subject intimidates female learners to take the subject? Why?

Appendix D: Lesson Observation Tool

Name of teacher: _____

Name of school: _____

Subject: _____

Grade: _____

Date: _____

Topic: _____

Observation objectives:

- To understand how practical lessons are delivered by male and female teachers Civil Technology teachers in a classroom.
- To see how learners are treated by male and female teachers Civil Technology teachers in the classroom based on their gender.
- To see first-hand the challenges that female teachers face in teaching the subject.

Activity	Notes
Teacher monitoring the learners.	
Interaction between learners.	
Interaction between learners and teacher.	
Learners getting more attention (male/female)	

Teacher attitude when female learners need assistance.	
Involvement of female learners during lesson demonstration or preparation (preparing tools, cutting materials…)	
Lesson demonstration by female teacher. (presentation, using of tools and machines)	

Appendix E: Samples of Interview Transcriptions

Interview 1 (Teacher E)

Area of specialization – Woodworking
Years of experience as a subject teacher – more than 20 years

Interviewer: Tell me about yourself as a Civil Technology teacher.

Interviewee: *"Civil technology we used to , when we started there were various fields of study where I was working before I came to this school ,there were workshops ,it started when I joined teaching at college ,it was Soweto college at that time it did not offer technical subjects it was only mainstream ,but then when I entered there was variation of attending technical college and mainstream college, so that's when I started to be a civil technology teacher training"*

Interviewer: Why did you choose teaching as a career especially teaching Civil Technology teacher?

Interviewee: *"I guess I am patient, I am so patient so I thought I will fit in, school kids need someone who is patient, who can listen to them and explain to them so, I thought I will be perfect"*

b. Why Civil Technology?

Interviewee: *"Like I said before Soweto college did not have Civil Technology on the ,so on the year that I wanted to study, I found out that there was a college which offered technical studies so I went there and found out that, there were many streams that you can choose from, I chose Civil Technology because I can work indoors, wood work, as a subject I can work indoors, whether its hot or cold ,woodwork I can work anywhere".*

Interviewer: How do male teachers perceive you as a female Civil Technology teacher?

Interviewee: *"It was a challenge actually from college, it was wow, wow why are you doing this as a girl, I think I had this question, from when I was at college, why are you doing Civil Technology subjects because they are perceived as male subjects, but then I just thought its things that I am able to do, I didn't see it as something easy, I knew it will be very challenging but at the same time I thought I could do it, if people can do it, I doesn't matter it's a male or female, I just saw myself doing it".*

Interviewer: Based on your experience in teaching Civil Technology subjects, would you say that this is a subject that should be taught by males and why?

Interviewee: "*No not males only, I am teaching it and I am a female and I am able to do what many men can't do, so it's actually a subject that*

needs someone who is active and hands on, someone who wants challenge, I want to be challenged somehow, so I thought why not".

Interviewer: What is your working relationship with your male colleagues in this subject?

Interviewee: *"Some male colleagues are encouraging, they actually envy what I do, I have met males who were not pro, I what I am doing they would always look at me as someone who could probable be failing, they actually thought I am failing at what I am doing, they did not think I could make it".*

Interviewer: What are the gender related challenges that you face in teaching the subject?

Interviewee: *"I remember in my early years when I started teaching, when I got qualified to teach, I would go to workshops and I would meet male counterparts there, I remember some of them would make jokes like "when you are actually teaching, I wish to attend your class as you teach and see how you are doing it, it was also negative, they will be laughing at me, why will they think I have to fail, like why would I be here if I am failing, yeah I had those challenges".*

Interviewer: How did you respond to such challenges?

Interviewee: *"I just had to walk past through them, and I knew what I was doing, my results were speaking for themselves, that's when they started noticing that I was in the top 3 of the best performing schools in Gauteng, so did not matter that they were saying negative things"*

Interviewer: What are the hands and power tools that are in your workshop, you may mention a few.

Interviewee: *"Many machines are in here, band saws, I have a band saw, I have a circular saw, a medium arm saw, disk sanders, sanding belt".*

Interviewer: How well are you able to use these hand and power tools?

Interviewee: *"I am able to use all of them, I am confident"*

Interviewer: How well can you do basic maintenance of the machines and power tools?

Interviewee: *"That's a bit of a challenge, yes there are a few machines that I can maintain myself like a band saw, I can change a bent saw plate, I can change a belt sander disk, I can do a few not much though I need someone with expertise".*

Interviewer: How do you demonstrate to your learners the project that they are supposed to do?

Interviewee: *"I gather them around and I explain safety rules first and the PPE's that's needed as a requisite then I'll start step by step to show them what to do".*

Interviewer: Does your school have all the required resources and tools to carry out the required work? Why?

Interviewee: *"I can say, not all but I have a lot of the tools and the machines that are needed".*

Interviewer: As educators how often do you receive training from the Gauteng Department of Basic Education?

Interviewee: *"As educators we often get invitation to attend workshops that's where I even learnt how to do basic maintenance for machines, yes we do get training".*

Interviewer: Do female teachers receive more attention as compared to male teachers during training? Why?

Interviewee: *"I wouldn't say female teachers receive more attention I think we all get the same attention, but as an individual, I remember there was one educator I could see was good with machines that was the one I asked in terms of maintenance, like please show me how this is done, I was the one to ask".*

Interviewer: In your classroom, are there more male or female learners? Why?

Interviewee: *"I have more males than female learners and am actually thinking these girls they come because they see I am a lady, so they actually think if I can do it ,they can also do it".*

Interviewer: What do you think should be done to encourage female learners to take Civil Technology as a subject?

Interviewee: *"At our school we have adopted going to schools that are doing lower subjects going to their classes Grade 9 explain to them the subjects, take them to our workshop and also explain we have other female who have also done this and thy are working and making their lives, I think also female teachers were also an encouragement to the lads as well".*

Interviewer: What do you think can be done to motivate female teachers in Civil Technology to remain confident in teaching the subject?

Interviewee: "*We do have female teachers but encouraging them is also around meeting them at workshops and that's when we talk, I can*

see how female educators when they look and listen to me, other experienced teachers they get to be encouraged, they want to do more, we exchange numbers and they ask questions and they will also be encouraged".

Interview 4 (Teacher C)

Area of specialization – construction
Years of experience as a subject teacher – 4 years

Interviewer: How many years have you been teaching construction?

Interviewee: *"Since 2019".*

Interviewer: Can you please tell me about yourself as a Civil Technology teacher?

Interviewee: "I am a Civil Technology teacher, I am qualified teacher, I am currently doing master's in Civil Technology construction. My highest qualifications is honours in Civil Technology."

Interviewer: Why did you choose teaching as a qualification especially teaching Civil Technology?

Interviewee: *"Okay, I think teaching, I did not choose it, it actually chose me, it was something I was not familiar with, I wanted to just explore other subjects and know what this subject civil technology is, as I started doing it, I found that it was interesting."*

Interviewer: How do male teachers perceive you as a female teacher? Why?

Interviewee: *"I think that construction is for men, so you are treated like an egg, that you cannot do this or do that."*

Interviewer: Based on your experience of teaching the subject would you say it's a subject for males only and why?

Interviewee: *"No I do not think so, I think it can be taught by both male and female we are trying to address or redress the inequality that existed that of the past to say there are careers for male and careers for female, females can also teach the subject."*

Interviewer: What is your relationship with male teachers in the subject?

Interviewee: *"We have a good relationship, they assist in any way they can assist me, as they also believe as a female you can't do 1,2,3. They help where I need help".*

Interviewer: What are the gender related issues you are facing in teaching the subject?

Interviewee: *"Just to be realistic some of the activities are difficult to be carried out by female, for instance, when you need to move a bag of cement from one place to another, it's difficult because you need man power and*

obviously at school we don't have enough power tools to carry out the work to make it easy for both gender ,sometimes you need man power".

Interviewer: So how do you respond to these challenges?

Interviewee: *"I seek assistance where I need man power and my learners, the boys they say you can't do this, let us lift it for you".*

Interviewer: Which hand and power tools as well as machines do you have in your workshop?

Interviewee: *"Gauge, brick layer, trowel, apparatus for testing, concrete mixer, drill, grinders".*

Interviewer: How well are you able to use these hand and power tools?
Interviewee: *"I think I am average; I am able to operate all the power tools and the machines that I have."*

Interviewer: How well can you do basic maintenance on the tools and machines?

Interviewee: *"I can't, I don't have the knowledge of maintaining tools, we don't do the maintenance."*

Interviewer: How do you demonstrate to the learners the projects that they are supposed to do?

Interviewee: *"I do it myself usually I do it in our workshop practically, I get a chance to do my practical work, I bring it to the school and I demonstrate to them, how to achieve the product, so I will get explain to them were to start I show the tools, how they are used and in future you allow them to do as you will be watching correcting were they are using machines incorrectly."*

Interviewer: Does your school has the necessary equipment to perform the practical work? Why?

Interviewee: *"We have the basics needed tools we do, not have all the tools, some of the tools we read about them but we do not have them."*

Interviewer: How often do you receive training from the department of education?

Interviewee: *"We receive training once a year in June, it is a weeklong training."*

Interviewer: In your classroom, are there more males or female learners or vice-versa? Why?

Interviewee: "*There are more female learners in my classes all of them, there are more boys than girls".*

Interviewer: What do you think should be done to encourage female learners to take Civil Technology as a subject?

Interviewee: " *I think it starts by if the subject is being taught by a female teacher ,it motivates them ,seeing a women in construction, I think that's why in my case I have more females than boys, I think if a teacher can encourage more females to take on teaching the subject. Maybe we can have female empowerment bursaries that can motivate females to teach the subject in turn female learners would also be encouraged to choose it."*

Interviewer: What do you think can be done to motivate female teachers, teaching Civil Technology to be confident in teaching the subject?

Interviewee: *"I think maybe we can have female empowerment bursaries, that can motivate females to teach the subject in turn female learners would also be encouraged to do it."*

Interview 5 (Teacher A)

Area of specialization – construction
Years of experience as a subject teacher – 5 years

Interviewer: What is your understanding of gender-based challenges in the workplace?

Interviewee: *"Preference given to a certain gender it can be traced to work issues and mentality of people, looking at the work situation whereby man try to do female stuff or women try to do male stuff they end up meeting these challenges due to the strenuous part of the job."*

Interviewer: Do you consider technical subjects as subjects that should be taught by male only? Why?

Interviewee: "*No because if it was to be taught by males only when there are female students doing the subject."*

Interviewer: Have you ever worked with a female teacher before?
Interviewee: "*Yes"*

Interviewer: What was your experience working with a female teacher?

Interviewee: "It was a good working relationship, a good experience, she was more open to ask where she needed help, it's not like there's certain comparison or certain disability because she was a female, it was same like working with male teachers."

Interviewer: During practical lessons who do you prefer working with between female and male learners? Why?

Interviewee: *"All the learners because they are all ready to partake and see how it's been done and understand how it's been done, so al the learners it shouldn't be gender based, all of them needs the information and all of them needs the skills".*

Interviewer: How often do you attend training of the Department? Why?

Interviewee: "*Regularly as long as we get the memo, and all the invites."*

Interviewer: Do you think female teachers are given the same attention as male teachers during the training? Why?

Interviewee: *"Yes, because we are all seen as 1, and we all partake in the given tasks and discussions and it's not like we are separated we are all seated together in one venue".*

Interviewer: Have you ever offered to assist a female teacher with her work during training? Why?

Interviewee: *"Yes, when I see the need to or I have the necessary skills I just assist".*

Interviewer: In your classrooms are there more male or female learners? Why?

Interviewee: *"Its balanced, more or less it depends on, the learners themselves there are the ones that choose the different trade subjects that they can do, it's not specifically me who choose but usually the classroom is more balanced, some year you get more males and some you get more females."*

Interviewer: What do you think should be done to encourage female learners to take Civil Technology subjects?

Interviewee : *"There should be more outreach programs for learners so that they can understand that it's not for meles and it's not strenuous anyone can do it so there can be more outreach ,open days for learners so that they can come in the workshop experience the machines ,look at things that are done there so that we can take them up the following years when they get motivated to join the subject"*

Interviewer: What do you think you be done to teachers, teaching civil technology so that they can be confident in teaching the subject?

Interviewee *"Just giving them support material and making them feel free within the subject its self, it's not make based and they should know that it's like any other subject, it's just them taking the opportunity and teaching the learners, and not looking at the surroundings because of certain tools being used seen as male tools and so on, it's supposed to be just tools whereby everyone is confident to touch them, work with them, I think more or less workshops just to encourage them to understand that they can do this."*

Interviewer: Do you think being a male teacher intimidates the female learners to take the subject? Why?

Interviewee: *"No, more or less the situation around the workshop, machinery or maybe the workshop is the one that intimidates the learners because they are used to be taught other subjects, so I doubt it can be me the male teacher who do that, it's just that, they need to know that the workshops and the machinery isn't just males only they are for everyone who wants to take up the subject."*