AN EVALUATION OF THE IMPLEMENTATION OF THE DESIGN AND TECHNOLOGY CURRICULUM IN SELECTED SECONDARY SCHOOLS IN KAPIRI MPOSHI DISTRICT: A CONTEXT INPUT PROCESS AND PRODUCT (CIPP) MODEL

By

Nephat Kasebusha

A thesis submitted to the University of Zambia in fulfilment of the requirements for the award of the degree of Doctor of Philosophy in Curriculum Studies

The University of Zambia

Lusaka

2025

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I, **Nephat Kasebusha**, do hereby declare that this thesis represents my own work, except where otherwise acknowledged, and that it has never been previously submitted for a degree at the University of Zambia or any other university.

Signed: ………………………………………………………………………………

Date: ……………………………………………………………………………...

CERTIFICATE OF APPROVAL

This thesis of **Nephat Kasebusha** is hereby approved as fulfilling the requirements for the degree of Doctor of Philosophy in Curriculum Studies by the University of Zambia.

External Examiner …………………………..……………………………………

Signed: ……………………………… Date: …………………………………………

Examiner 1: ………………………………………………………………………..

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Examiner 2: …………………………………………………………………………

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ABSTRACT

There has been a consistent decline in financing the education sector from 2015 to 2022, and the failure rate of learners in the Design and Technology subject has increased from 2016 to 2022. Thus the purpose of the study was to evaluate the implementation of the Design and Technology curriculum in selected secondary schools in Kapiri Mposhi district in order to establish the adequacy of the for the effective implementation of the subject. Mixed research approach using embedded research design was used to collect and analyse the data. Five-point likert scale questionnaires were used to collect quantitative data from the 64 Design and Technology subject learners while the interviews were conducted to 10 Design and Technology subject teachers, 4 head teachers, 4 deputy head teachers, 4 practical subjects heads of department, 1 Senior Education Standards Officer (SESO) and 1 District Education Standards Officer (DESO) and observation to collect qualitative data. The quantitative data were analysed using descriptive statistical analysis. A constant comparative qualitative data analysis method was used to analyse the interview data.

The study's findings indicated that secondary schools had inadequate workshops and that those they have small rooms and spaces to accommodate all learners. The study also indicated the inadequacy of the teaching and learning resources of Design and Technology subjects. The inadequacy of the teaching and learning resources for the subject influences teachers to use group methods during practical teaching. The study has also shown that the schools that offer Design and Technology subject do not implement it according to the duration prescribed by the 2013 curriculum framework. The learners partially develop the practical skills, but fail to apply them. The study recommends that the Government, through the Ministry of Education fund schools offering Design and Technology subjects to upgrade existing workshops and build new ones with sufficient space and resources. The Ministry of Education should advocate for reinstating of allocated teaching periods for Design and Technology subjects in school timetables.

Key words: *Evaluation, implementation, design, technology, curriculum, context, inputs, process, product, secondary, school.*

DEDICATION

I dedicate this thesis to my late father and mother Duncan Peter Kasebusha and Daisy Moyo Kasebusha. To my father, I still recall the words you consistently used to tell me that I should concentrate on school and that it would be through education that I would become the family's pillar. To my mother, you died when I was in grade one, but still remember the words of encouragement that I should concentrate on education. You both laid a very strong education foundation for me. I still feel your spiritual presence furthers my academic journeys to this far. May your Souls Rest in Eternal Peace.

ACKNOWLEDGEMENT

This thesis would not have been a reality without God's guidance, wisdom, and strength, which He accorded me during the entire process of the study.

I deeply want to appreciate my Principal Supervisor, Prof. Innocent Mutale Mulenga and the Co-Supervisor Dr. Kapambwe Mwelwa of the University of Zambia, School of Education who generously dedicated their effort and strength to supporting me in the writing of this document. I appreciate them for supervising and guiding me through rephrasing the research title and writing the research proposal and thesis. I also thank them for their technical advice and endless efforts in guiding me during this work. The criticism of my supervisors opened my mind to academic writing. With the knowledge and skills I gained from them, I would like to assure them that they provided me with the opportunity to become an academic writer and a researcher soon. I would also like to thank Dr. Esau Mbewe, my statistics mentor, for his wise guidance and strong background in statistics, which were invaluable in supporting my work.

I wish to also thank the Provincial Education Officer (PEO) of Central province and the District Education Board Secretary (DEBS) of Kapiri Mposhi district for allowing me to carry out the study in the selected secondary schools in the district. Without the research respondents and participants, this document would have been incomplete. I therefore thank all the respondents and participants for their willing participation and cooperation during the study. It would be unfair to pass without commending the school management of the schools sampled for data collection for their welcoming spirit during the collection of data that gave proper meaning to this study. May the Almighty God bless you abundantly to all you mentioned in this acknowledgement.

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LIST OF ACRONYMS AND ABREVIATIONS

CIPP	Context Inputs Process and Products
CBC	Competence Based Curriculum
DT	Design and Technology
DEBS	District Education Board Secretary
DHTR	Deputy Head Teacher
DESO	District Education Standards Officer
ESO	Education Standards Officer
ECZ	Examination Council of Zambia
GDP	Gross Domestic Product
HoD	Head of Department
HTR	Head Teacher
ILO	International Labour Organisation
MoE	Ministry of Education
MoGE	Ministry of General Education
OBE	Outcome Based Education
PEO	Provincial Education Officer
SESO	Senior Education Standards Officer
SDG	Sustainable Development Goals
TR	Teacher
TEVET	Technical Education Vocational and Entrepreneurship Training
UNICEF	United Nations International Children's Emergence Fund
UNESCO	United Nations Education Scientific and Cultural Organisations
USAID	United States Agency for International Development
ZANEC	Zambia National Education Coalition

CHAPTER ONE: INTRODUCTION

1.0 Overview

This chapter provides the introductory information of the study which focuses on the implementation of the Design and Technology Curriculum in secondary schools. This chapter therefore establishes the study's background, the statement of the problem, and the study's purpose. It also elaborates on the research objectives, research questions, significance of the study, the CIPP theoretical framework, and conceptual framework. Furthermore, delimitation, limitations and operational definition of terms and the structure of the thesis are also presented in this chapter.

1.1 Background

Education is an avenue of training and learning, especially in schools or colleges, to improve knowledge and develop skills. The ultimate purpose of education is to empower learners to excel in a chosen field of endeavor and to positively improve their environment. Zambia has had two major curriculum shifts or orientations from the inception of formal education by the various missionary groups. Zambia's first curriculum was a Content-Based Curriculum which it has been using since its political independence in 1964 (Mulenga and Kabombwe, 2019). However, Zambia's education system has experienced dynamic and quick changes that have had far reaching consequences for learners, educational institutions, and society. According to Tuchili (2022), there have been significant changes in policy development and directives since the country's independence in 1964, one of which was establishing a vocational career route in the educational system.

Shiundu and Omulando (1992) argued that no curriculum remains relevant and perfect for all ages. It must keep on changing to address the needs and challenges that emerge as society changes. This helps construct and reconstruct the curricular to make them relevant to learners and society. In 2013, the Government of the Republic of Zambia through the Ministry of Education (MoE) with the help of the United States Agency for International Development (USAID) revised the curriculum to enhance pupil performance at secondary school level that saw the introduction of the vocational career pathway. The vocational career pathway is for learners with ambitions and interests in technical and practical jobs. The education system adopted a Competency-Based Curriculum, an Outcomes-Based Education type (MoGE, 2013). The curriculum was reformed to prepare learners for future challenges in the rapidly changing global world. The vocational pathway provides practical skills to learners from grade 8 through to 12.

In an effort to revise and tailor the school curriculum to the changing educational needs, Wood Work, Metal Work, Technical Drawing, Building and Plastering and Graphical Communication were integrated into Design and Technology at secondary school level. This was done to produce holistic learners with knowledge and skills (Ministry of General Education, 2013). Design and Technology focuses on practical work, preparing learners for a particular trade or skilled profession. Design and Technology allows learners to gain practical experience in their career path before they even graduate. It is designed to make learners acquire knowledge and develop practical skills. Thus it was meant to provide practical education, so that learners develop specific industry skills to jump right into their profession and get started.

The rationale for the integration of design and technology into the education system is the sustainable development of technology. According to Tanna and Kumar (2015), Design and Technology has a number of distinctive and innovative features such that it commences with building a science-based foundation followed by basic engineering principle as well as the area of design concept (Milne, 2018). The higher expectation regarding design and technology is related to self-reliance, entrepreneurship, and skills acquisition among learners in secondary schools. Thus, the Design and Technology subject offers the opportunity for learners to investigate and evaluate the use of materials in to products (Primary Teachers' Diploma Curriculum for Colleges of Education, 2015).

Design and Technology is one of the vocational subjects taught in secondary schools and tertiary institutions in many countries across the world. For instance, countries that have Design and Technology as a subject include England, Iceland, Australia, Singapore, Cyprus, Botswana, Papua New Guinea, among others. In essence Design and Technology was introduced into National Curriculum in England and Wales as a distinct academic subject in 1990 to inspire young people to enter the engineering and technology education professions and develop new technology skills (Smithers, 2016).

Zulu (2015) indicated that the 2013 Zambian curriculum aimed at equipping learners with vocational knowledge and skills to help them develop survival and lifelong skills for self- reliance. The rationale for this revision was to make the curriculum more responsive to societal needs by providing learners with relevant knowledge, skills, and real-life values. It is worth noting that the new look for the practical initiative is the provision of learners with survival skills and appropriately preparing them for upward mobility (Zulu, 2015 and Tuchili, 2022). This would develop values and cater for the learners' needs and aspirations for self-reliance and entrepreneurship to develop a responsible, productive, and self-sustaining citizen. Design and Technology was meant to generate basic knowledge, skills, and dispositions among learners that might prepare them to think of becoming skilled workers or entering manual operations. It was meant to train learners in skills and provide them with knowledge related to a specific trade, occupation or vocation in which they wish to participate. Hence the subject constitutes forms of knowledge, skills and values that learners should poses to help them deal with the challenges of unemployment as Barlex (2014) indicated also that Design and Technology in England and Wales was meant to help prepare learners for post-school employment or vocational training.

Planning for Design and Technology should be organised well with the provision of adequate and properly trained Design and Technology teachers. Provision of an enabling environment, specifically, functional workshops and laboratories and practical material resources necessary for teaching Design and Technology should be made. According to MoE (1996) in the 'Educating Our Future Education Policy', if practical subjects are to be properly taught and meaningfully learned in schools, they require not only teachers who are competent to teach but also schools that are adequately supplied with equipment, apparatus and relevant books and appropriate infrastructure.

To achieve human development, UNESCO (2016) pointed out that school must have all the necessary educational requirements, infrastructure, classrooms, desks, chairs and text books to successfully teach and learn practical subjects. Kekaya (2014) also added that in order to effectively implement practical subjects, schools should have adequate workshops, laboratories, classrooms, libraries, course and reference books. It is therefore clear that for an effective teaching and learning of Design and Technology, schools have to be adequately prepared with conducive context (workshops, laboratories, classrooms and libraries) and input resources such as tools, equipment, books and well prepared teachers.

For effective teaching and learning in schools, the Ministry of Education (2013:58) in the Zambia Education Curriculum Framework guided that:

> *Learning institutions should have appropriate infrastructure such as classrooms, specialised rooms, laboratories, workshops and resource rooms. This infrastructure should be well stocked with adequate equipment and materials needed for effective teaching and learning. They should also have user-friendly facilities for learners. The Library is a very important resource-room in a learning institution. Therefore, it must have adequate and appropriate reading and other learning materials for both learners and staff.*

Given the issues raised here, schools that adopt Design and Technology should have appropriate and standard context (infrastructure) in which teaching and learning of Design and Technology should occur. Thus, without adequate and conducive context with appropriate inputs, it would be difficult to effectively and successfully implement the subject to achieve its main intended goals and objectives. This was also explained by Mubangwe (2016) that the environment where teaching and learning of Design and Technology subject takes place is an important educational factor that needs to be considered by everyone concerned, the environment needs adequate attention in the area of infrastructural facilities, and made conducive for learning purposes in order to achieve the set goals and objectives.

Kakupa (2017) discussed that the 2013 curriculum declared the vocational career pathway as a progressive and a giant step in helping youths acquire skills for self-reliance, but its successful implementation remains uncertain. The context in which Design and Technology is being implemented is cardinal and should be greatly considered. This is the why Kakupa (2017) wondered how vocational education could be realised amid limited infrastructure and critical teacher shortages. He thus recommended for possible reversal of the programme up to such a time when the country had enough resources to implement it. The implementation of a vocational education in secondary schools in Zambia is likely to face challenges because schools already had insufficient funding, poor infrastructure and low staffing levels.

There has been a consistent observation of a steady decline in financing the education sector from 2015 to 2022 (Ministry of Finance National Budget, 2015-2022), which does not only pose a threat to the furtherance and aspiration of the country's ability to sustain the provision of quality education, but is also fundamentally dichotomous to the global/regional benchmark of 20% or 4% - 6% of GDP of annual national budget to the education sector (UNESCO, 2018; Hampongo, 2020). Sustainable quality education cannot be realized without a significant and well-targeted increase in financing the sector (UNESCO, 2016; World Bank, 2019; and Yang, 2019) for required demand driven investments. Masaiti et al., (2018:89) also observed an amusing drastic steady reduction in sectoral budgetary allocations from 2015 to 2017 with an emphatic recommendation for an in-depth analysis of the phenomena as no study had been done to specifically address the occurrence.

Vocational subjects such as design and technology are expensive to implement effectively because of the context and inputs that should be in place before the implementation. This was the more reason why ZANEC (2017) got concerned with the education budget 2017 which was at 16.5 % from 20 % in 2014 of the total budget, and that education system continued to receive diminishing funds. This might have directly affected the implementation of vocational education. Thus, the spillover effect of the inadequate financing of education would manifest itself in the failure of the government to ensure learners develop practical vocational skills (UNICEF, 2022). Design and Technology is a vocational subject which is demanding and expensive because it requires a lot of funding for its effective and successful implementation due to its high cost (UNICEF, 2016; Kakupa, 2017). Zambia's budget distribution to the education sector as a percentage of the overall national budget in the last seven years shows a downward public education expenditure budget trend from 2014 to 2022. Table 1.1 shows the public education expenditure budget trend from 2014 to 2023.

1.1.1 Trend of Public Education Expenditure Budget, 2014 to 2023

Table 1.1: Trend of Public Education Expenditure Budget, 2014 to 2023

Year	Budget allocation (Billion Kwacha)	Expenditure %	GDP (%)
2014	8.6	20.0	5.2
2015	9.4	20.2	5.1
2016	9.1	17.2	4.2
2017	10.6	16.5	4.3
2018	11.6	16.1	4.2
2019	13.9	15.3	4.4
2020	11.2	12.4	4.0
2021	13.8	11.5	3.8
2022	18.8	10.4	3.9
2023	23.2	13.9	4.4
2024	27.4	15.4	4.3

Source: *UNICEF; Zambia Budget Brief Education, 2024*

Table 1.1 shows a decline in funding to the education sector in Zambia. The Education 2030 Incheon Declaration and Framework for Action, a global plan agreed upon by countries in 2015 for the implementation of SDG 4, urges governments to allocate at least 15-20 % of their total public expenditure at all levels of education, while the second, more widely accepted, set spending of 4-6 % of GDP on education (Global Partnership on Education, 2016). Zambia's declining share of education has significant implications for attaining SDG 4 and Vision 2030.

Design and Technology was introduced in Zambian schools in 2014 to help learners depend not only on the acquisition of knowledge but also on practical skills, values, and change of attitudes towards vocational activities, which will most likely help bridge the gap between the labour market and the school system. Though this approach works well for countries where it has been put into practice, Zambia has a different environment. For instance, the national budgetary allocation to Zambia's education and skills sector has been reducing since 2015, as indicated already. In the 2022 budget, the Government announced a K18.1 billion allocation toward education. The proposed expenditure on education represents a 31% increase compared to the 2021 allocation of K13.8 billion. This amount also represents a marginal increase compared to 2021 when expressed as a share of GDP. However, as a share of total expenditure, the allocation to education reduced from 11.5% in 2021 to 10.4% in 2022 (UNICEF, 2022, and Banda, 2021). UNICEF (2023:8) indicated that, "in 2023 education spending was at 4.4 % of GDP which aligns with the global recommendation. However, as a share of the total budget 13.9 %, the education budget remains below the lower threshold of the Incheon benchmark." Therefore, the subjects under vocational track in secondary schools are likely to face very difficult implementation process due to the decline in educational budget expenditure.

Design and Technology is a practical subject, hence both teachers and learners need to see and touch the teaching and learning resources (inputs) or tools and other equipment during the teaching and learning process. The subject cannot be effectively implemented without adequate resources, otherwise the teaching of the subject maybe be as theoretical as the academic subjects. Thus Kakupa (2017) argued that secondary schools in Zambia were not ready for full vocationalisation because of the lack of facilities that may negatively affect the quality of education in the vocational career pathway, as rote learning (as opposed to actual performance), is likely to result. Design and technology may not be easily implemented in secondary schools, where appropriate infrastructure, tools, and equipment are required to meet their demands. It is important to indicate that without investing in new infrastructure, the implementation of Design and Technology subject will likely not meet its intended objectives.

The implementation of Design and Technology seems expensive and difficult to undertake in the Zambian context. The availability and state of the context and inputs and how the Design and Technology is being implemented have not been assessed in secondary schools amid declining fundings towards the Ministry of Education from 2014 when it was introduced in schools. Therefore, there is no well-documented evidence-based research assessing the context, inputs, processes and products of Design and Technology subject in secondary schools in Kapiri Mposhi district, which is the researcher's motivation and therefore the pre-occupation of this study.

1.1.2 Learners Performance Report for Design and Technology 2018 to 2022 in Percentage (%)

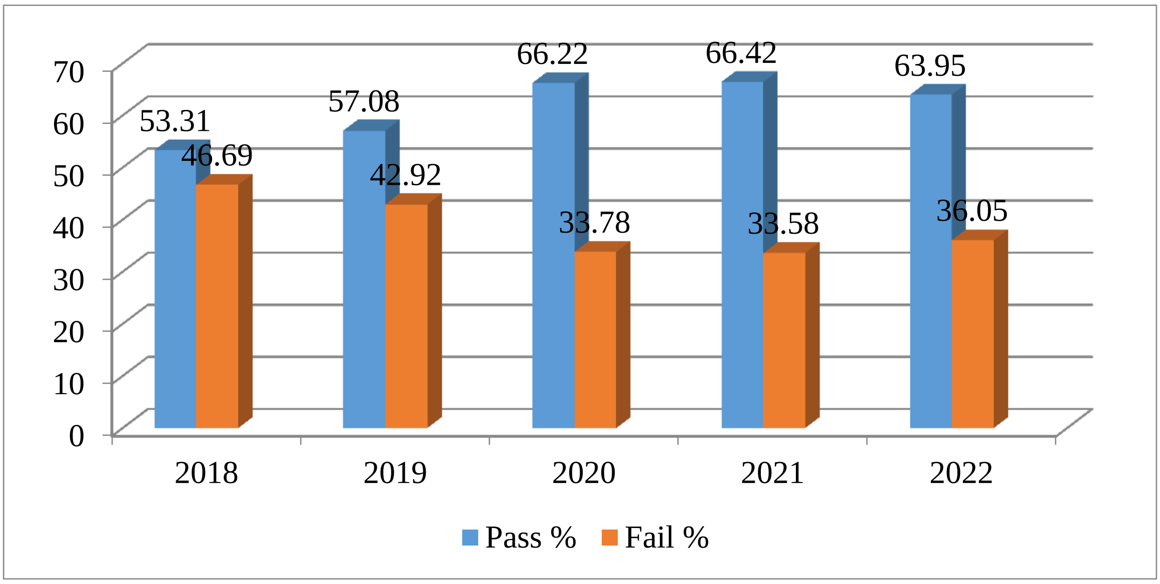

Figure 1.1: Learners Performance Report for Design and Technology 2018 to 2022

Source: *ECZ Performance Reports – 2018 to 2022*

The data presented in Figure 1.2 highlights fluctuations in the pass and fail rates of candidates who sat for the Design and Technology subject between 2018 and 2022, revealing an overall improvement in learners' performance despite some variations. In 2018, the pass rate was at its lowest, recorded at 53.31%, with a fail rate of 46.69%. However, in 2019, there was an improvement, as the pass rate increased to 57.08% while the fail rate dropped to 42.92%. The highest performance was observed in 2021, where the pass rate peaked at 66.22%, accompanied by the lowest fail rate of 33.58%, suggesting notable improvements in teaching and learning, curriculum implementation, or learners' preparedness. In 2022, although the pass rate slightly declined to 63.95% and the fail rate increased to 36.05%, the results remained better than in 2018 and 2019. Overall, the pass rate ranged between 53.31% and 66.22%, while the fail rate fluctuated between 33.58% and 46.69%. These variations indicate a general positive trend in learners' performance, though the slight drop in 2022 suggests potential challenges.

1.1.2 Design and Technology Results Analysis 2016 to 2022

The Examination Council of Zambia (ECZ) reports indicated that learners performed poorly in the Design and Technology subject. The performance of learners in the subject has been consistently poor from the time the subject was first examined in secondary schools in 2016. Figure 1.1 shows results analysis for Design and Technology 2016 to 2022 in Kapiri Mposhi district.

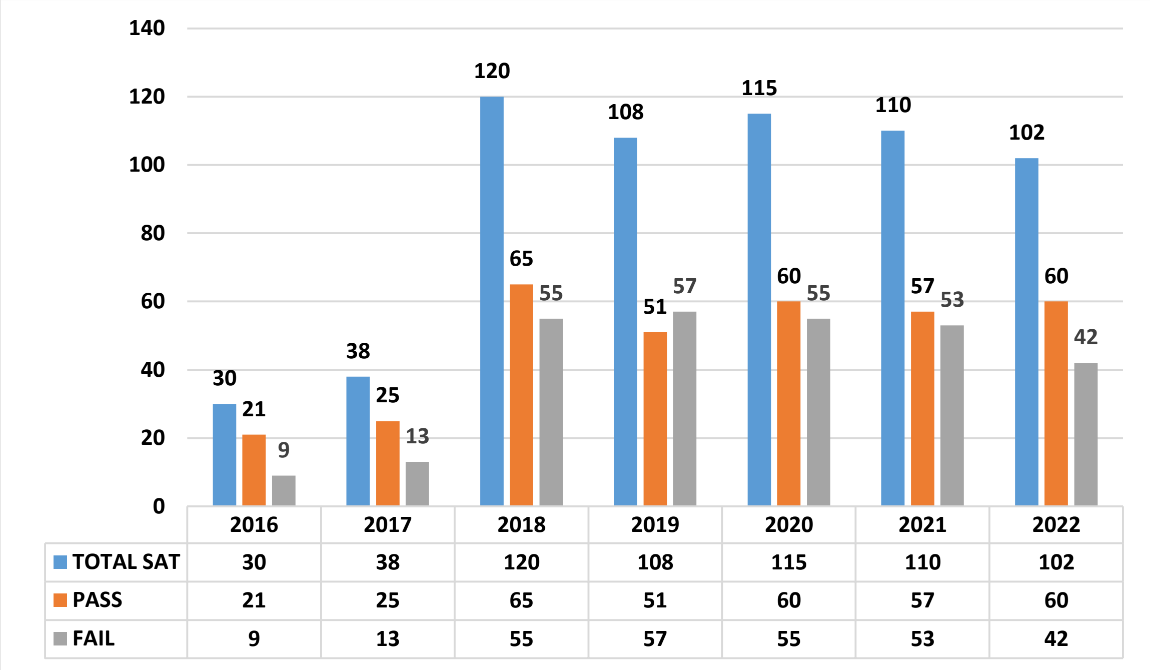

Figure 1.2: Kapiri Mposhi District Design and Technology Results Analysis 2016 to 2022

Source: *ECZ 2016-2022 - Kapiri Mposhi District*

Figure 1.1 shows 21 out 30 learners who sat for Design and Technology examination in 2016 representing 70 % of the candidates passed while 9 out 30 representing 30 % of the candidates failed. In 2017, 25 out of 38 representing 66 % of the candidates who sat for the subject, passed while 13 out of 38, representing 34 %, failed. In 2018, 65 out of 120 candidates who sat for Design and technology representing 54 % passed the subject while 55 out of 120, representing 46 %, failed. In 2019, 51 out of 108 representing 47 % of the candidates who sat for the subject passed while 57 out of 108 representing 48 % of the candidates who sat for the subject failed. In 2020, 60 out of 115 representing 52 % of the candidates who sat for the subject passed while 55 out of 115 representing 48 % of the candidates who sat for the subject failed. In 2021, 57 out of 110 representing 48 % of the candidates who sat for the subject passed while 53 out of 110 representing 52 % of the candidates failed. In 2022, 60 out 102 representing 59

% of the candidates who sat passed while 42 out of 102 representing 51 % of the candidates who sat for the subject failed.

Design and Technology subject requires creativity, critical thinking, and problem solving skills. Thus learners who lack interest or motivation in the subject do not fully engage with the material and perform poorly. The subject often requires hands on projects, access to workshops, tools, and materials. Schools with limited resources struggle to provide learners with the necessary equipment and facilities for practical learning experiences. Effective teaching of design and technology requires specialized knowledge and skills. If teachers lack proper training and expertise for the subject, negatively impact learners' understanding and performance. Barlex (2014) discussed that Design and Technology subject often require a strong foundation. Learners who lack these foundational skills may struggle to grasp the more advanced concepts as they have limited exposure to real world applications of Design and Technology concepts struggle to see the relevance and value of the subject.

1.2 Statement of the Problem

The teaching and learning of Design and Technology in secondary schools aim to equip learners with practical skills, knowledge, and a positive attitude toward the subject. However, effective implementation requires adequate funding, proper infrastructure (workshops, laboratories, and classrooms), and essential inputs such as tools, trained teachers, and relevant teaching resources. When these elements are in place, learners can acquire practical skills more effectively, leading to improved academic performance. Unfortunately, the education sector in Zambia has faced a consistent decline in budgetary allocation, dropping from 20.2% of the national budget in 2015 to 10.4% in 2022, despite global recommendations to allocate 15-20%

of the budget or 4-6% of GDP to education. This decline is particularly concerning given the introduction of the Competency-Based Curriculum, which requires greater financial investment compared to the previous Content-Based Curriculum.

The reduction in funding has negatively impacted the successful implementation of vocational subjects like Design and Technology. Various studies (UNICEF, 2016; Kakupa, 2017; ZANEC, 2017) have expressed concerns about the feasibility of implementing vocational subjects without sufficient financial support. Sustainable quality education cannot be achieved without significant, well-targeted investments in teaching and learning resources and infrastructure. Since the introduction of Design and Technology in Zambian secondary schools in 2014, no comprehensive study has assessed the subject's implementation in terms of context, inputs, processes, and outcomes. Moreover, the extent to which declining funding has affected the availability of teaching and learning resources, as well as infrastructural facilities crucial for delivering the subject, remains largely unknown, necessitating further investigation.

The performance of learners in the Design and Technology subject varied significantly at both national and district levels over the years. National data from 2018 to 2022 shows fluctuations in pass and fail rates, with the lowest pass rate recorded in 2018 at 53.31% and the highest in 2021 at 66.22%. However, a decline to 63.95% in 2022 raises concerns about the sustainability of these improvements. Similarly, at the district level, pass rates dropped from 70% in 2016 to 48% in 2021 before rising to 59% in 2022. Failure rates remained high, reaching 52% in 2021, indicating ongoing challenges in achieving consistent academic success. These variations suggest persistent difficulties in the effective implementation of the Design and Technology curriculum. Despite some improvements, the inconsistencies in performance highlight the need to evaluate teaching methods, curriculum delivery, and student preparedness. Therefore, this study assessed the context, inputs, processes, and products of the Design and Technology subject in secondary schools of Kapiri Mposhi district to establish the adequacy of implementing the Design and Technology subject.

1.3 Purpose of the Study

The study aimed to evaluate the infrastructure, teaching and learning materials, teaching and learning process, the knowledge and skills acquired and developed by learners from Design and Technology subject in selected secondary schools in Kapiri Mposhi district to establish the adequacy for effective implementation of the subject.

1.4 Research Objectives

The following research objectives guided the study:

i. To evaluate the infrastructure of the Design and Technology subject in selected secondary schools of Kapiri Mposhi district.
ii. To assess the teaching and learning resources of the Design and Technology subject in selected secondary schools of Kapiri Mposhi district.
iii. To establish the adequacy of the teaching, learning and assessment processes in the Design and Technology subject in selected Kapiri Mposhi district secondary Schools.
iv. To analyse the extent to which the knowledge and skills of Design and Technology subject are developed and applied by learners in selected secondary schools of Kapiri Mposhi district.

1.5 Research Questions

To attend to set research objectives, the study answered the following research questions:

i. How conducive is the infrastructure of the Design and Technology subject in influencing effective implementation?
ii. To what extent are the teaching and learning resources adequate for the Design and Technology subject?
iii. How adequacy is the teaching, learning, and assessment processes in the Design and Technology subject?
iv. To what extent are the knowledge and skills of Design and Technology subject are developed and applied by learners?

1.6 Significance of the Study

The study findings might be specifically helpful to the government and the Ministry of Education on the inputs for effective Design and Technology implementation in secondary schools. The study's findings might also guide curriculum planners, designers, developers, and teachers on the best possible way to implement Design and Technology in schools. The study's findings might also be of great value to future researchers on the implementation of the Design and Technology by adding knowledge to the existing literature on the implementation of Design and Technology subject. To the government of the republic of Zambia, policy makers, donors, and implementers of the Design and Technology subject, the study might provide information on the current challenges, remedies to tackle these challenges, and the best way to implement the Design and Technology subject in secondary schools.

1.7 Evaluation Frameworks

The most common frameworks used for evaluating curriculum implementation include Tyler's evaluation model, Kirkpatrick's four level evaluation model and CIPP evaluation model. This study used the CIPP evaluation model because it allowed the comprehensive and holistic evaluation of the adequacy of the workshops for the Design and Technology subject, tools, equipment and machineries, adequacy of teaching, learning and assessment processes, the knowledge acquired and skills developed and applied by the learners in schools.

1.7.1 Tyler's Objective-Based Evaluation Model: 1949

Tyler's Objective-Based Model, developed by Ralph Tyler, is one of the most widely recognized and foundational models in curriculum evaluation. According to Tyler (1949), the model focuses on assessing whether instructional objectives are achieved, making the evaluation process highly structured and goal-oriented. The model is based on four key steps: first, defining educational objectives, where clear, measurable goals for student learning are established; second, identifying learning experiences, which involves selecting activities and materials that will help achieve these objectives; third, organizing the learning experiences into a logical sequence to facilitate effective teaching; and finally, evaluating whether the objectives have been met through assessment. This step-by-step approach provides a clear framework that allows educators to measure the effectiveness of their teaching strategies and the learning outcomes of their students (Tyler, 1949). Because of this systematic structure, it is particularly useful in ensuring that specific, measurable goals are pursued and achieved in a curriculum (Print, 1993).

However, despite its clarity and focus on measurable outcomes, Tyler's objective-based model has certain limitations. One of the main drawbacks is its rigid structure, which may not account for the complexities of the educational process (Glatthorn & Joyner, 2003). For instance, the model does not fully consider unintended learning experiences, such as spontaneous moments of discovery or unplanned student interactions that can contribute significantly to learning (Schiro, 2013). Moreover, the emphasis on achieving predefined objectives may limit the model's flexibility in dynamic learning environments where students' interests and needs may evolve in unpredictable ways. This can result in a somewhat narrow view of what constitutes successful learning, overlooking the broader, more holistic impacts of education, such as the development of critical thinking, creativity, and social skills (Glatthorn & Joyner, 2003). Therefore, while Tyler's model provides a clear and goal-oriented approach to curriculum evaluation, its lack of flexibility may restrict its effectiveness in diverse and evolving educational settings (Schiro, 2013).

1.7.2 Kirkpatrick's Four-Level Evaluation Model: 1959

The Kirkpatrick's Four-Level Model was developed by Donald Kirkpatrick in 1959**.** Kirkpatrick's Four-Level Model, originally developed for evaluating training programs, and has been widely adapted for curriculum assessment due to its structured and comprehensive approach. According to Kirkpatrick (1994), the model evaluates curriculum effectiveness through four levels: reaction, which assesses learners' perceptions and satisfaction with the curriculum; learning, which examines the knowledge and skills gained during instruction; behavior, which evaluates how well learners apply their acquired knowledge in real-world settings; and results, which measures the overall impact of the curriculum on academic and professional success.

This multi-dimensional approach allows educators to assess not only immediate learning outcomes but also the broader effects of education on learners' future performance (Kirkpatrick & Kirkpatrick, 2006).

However, despite its thorough assessment framework, Kirkpatrick's model has certain limitations. One major challenge is the difficulty in accurately measuring long-term impacts and behavioral changes over time (Reio et al., 2017). While the model effectively captures initial reactions and learning gains, tracking behavioral changes and long-term results requires continuous follow-up and additional data collection, which can be resource-intensive. Additionally, the model assumes a direct relationship between learning and behavior, yet external factors such as workplace culture or personal motivation may influence whether learners effectively apply their knowledge (Bates, 2004). Despite these challenges, Kirkpatrick's four-level model remains a valuable tool in curriculum evaluation, offering a structured approach to assessing both short-term learning achievements and broader educational impacts.

1.7.3 Daniel Stufflebeam CIPP Evaluation Model

This study was guided by Daniel Stufflebeam's Context, Input, Process, and Product (CIPP) theoretical framework. The CIPP theoretical framework has been applied in many evaluation studies to inform academic scholars and educational practitioners about educational phenomena and programmes (Patil and Kalekar, 2014; Shamsa and Munazza, 2018). The CIPP requires the evaluation of the context, input, process and product in judging a program's value. Daniel considered that the CIPP helps the evaluator systematically collect data about a program to identify strengths and challenges in content and delivery, improve program effectiveness, or plan for the future of a program. Sancer, Baturay and Fadde (2013) indicated that one of the strengths of the CIPP approach is that it is a valuable and simple for helping evaluators produce questions of vital importance to be asked in an evaluation process. Evaluators can determine the number of questions for each component of the model. The CIPP evaluation model was applied as it was applied by Patil and Kalekar (2014) in one of their studies. This resonated with how the model informed this study.

Stufflebeam's CIPP evaluation model concentrates on four parts of a program: the overall goals or mission (Context Evaluation); the plans and resources (Input Evaluation); the activities or components (Process Evaluation); and the outcomes or intended objectives (Product Evaluation) (Stufflebeam, 1971). The CIPP evaluation model has been widely used to evaluate programmes and policies and can also be used to evaluate a curriculum programme such as Design and Technology a subject in the vocational career pathway that is being implemented in Zambian schools. Patil and Kalekar (2014) explained that the evaluation process provides individuals with feedback to account for the program's activities.

According to Shinkfield (2007), evaluation model emphasises learning by doing to identify corrections for problematic features. The proactive application of the model can facilitate decision-making and quality assurance. Its retrospective use allows faculty members to continually reframe and sum up the project's merit, worth, integrity, and significance. The four components of the context, input, process, and product evaluation model help guide the stages of a project and programmes such as the subjects that run in schools. The cardinal thing about this theory is that it provides a holistic view of every element by evaluating the context, input, process, and output from all angles. With the aid of this theory, evaluation can be done systematically, fulfilling the general needs of evaluation. The critical element that makes this model is different from other evaluation models is that it focuses on the context for evaluating the teaching-learning and development process (Stufflebeam and Shinkfield, 2007).

1.7.3.1 Context Evaluation

Context evaluation helps evaluate the needs and opportunities within a defined context or environment (Stufflebeam and Shinkfield, 2007). Context evaluation aims to define, identify and address the needs of the target population, identify the problems, and assess whether the goals are responsive to the desired needs (Khuwaja, 2001; Stufflebeam, 2001). Context is about studying the environment in which the curriculum is implemented. The purpose is to evaluate what is happening and examine why the needs of the stakeholders may not be met. Everyday activities at this stage include the physical environment and the philosophical foundations of the curriculum. In this study, understanding the context in which Design and Technology is being implemented in secondary schools was highly informative. Thus the design and technology context should be a replica with the working environment (workshops and laboratories) conducive with available tools and equipment for an effective implementation of the subject.

1.7.3.2 Input Evaluation

Scriven (1994) discussed that input evaluation determines whether adequate resources exist. Evaluators pay attention to the goals and strategies of the evaluation. Other approaches may be suggested to evaluate the curriculum if there are concerns. In many ways, this is when the evaluation methodology is checked rigorously. This evaluation aims to determine the resources used to meet the program’s goals (Khuwaja, 2001). The resources include time, human resources, physical resources, infrastructure, curriculum, and content for evaluating each school’s education quality.

1.7.3.3 Process Evaluation

The primary purpose of the process evaluation is to describe all the activities in the program (Stufflebeam, 1971). Process evaluation concentrates on the programs running and, in this case, the teaching and learning processes. Implementation is when the inputs are used effectively to achieve the product's desired aims, objectives, and goals. The evaluator assesses the processes to understand how the school works and which processes are responsible for better working and maintaining the quality of education. In this phase, implementation decisions are taken (Patil and Kalekar, 2014). School processes include systematic approaches, teaching and learning activities, and examinations based on summative and formative assessments (Print, 1993). At this level, evaluators examine if the plan is happening in the classroom. Evaluators look for weaknesses and strengths in implementing or using of the curriculum. Whatever challenges are identified, strategies are developed to address them.

1.7.3.4 Product Evaluation

Product evaluation includes the outcomes of the program or project. Product evaluation focuses on the student's academic achievement, the acquisition skills, values, attitudes, and knowledge which the learners will use to benefit themselves and society. Product evaluation assesses outcomes or outputs, short and long term, intended and unintended outcomes, which keeps track and focuses on the objectives' fulfilment or not (Stufflebeam, 2003). The CIPP evaluation model deals with products or outcomes at the end and different points during the educational program's beginning and implementation. The products are then mapped with objectives, weaknesses are noted, and expected changes are made to improve the quality of education (Sancer, Baturay and Fadde, 2013). The product stage involves collecting data to decide on the curriculum. Data is gathered to see how well the curriculum is meeting objectives. From this, decisions are made.

Based on Stufflebeam (2003) evaluation model, the study assessed the context, inputs, processes and product of the Design and Technology subject in the selected secondary schools of Kapiri Mposhi district. These dimensions included the environment it is implemented and strategies used in the subject's teaching and learning processes, including skills of teachers and equipment responsible for achieving the products. The CIPP evaluation model was used in the study. The model was adopted because it is more comprehensive than Tyler's and Kirkpatrick's models, making it better suited for evaluating the implementation of the Design and Technology subject in schools. Unlike Tyler's model, which focuses only on predefined objectives, CIPP provides a systematic and continuous evaluation by assessing context, inputs, processes, and outcomes. While Kirkpatrick's model is more suited for workplace training, CIPP supports both formative and summative evaluation, allowing real-time improvements and long-term assessment. Its ability to identify weaknesses and provide ongoing feedback makes it superior for ensuring continuous improvement in education.

1.8 Conceptual Framework

Miles and Huberman (1994) explained that a conceptual framework shows a visual or written product that explains diagrammatically or in the narrative the main things to be studied, concepts or variables, and the presumed relationship. A conceptual framework shows the series of actions the researcher intends to carry out in a study (Dixon, Gulliver and Gibbon, 2001). It guides research paths and offers the foundation for establishing its credibility (Dickson, Joseph and Emad, 2018). Ravich and Carl (2016) pointed out that the researcher constructs a conceptual framework and must be expressed in writing to be understood clearly. After producing a diagrammatic representation of the study's main variables, there is a need to explain their relations and how their complementation helps answer the major research problem defined.

The conceptual framework in research held paramount significance, serving as the theoretical backbone that structured the entire research endeavour. The conceptual framework delineated the theoretical foundation and guided the researcher in defining the study's scope, objectives, and boundaries. It assisted in identifying the central concepts, variables, and relationships examined and assessed, thus ensuring a clear roadmap for the research trajectory. It served as a scaffold to organize existing knowledge and pertinent literature within the research domain. By synthesizing and integrating theories and concepts, the framework contextualised the study within the broader scholarly discourse, providing a basis for comparing and contrasting ideas.

The framework aided in the research questions by establishing logical connections between key variables or constructs. It fostered a systematic and rigorous inquiry process and enhanced the validity and rigour of the research. It helped in define and operationalize variables, providing a coherent collection and analysis structure. This structured approach contributed to the reliability and credibility of research findings. It also provided a lens through which collected data were interpreted and analysed. The framework assisted in contextualising findings within theoretical frameworks, enabling a deeper understanding of the underlying patterns, relationships, and implications derived from the data. Figure 1.2 under 1.8.1 shows the conceptual framework that was employed in the study.

1.8.1 Conceptual Framework of CIPP

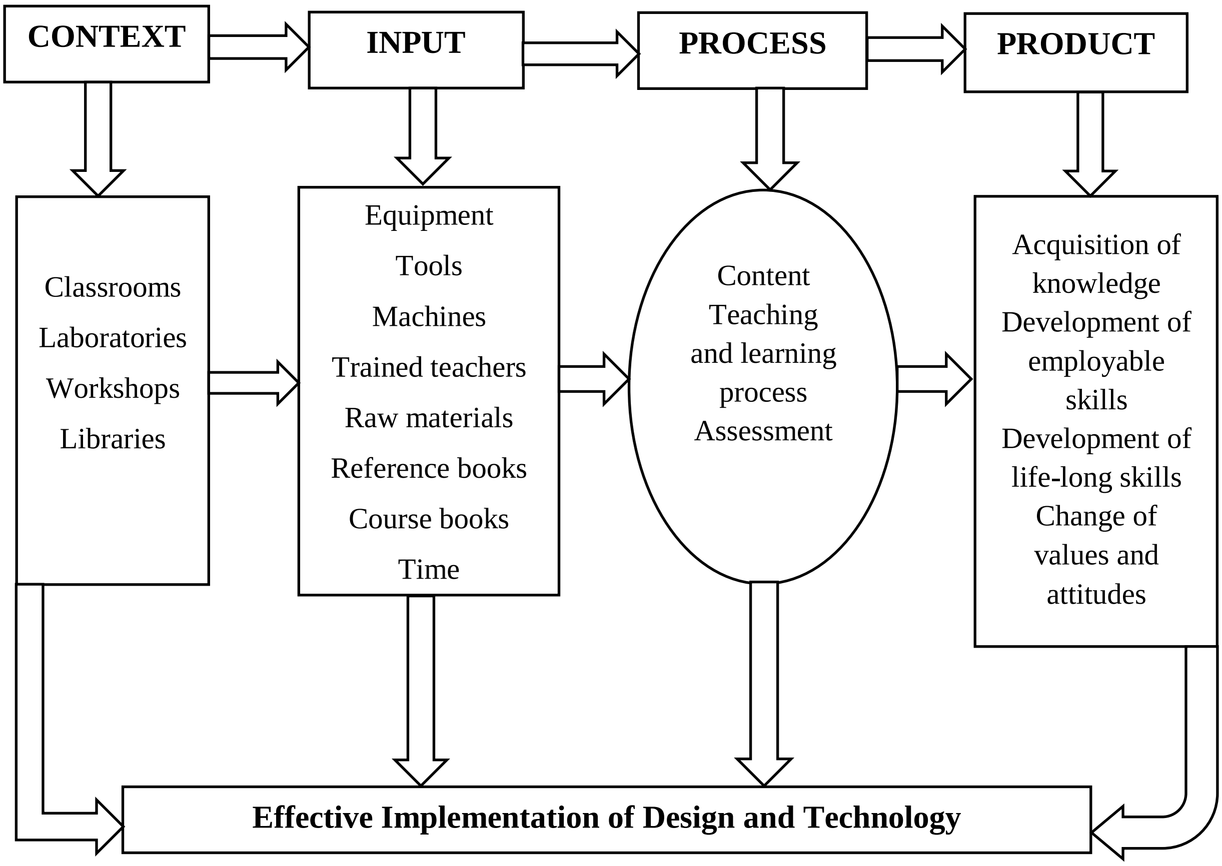

Figure 1.3: Conceptual Framework

This study used a conceptual framework to help visualise the context, inputs, process, and products of Design and Technology in selected secondary schools in the Kapiri Mposhi district and determine if the subject was effectively implemented. From the system perspective, the school is viewed as a productive system that receives inputs from the context necessary during the process of teaching and learning of Design and Technology. For an effective and successful teaching and learning of Design and Technology, there should be a direct interaction of the tools, equipment, resource materials, teachers, financial resources, physical facilities such as workshops, laboratories, classrooms, and the school physical environment (context). The framework presents physical facilities, teaching and learning resources, and human resources as inputs in the Design and Technology implementation process. These inputs interact with the teaching and learning process help learners acquire knowledge and develop employable and lifelong skills and change their values and attitudes towards the subject.

The framework shows that physical facilities, teaching and learning resources, and human resources mutually influence the quality of the subject implementation. The framework views the implementation of Design and Technology as interplay of content, teaching and learning resources, support services, monitoring, and feedback activities to achieve the intended objectives (Ebenehi, Rashid and Barkar, 2016). Therefore, utilising these physical facilities, teaching, and human resources in the implementation process eventually determines the effectiveness of the teaching and learning process. Each one of the factors plays a role in the implementation of design and technology to yield intended educational objectives. Teaching and learning resources are useful in the development of instructional content. Physical facilities are important because they provide a supportive environment for learners to interact with the content. The human resources implement what has been planned in the curriculum to help learners develop employable and lifelong skills; acquire knowledge, and change values and attitudes towards the subject which are the products of learning Design and Technology subject.

1.9 Delimitation

The study was conducted in the selected secondary schools where Design and Technology subject is taught in Kapiri Mposhi district and which were already established in January 2014 when Design and Technology was introduced in the 2013 education curriculum. The study also focused only on head teachers, deputy head teachers, heads of practical subjects department, teachers and learners of Design and Technology, the Senior Education Standards Officer (SESO) of Central province and the District Education Standards Officer (DESO) of Kapiri Mposhi district were also included in the study and the study focused on the context, inputs, processes and products of the Design and Technology subject in the selected secondary schools.

1.10 Limitations

The researcher ran across some issues that hampered the study's ability to achieve its objectives. Some respondents could not be found as they were on leave and others were out of the station, the researcher managed to obtain the data from those who were acting in the offices. They might not have provided enough information because of their little or no understanding and experience of Design and Technology subject implementation in schools. However, the use of different data collection techniques (interview guide, interview schedule, and questionnaire and observation checklist) with triangulation of the study enabled the researcher to compare the data from various sources.

1.11 Operational Definition of Terms

Evaluation: process used to determine the effectiveness and quality of teaching and learning of Design and Technology subject.

Context: the environment Design and Technology subject is being implemented.

Inputs: required resources for the implementation of Design and Technology subject in school.

Process: implementation of the Design and Technology subject.

Product: knowledge and skills learners acquire and develop during and after the teaching and learning process of Design and Technology subject.

Design and Technology: is a practical study with the composition of Technical Drawing, Carpentry and Joinery (Wood Work), Metal Fabrication (Metal Work), Building and Plastering, Electrical installation and graphical communication.

Curriculum: all students' learning which is planned by and directed by the school to attain its education goals.

Curriculum Implementation: putting into practice the officially prescribed courses of study, syllabuses and subjects to help learners acquire knowledge and skills.

Vocational Education: giving skills and knowledge that is needed in order to do a particular job.

Skills: the domestic electrical installation, carpentry and joinery, metal fabrication, bricklaying and plastering and graphical communication (geometric drawing) knowledge and skills learners acquire and develop during and after the teaching and learning process of Design and Technology subject.

Knowledge: facts, principles, generalization, awareness and sensitivities to real life situations.

Vocational Pathway: aspect of education which provides learners with essential knowledge and practical skills necessary for admittance into the world of work as employees or self-employed.

Vocational Subjects: refers to subjects that lead to specific careers or jobs among learners in secondary schools.

1.12 Structure of the Thesis

Chapter one provides the background of the study. In order to show the gap that this study sought to fill in and to ground the study on solid theoretical and conceptual theoretical framework, the literature review was discussed according to the following themes: meaning of curriculum implementation, description of Design and Technology. The funnel approach of reviewing literature on the teaching and learning of Design and Technology subject from the global, African and Zambian studies was done and presented in Chapter 2. Chapter 3 explains the justification of the research paradigm. It has discussed the mixed research approach and embedded research design used in this research, the consideration of ethical issues and description of the research setting. Chapter 4 presents the analysis and findings in line with the research objectives and questions. Chapter 5 focuses on the discussions of the findings, their implications on the theory and practice of the implementation of the Design and Technology subject. Chapter 6 provides the conclusions of the thesis, theoretical and practical implications, and recommendations based on the findings of the study.

1.13 Summary

This chapter established the background of the study which helped set the study's context and justified why the study is important to be carried out. The background of the study led to the description of the statement of the problem. Furthermore, the purpose of the study was stated, research objectives and questions were provided, and the significance of the study was provided too. The theoretical and conceptual frameworks were discussed, after which the delimitations and operational definitions of terms were presented. The subsequent chapter reviewed various related literature that helped identify the research gap.

CHAPTER TWO: LITERATURE REVIEW

2.0 Overview

The previous chapter provided the introductory information of the study on the implementation of the Design and Technology curriculum. This chapter presents the literature review according to the following themes: meaning of curriculum implementation and the description of Design and Technology. The researcher used the funnel approach of reviewing literature from global studies on the teaching and learning of Design and Technology subject, the teaching and learning of Design and Technology subject in Africa and the implementation of Design and Technology subject in Zambia, which had provided the gap for this study but also to consider studies done outside Zambia to address the research objectives. Studies done in Zambia were used to provide specific background to this study. The global and African studies provided additional general background and helped the researcher compare findings on how different countries were prepared to implement Design and Technology subject in schools. This eventually helped to identify the research gap.

2.1 Concept of Curriculum Implementation

Shirley (2016:96) explained that “curriculum implementation entails putting into practice the officially prescribed courses of study, syllabuses and subjects.” It is therefore, the process of helping learners acquire relevant knowledge, experiences and skills. In this study, curriculum implementation implies the teaching and learning of Design and Technology. Since learners are the central figure in the implementation process, implementation occurs as the learner receives the planned and intended experiences, knowledge, skills, ideas, and attitudes to enable them to function effectively in society.

Curriculum implementation refers to the stage when education programs are put into effect. George (2019:12) indicated that “putting the curriculum into operation requires an implementing agent who is a teacher.” Stenhouse (2016:4) also added that “implementation is how the teacher selects and mixes various aspects of knowledge enclosed in a curriculum document or syllabus.” Curriculum implementation thus refers to how the teacher translates the planned or officially designed syllabus into schemes of work, and lessons to be delivered to learners. Teachers are the central curriculum implementers, while learners, parents, and school administrators can directly or indirectly participate in the implementation process. It also simply means that implementation should bring desired change and improvement in learners (Tamil, 2021).

2.2 Design and Technology

Design and Technology is a practical study with the composition of Technical Drawing, Wood Work, Metal Work, Building and Electrical, and ICTs (Mubangwe, 2016). Design and Technology is a school vocational education subject offered at all primary and secondary school levels. It is meant to help learners acquire knowledge and develop designing and technology skills. In Design and Technology, learners apply their knowledge, practical skills and processes when using technologies and other resources to create innovative solutions to meet current and future needs. Design and Technology is an area of study that focuses on planning, designing and creating things (products) which people use (Billet, 2018; Finch, 2019). Design and Technology is a school subject that explores designing and making products that solve problems, and then evaluate the successfulness of the results. However, for learners to acquire knowledge and develop practical skills, the subject should be taught in a conducive and well equipped environment that is beneficial for implementing Design and Technology.

The Design and Technology subject aims at making learners develop critical understanding of design and technology on daily life and the wider world. Priowirjanto (2020) also discussed that Design and Technology builds on the skills and knowledge learners have already learnt at primary school. As learners progress through this phase, they may be given the opportunity to focus on specific aspects of the subject such as product design, food technology, engineering, systems and control, electronics, textiles and graphics. Learners learn to design and make products that solve genuine, relevant problems within different contexts whilst considering their own and others' needs, wants and values. Darren (2015) discussed that Design and Technology are practical and valuable subjects. It enables learners to actively contribute to the creativity, culture, wealth, and well-being, as well as their community and nation. It teaches how to become more resourceful, innovative and enterprising.

Design and Technology enables learners to draws on their mathematics, science, engineering, computing and art skills. The context in which Design and Technology subject should be implemented as a replica of the environment such as through workshops and laboratories where learners will apply the design and technology knowledge and skills acquired from school. The learners should touch and manipulate the tools and equipment for an effective learning that can enable them to acquire knowledge and develop practical design and technology skills (Roberts, 2015; Archer, 2019).

The learning contexts establish the foundation for developing the school's learning expectations and learning processes. The context should be a replica of the working environment such as industries, workshops trained personnel apply their acquired knowledge and skills (Roberts, 2015; Paliwe, Siphelo, Veronica and Maria, 2015). Therefore, schools should have laboratories, workshops and classrooms for practical lessons for Design and Technology subject be effectively implemented and achieve its intended objectives. Todd and Dunbar (2018) pointed out that the context in which Design and Technology subject is being taught should be conducive for the teaching and learning of the subject. The workshops should be an environment to allow for a free exchange of ideas, thoughts and skills among the teachers and learners to achieve the expected educational goal by considering learners' physical and psychological needs.

The implementation of Design and Technology aim at imparting practical knowledge and skills. In order for learners to improve their performance, learning should therefore take place in a conducive environment, and they should be able to see and touch the tools, equipment and other materials unlike learning from abstract. This is why Valerie (2014) discussed that the physical environment includes project-based physical learning environment such as good lighting, including track or task lighting, and a light table to provide access to technology. Tang and Shi (2017) supported Valerie (2014) that the infrastructure and mechanical systems of the building should be exposed, making the building a learning tool. These infrastructures should be well stocked with tools and equipment as teaching and learning resources (inputs). This can enable them to properly comprehend and evaluate their understanding of the learnt content effectively.

Furthermore, Sun et al (2019) indicated that the learners and teachers should be able to see, touch or manipulate the teaching and learning resources to ensure the practical lessons take place. These inputs should match with the age and grades of the learners. For this reason, the inputs should be readily available in schools, particularly in classrooms, workshops and laboratories. Roberts (2015) also discussed that for design and technology lessons to be practical, teachers and learners must demonstrate the practical aspects of teaching and learning the subject. The inputs should be readily available and adequate to allow all learners and teachers equal access to them and be appropriate in terms of learners' education level. With the experiential learning processes, each of the upper floors is designed to have a shared space with workbenches, hand tools, equipment, storage, and supply areas.

The teaching and learning of the Design and Technology subject should be conducted in a practical way. Doing so enables learners to acquire knowledge and develop practical skills during and after learning (Scott, 2015; Roy, 2018). The ideal process of Design and Technology should be noted with practical demonstration of the lesson. By doing so allow a practical way of teaching and learning the subject. Therefore, the acquisition of knowledge and development of practical skills can easily be achieved when practical teaching and learning are enhanced in the classrooms, workshops, and laboratories. Therefore, manipulating the tools and equipment is critical for a practical lesson if knowledge and practical skills are to be developed among learners of Design and Technology subject. Akinpelu (1989) indicated that man learn by acting on the natural phenomena, transforming them while experiencing their influence, the experience is the criterion of truth.

The implementation of Design and Technology should seek to integrate theory and practice. The learners should be exposed to both theory and practice for experiential learning which requires learners practice what they learn from theory in order to experience its influence. The implementation of Design and Technology should lead to significant practical skills acquisition. The learners should be exposed much to practicals than theory for easy acquisition of knowledge and practical skills development (Shirley and Hasse, 2015).

The theoretical aspect of education deals with the masterly of content while the practical aspect aims at equipping learners with the practical skills to shape them to become productive and useful in society. The implementation of the Design and Technology subject has to help improve learners' performance. Marx (1866) indicated that man learn by acting on the natural phenomena, transforming them while experiencing their influence. Marxist epistemology views this experience as criterion of truth. The implementation of the subject should integrate theory with practice in order to produce a learner intellectual. The idea of practice is central in Design and Technology. The emphasis is on the value of activity and experience. The implementation of the subject should stress on the educative productive work. Obwavo (2021) discussed that education and work should be perceived as inseparable parts of life in order to improve learners' performance. Okoye (2015) added that schools should put teaching and learning materials in place in order to support the practical implementation of the subject of design and technology effectively. By doing so help promote effective implementation of the subject and motivation to both teachers and learners to smoothly implement it. Effective teaching and learning can only take place where the teaching and learning is done on the same way with the same operation and materials as in the occupation itself.

The MoE (1996) indicated that the basic education aims to provide each learner with solid academic and practical foundation that will serve as the basis for a fulfilling life and equip each one with the pre-requisites skills and knowledge needed for a working life. Thus a well and effectively implementing the curriculum should help prepare learners for a future working life. It is therefore noted that the goals of basic education is to prepare learners acquire a set of life skills, values, attitudes and knowledge, which will play a foundation for school leavers ability. Luhala (2021) discussed that during and after process, learners are expected to acquire knowledge and practical skills, change of their values and attitudes towards practical subjects such as Design and Technology because many learners and other people think it is a career pathway subject for slow learners and those who did not perform well after examinations and have weak examination grades. Therefore, learners are expected to change their attitudes towards the Design and Technology subject having acquired the knowledge and developed skills in this curriculum. The change of attitude towards Design and Technology subject is critical; many learners would prefer white collar jobs than the practical jobs or vocational ones. Consequently, learners are expected to change their attitude towards the subject during and after the learning program.

Design and Technology subject should make learners become entrepreneurs during and after the learning process. Kekaya (2014) also indicated that the learners are expected to acquire the knowledge and develop practical skills after learning design and technology. Therefore, the aim of learning the subject is to make the learners stand on their own, become self-reliant and reduce on the dependence syndrome. Hence the goal of the subject is to enable learners become creative and starts their own productive projects even before they complete their course of study. Most of the available job opportunities in the informal and non- formal sectors require some form of practical skills. For this reason, the school system has to focus on providing practical education if learners are to become creative and innovative. This may help learners to believe that education aims not only to be employed but also to be self-employed and employ others.

Design and Technology education help bring about the required change to respond to the nation's and learners' needs. The subject therefore seeks to equip learners with the competencies and skills necessary to successfully operate a particular job. Thus, the implementation of Design and Technology subject should put much emphasis on labour market by the development of innovative, creative and entrepreneurial skills. According to MoGE (2013), cognitive skills have to do with intellectual competences that have to do with the mind and reasoning abilities while the psychomotor skills are about using the body (hands and legs). For this reason, for one to be competent should have both knowledge and the skill. Implementation of Design and Technology should seek to facilitate the acquisition of knowledge and development of skills to enable learners become self-employed.

The focus of Design and Technology subject should shift to what learners can do with their knowledge and skills and use what they know to meet the goals and objectives of the educational policy. Spady (2014) pointed out that outcomes are high quality, culminating demonstrations of significant learning in content. The subject intended to meet the national educational goal whose aim is to achieve an all-round development of the learner through self-reliance of an individual. Killen (2017) added that the education system should focus on the all-round development of learners. Design and Technology should prepare the minds of learners for the role and responsibilities they are expected to assume and perform before and when they turn into adults.

2. 3 Global Studies on the Teaching and Learning of Design and Technology Subject

Khunyakari, (2015) explained that world over, the Design and Technology subject is taught at primary and secondary school levels with a view to develop in learners' manipulative and critical thinking skills. Learners design and make artifacts, following a standard design process. This process must be taught comprehensively to enable learners to societal needs positively. Therefore, learners must be provided with a good learning environment to fully tap their practical abilities (Williams, 2014). This is only possible through application of a good pedagogy during lesson delivery. A good pedagogy application does not only bring out the interaction between teachers, learners, and learning environment, but also the learning tasks (Lucas, 2014). Teachers must therefore endeavor to find and apply suitable pedagogies for the lessons.

Furthermore, technological changes remarkably influenced the Design and Technology curriculum (Lucas, Spencer, & Claxton, 2015). Design and Technology provides teaching of diverse competencies to learners, these need different applications of pedagogies. It is from this background that (Pamies., Blanco, Sanchez,. & Villanueva, 2015) propose the need for developing a common training for teachers and pedagogies so that they can work in interdisciplinary groups.

According to UNESCO (2017) most schools have challenges in creating a conducive environment for learning of both knowledge and practical subjects. Learning should take place in an environment that is of good standard and offers safety to the learners. Foster (2017) discussed that the application of the curriculum should be based on planning physical, human, and financial resources to ensure the high quality of teaching and learning of students in the education process. The teaching process must be supported with adequate infrastructure to enable performance in the class system such as mentor activities, practical activities in conducive school workshops or specialised rooms and laboratories. When schools do not have such facilities, implementing practical subjects may consequently result into producing learners with little or no skill and expected knowledge for hands on activity (Valerie and Marlene, 2015).

The study by Kwaira (2016) in Ghana reported that learners were reasonably well accommodated in relevant classrooms, workshops, drawing offices and work sheds. However, the study established that learners complained of critical shortages of machinery and important hand tools. There was a general dissatisfaction towards the situation regarding the state of machinery and tools in schools. In most schools, machines like; lathes, drills, power saws and computers (for Computer Aided Design) were either absent or in bad shape. This showed that for a successful implementation of Design and Technology, both infrastructure and resources should be appropriately available for learners' practical experiences. Scott (2015) also pointed out that Design and Technology was poorly understood aspect of educational practices, particularly as it applies in primary school classrooms. In a number of countries around the world the implementation of Design and Technology had met with difficulties as it applies to education practice.

The study by Earthman (2015) revealed that comfortable classroom temperature and smaller classes in California enhance teachers' effectiveness and provide opportunities for learners to receive more individual attention, ask more questions, participate more fully in discussions, reduce discipline problems and perform better than learners in schools with substandard buildings. The nature of Design and Technology subject is purely a hands on subject, thus it requires a conducive environment for an effective teaching and learning to take place. Schools that adopted Design and Technology must ensure that infrastructure exist in their schools and put in place workshop tools and equipment. The idea of not having hands on tools and equipment may indeed contribute to ineffective implementation of Design and Technology in schools. This is the more reason Valerie etal (2014) pointed out that learners need to benefit from what the good infrastructure can offer to teaching and learning of practical subjects. Therefore, schools that do not have infrastructure for Design and Technology may face challenges when it comes to teaching and learning because learners are likely to be denied the opportunity for practical acquisition of knowledge and development or improvement of their skills.

Furthermore, Danmole (2018) recommended that suitable infrastructure, equipment and facilities should be put in place to support the implementation of practical subjects. Infrastructure should be well-furnished classroom blocks and equipped laboratories with tools, equipment and other learning resources for effective teaching and learning. Teaching and learning materials should be adequate to enable teachers and learners effectively use them. Therefore, it should be noted that there should be specific infrastructure for the subject and resources in place in implementing Design and Technology. David (2018) alluded that the need for specific infrastructure such as workshops, classroom blocks and laboratories, support an effective implementation of Design and Technology in the institutions of learning. Thus in schools where infrastructure is being shared by learners, new infrastructure should be put in place to curb such scenarios. This may expose the learners to practical experiences, acquire relevant skills, and change their attitudes towards the subject without any hindrance.

World Bank (2016) lamented that shortage of classrooms and textbooks account for the consistently low learning practical outcomes. This is attributed to shortages of resource books, particularly for practical subjects, which is a great challenge that affects practical education implementation in developing nations. Due to globalization, there is an increasing importance of practical education in the 21st century, and rapid modification have made knowledge necessary for competing in the world economy. Practical education provides countries with the skills and knowledge needed for economic growth and development. Practical education produces substantial returns, offering learners the chance to acquire attitudes and skills that are unlikely to be developed if standard infrastructure that support practical learning exist (Mohan, 2014). This enables learners to develop job oriented skills, participate fully in society, take control of their own lives, and continue learning.

The nature and role of infrastructure in teaching and learning Design and Technology is basically the enhancement of the knowledge acquisition and attainment of quality assurance. Thus Schneider (2022) indicated that school facilities directly affect teaching and learning of Design and Technology. The poor conditions of school facilities may make it difficult for teachers to teach learners or provide an adequate education to learners. Foster (2017) lamented that the effectiveness of implementing process of subjects depend largely on several factors such as workshops and other physical facilities well equipped with practical tools and equipment. Most of all, consensus and involvement of all actors are needed in the process. Each actor should consider the consequences on its role in the implementation process. Thus the effective implementation of Design and Technology subject depends on physical facilities, human resource, information and financial resources to ensure high quality teaching and learning.

Valerie and Marlene (2014) carried out a review of the impact of Design and Technology in schools in England. The study reviewed the fact that concentration on product outcomes might undermine the design process and problem-solving activity that teachers wish to foster. Her study found that the desire to ensure successful products or outcomes prevented learners from failing to produce outcomes, reduced the risk involved in the process, and thus prevented learners learning from failure. To ensure high standards of teaching and learning Design and Technology in England it is taught as part of a cross curricular termly topic, focusing on the knowledge and skills stated in the National Curriculum, this is vital in enabling all learners to gain real life experiences provide maximum opportunities to embed deeper practical learning and this could only be achieved when appropriate context and inputs are readily available in the institutions of learning.

Adran, Addysg, Gydol and Sgiliau (2019) indicated that the implementation of Design and Technology should ensure that learners have opportunities to develop, practice and apply the skills identified in the programmes of study. Therefore, safe and appropriate use of tools and other equipment should be embedded throughout all learning activities. Learners should progress from working safely with support and supervision to working safely, responsibly and independently, thus ensuring their safety both within and outside of the school environment. The learning plan should always allow the relevant and realistic experiences through which learners are able to acquire knowledge and develop practical skills for life.

Furthermore, teaching assist learners in acquiring new knowledge and practical skills. It should consist of the principles of showing and guiding the learners in relation to task performance and then measuring their results. For this reason, Mohan (2014) pointed out that learning should be a process of acquiring knowledge and skills and developing practical skills for the learners. Design and Technology is a practical subject that is mostly taught through discovery learning. It is a subject of learning by doing and believes that practicing is a foundation of learning, and without learning practice, learners get lost. Therefore, design and technology are practical subjects, so teachers and learners should have hands-on teaching and learning experiences. This can be realised if an environment where teaching and learning takes is conducive and well supplied with teaching and learning inputs.

Gloria, Terry and Kanyan (2022) studied the challenges of Design and Technology in Malaysian secondary schools. The study reviewed that challenges exist in various aspects, as the subject in the early implementation stage of the subject need great consideration of inputs for a successful implementation. Challenges such as teachers' knowledge and skills, learners' lack of understanding in abstract topics and insufficient facilities, equipment, and resources offer opportunities. Thus, suitable technology assisted strategies should have been developed and utilised to facilitate the visualisation of learners' abstract details in technological application topics. Ackram (2018) studied the factors affecting curriculum implementation in secondary schools. The study revealed that the challenge facing practical education was the provision of quality teaching and learning programmes that ensured the development of a diligent and efficient workforce capable of meeting international competitiveness. The study also indicated that practical education requires workshops, tools, equipment, and materials for demonstrations and practical works if effectiveness of the implementation is to be achieved. Thus for a successful teaching and learning of Design and Technology in secondary schools greatly depend on the availability of infrastructure and resources.

Cathrine and Sabariah (2019) explored teachers' content pedagogy knowledge (CPK) in Malaysia, following the issue of design and technology teachers not being well trained to teach the subject. The results of the study indicated that teachers' CPK had not reached a satisfactory level. The teachers tend to use the traditional lectures approach due to resource constraints, although they were aware of the suitable pedagogical approach proposed. Fazidah et al. (2019) discussed that well equipped and knowledgeable teachers motivate learners by diversifying approaches, methods, and assessments throughout teaching and learning sessions. The study recommended that Ministry of Education organise planning to provide adequate and properly trained Design and Technology teachers. Provision of an enabling environment with functional workshops, laboratories and practical material resources necessary for teaching of Design and technology should be made available in Malaysia. In addition, well-trained teachers are an important aspect that should be considered when teaching and learning design and technology in secondary schools.

Amphiah (2014) lamented that teachers regard vocational subjects as being for academically weak learners. Luhana (2021) indicated that parents think TVET is the educational path for those who fail; hence, they do not educate their children on the TVET path. The youths were not ready to join TVET colleges as they felt shy and lacked confidence because they took TVET as an educational path for those who failed and those with no future. The negative attitudes among parents, school administrators, and teachers towards vocational subjects negatively affect the implementation of the subjects as the distribution of funds is determined by the support of the school administrative system. Therefore, the challenge of lack of sufficient resources for teaching and learning emanates from the negative attitudes of the school administrators and teachers towards vocational subjects. Technical and vocational education constitutes many subjects, hence it is not clear the vocational subject Amphia (2014) and Luhana (2021) referred to.

The study findings by Mark (2019) on factors affecting learners’ performance in schools in Canada showed that the learners could not improve their performance without facilities, tools, and equipment. The hands on activities substantially affect knowledge and the development of relevant skills in a school with available resources. Chickoore (2014) indicated that education in Brazil had changed significantly. However, it was still unsatisfactory because public schools in poor regions, municipalities, and neighbourhoods tend to be of worse quality, and school achievement depends heavily on the family's economic, social and cultural background. Mkonongwa (2017) further discussed that inadequate physical facility in Tanzania leads to poor school curriculum implementation. The lack of school facilities such as laboratories compromises the implementation of practical subjects because topics meant to be taught practically are taught theoretically due to a lack of supporting physical facilities and equipment. Therefore, it is clear that the availability of facilities in schools positively affects learners' practical performance and enables acquisition of practical education for self-reliance.

The implementation of Technical education face challenges. The study findings by Borhene (2018) showed inadequate provision of basic workshops, tools, and equipment affect the practical acquisition of knowledge and practical skills. Generally, schools had a short supply of teaching and learning materials and essential tools. Since practical education relies on materials and tools, the short supply negatively affects practical skills acquisition. Selvarantnam (2022) argued against practical education in developing countries and that it fails due to a lack of subject requirements. Moustafa (2015) studied the challenges and priorities of practical education in developing countries. The biggest challenge facing practical education in developing countries was the provision of quality teaching and learning programmes that ensure the development of a productive and efficient workforce capable of meeting international competitiveness.

Design and Technology is a practical subject and should be taught using a practical approach that requires workshops, tools, equipment, and other resources for demonstrations and practical works. Claudia (2015) conducted a comparative study on barriers to accessing skills development and employment for Argentina and South African youths. The study shows that South Africa made more progress than Argentina in overcoming skills development. Despite the improvement in skills acquisition, unemployment was high among the youths in South Africa. Similarly, Alexandre (2015) studied vocational education challenges in India and Brazil. The study revealed that vocational education had increased the political agenda in India and Brazil. However, the study indicated many challenges in India surrounding vocational education; these included quality of delivery, shortage of vocational subject teachers, and inadequate infrastructure. The study showed similarities in the challenges faced in India and Brazil. However, the study could not clearly show the vocational subject it concentrated on. It is clear enough that to effectively implement design and technology, schools should be well equipped with appropriate context and inputs for learners to acquire knowledge and develop practical skills.

Vocational education should have a positive impact on a person's employment opportunities. It should strategically aim to reducing unemployment and protect people from becoming unemployed should be a priority. Thus practical learning should also not be seen as a one-time investment but as a continuous process, hence the role of Design and Technology is to prepare a generation that has appropriate skills in the field and preparing a generation that has good values and attitudes towards vocational subjects. The subject also aimed to improve the independence of learners in entrepreneurship according to the competencies they have developed (Kennedy, 2019). The preparation of some competencies should help prepare learners primarily to work in a particular field and prepares those graduates who are able and willing to work in their field of expertise (Yahya, 2015., and Usman, 2016). Therefore, this could be possible if the learning environment match with the working environment (workshops and laboratories) equipped with the same tools and equipment.

The implementation of practical education need appropriate tools that should be available in an appropriate workshop to support the practical implementation of the subject in schools. However, the study by Sherry (2023) on challenges faced in technical education in Korea reported that technical education in Korea was bedevilled with problems. Some of these challenges were a lack of facilities and materials for teaching and learning and a mismatch between acquired skills and market needs. Similarly, Elisha (2023) conducted a study on challenges facing technical education in developing countries. The most critical challenge identified by this study was the rampant and critical lack of teaching materials and workshops for teachers and learners to conduct practical activities so as to acquire relevant knowledge and develop practical skills. Therefore, schools in developing countries have an acute shortage of materials and workshops to conduct practicals and, in the end, compromise the quality of education among learners.

It is not just about doing well in school, but also about keeping teachers excited and achieving big things in education. Schools that do not have enough resources might see learners not doing well (Johan, 2014). Therefore, how well learners do in the examinations is also linked to having enough and using the right teaching and learning tools in the Design and Technology subject. The study done by Charles and Coombs (2016), Chang (2019), and Slavin (2020) showed that having enough learning tools is connected to how well learners perform in school. Levacic and

Vignoles (2015) discussed that there is a direct link between school resources and learners' academic performance. So, using these resources in the right way is a must for learners' acquisition of knowledge, skills development and better examination results. Quadri, Ogunjide, and Oladejo (2023) stressed that learners tend to do better when schools invest in resources, workshops and laboratories. Learning tools are not just for lessons; they make the classes more interesting and help learners be more creative, as Nyamubi (2023) noticed that when teachers use the tools rightfully, it affects how well learners perform in their learning. Thus the impact of learning tools is not only in grades; it also helps learners develop skills they can use in real life. Douglar et al (2023) explained that not having enough learning tools really affects how well learners are prepared in the subject. So, schools need to make sure they have the right tools to help learners learn better. When it comes to teaching design and technology, it is not just about what students learn but also about making sure the way they learn is top-notch.

2. 4 The Teaching and Learning of Design and Technology Subject in Africa

pointed out that as far as infrastructure is concerned, required resources such as textbooks, tools, specialists, and rooms should be available (Constantino and Mariana, 2015; Okebuka, 2022) argued that without adequate funding to procure the needed equipment, books, and inputs for appropriate structures to create a conducive infrastructural base, implementation of practical subjects including Design and Technology would be a mockery to learners and society. Therefore, the availability of a conducive infrastructural base is an important contributor to the successful and effective implementation of Design and Technology in secondary schools. This is because the subject requires conducive infrastructural facilities and material resources for practical teaching and learning to help learners acquire knowledge and develop practical skills.

The nature of infrastructure in teaching and learning Design and Technology in colleges of education is of greater importance in the development and making of a teacher. Ayeni (2015) discussed that the school learning infrastructure refers to the site, building or context for practical teaching and learning to take place. Thus infrastructure should be readily available in schools to contribute to a positive learning environment and quality education for secondary school learners of Design and Technology. Kekeya (2014) asserted that the quality of learning facilities in educational institutions should have a positive relationship with the quality of teaching and learning activities leading to the attainment of goals set. The quality of the school buildings and furniture determine how long such last while comfortable classrooms and adequate provision of institutional resources facilitate teachers' instructional task performance and learners' learning outcomes. Making sure there are enough school workshops is a big part of making a good place for practical learning.

According to Wandberg and Rohwer (2019) and Hyun, Ediger and Lee (2017), learners need to be involved in what they are learning physically and mentally. How the school workshops are set up can really impact how learners feel and how well they do (Lawanson and Gede, 2019). Keeping school spaces in good shape and managing them well is critical to making sure learners learn their best (Pearson and Thomas, 2010). This affects everything from how well learners do in their learning process to reaching their learning goals (Owoye, 2021). Thus the relationship between learning tools, workshops, and how teachers teach and learners learn is critical. Making sure there are enough resources and workshops, and using them right is crucial to ensure learners are engaged well in the learning process, and have a great

Design and Technology education. The importance of workshops thus goes beyond just having enough space; it is about making sure learners acquire the practical and useful education.

The condition of the school's learning environment including infrastructure has an important impact on teachers' effectiveness and learners' academic performance. The facilities that are needed to facilitate the effective teaching and learning in an educational institution which include the classrooms, offices, libraries, laboratories, conveniences and other buildings as well as other furniture items. Ayeni (2015) discussed that the quality of infrastructure and learning environment has strong influence on the academic standard which is an index of quality assurance in the implementation of Design and Technology in the institutions of learning. Okebukola (2016) identified lack of adequate infrastructure and large classes, as major challenges to effective teaching and learning of Design and Technology subject. The nature of infrastructure in teaching and learning of Design and Technology plays a crucial role in teaching and learning process. Design and Technology is a practical subject that requires use of equipment and tools, also the nature of infrastructure for teaching and learning of the subject should accelerate skills acquisition, safety on working, and performance enhancement.

The school infrastructure and learning environments like school buildings, laboratories and library. Olagboye (2014) discussed that infrastructure should be an integral component of the learning and teaching of Design and Technology. This is because a school's infrastructure enables learners and teachers to access a wide range of tools, service and resources to support learning and teaching within the environment it is being implemented. However, lack of electricity renders the virtues of technical education useless in such a context. The lack of resources is a critical factor in education because it may negatively affect classroom learning and teaching processes. On the one hand, that lack of facilities and under resourced schools are directly associated with the academic failure of practical subjects among learners (Lolwana 2014).

The best way of teaching Design and Technology is through exposure to any fields of human activities and the respective equipment used thereof. The learners must acquaint themselves with the mechanical systems involved. The study by Ibeneme and Eze (2020) revealed that the major factors hindering the growth of technical education in Nigeria was the lack of adequate qualified personnel, inadequate facilities, more theoretical training given to learners which greatly affect the effective implementation of Design and Technology in the institutions of learning. The placement of Design and Technology in schools lead to the acquisition of practical skill as well as the realization of the vision 2030 through technical vocational education (Ibeneme and Eze, 2020). The extent to which facilities are provided largely determines the attainability of quality practical education, training and graduates to be produced for society in technical education. The inability to provide right facilities can force the introduction of undesirable alternative measures that may undermine the standard of the overall set goals of the practical subjects. This implies the need for the provision of relevant and adequate training facilities, personnel and infrastructures to achieve the objectives of Design and Technology in the institutions of learning (Kumazhege and Egunsola, 2021).

The availability of the teaching materials plays critical roles in the implementation of the Design and Technology subject because it allows direct interaction with learners for practical education. Obanya (2014) also pointed out that the availability of teaching and learning resources in institutions of learning offer practical education are cardinal if learning has to take place. Adebanjo (2017) added that instructional materials in the teaching and learning process especially for vocational education subjects, should always be available and adequately prepared for learners because they enable learners to learn more, retain better what they have been taught, promote and sustain learners' interest. The availability and adequate instructional materials motivate learners and the teachers to implement Design and Technology subject in schools.

The implementation of the Design and Technology subject demands adequate fundings for the procurement of the resources. Cummings (2018) studied the unit costs associated with teaching practical subjects in Kenya and argued that a single practical subject taught to a class of about fifteen to twenty pupils would take at least twice as much capital as the academic subjects combined. Adeleke (2016) pointed out that the Design and Technology subject is quite expensive to effectively implement in schools to an expected standard. Practical work is one of the aspects of technical education, thus in this type of education system without practical work definitely fails to reflect the true nature of practical education. In practical education, learners learn best if they are given the opportunity to observe what they are taught in an environment where they can manipulate the tools and equipment. Thus a practical education classroom or environment should be nicely equipped with the necessary resources that promote practical teaching and learning.

The integration of Design and Technology, training of resource personnel as well as provision of workshops and sufficient funding is critical to the implementation of the subject in schools in order to realise the benefits of the subject to learners and society at large. Chedi and Hamza (2019) studied on Design and Technology for sustainable technologically development in Nigerian system of education. The study discovered that the new subject Design and Technology had a number of distinctive and innovative features which would transform industrialization vision into reality if the required appropriate inputs for the subject available. Woyo (2023) conducted a study on challenges facing technical and vocational education and training institutions in producing competent graduates in Zimbabwe. The study showed that lack of training materials for the various workshops, obsolete training equipment, large classes, inadequate learning facilities, and absence of industrial synergies affected the implementation of technical and vocational education and training institutions in producing competent graduates. The findings of the survey also showed that financing constraints were pervasive when the enrolments increased while the implementation remained underfunded.

Given the demands of technical education for physical and material resources, the extent to which the school infrastructural environment can promote teaching and learning processes should be a priority. This was the reason Lauglo and Lillis (2018) argued that practical subjects such as vocational education have high, complex resource demands that are not easily met, especially when they are to be established so quickly and on a large scale. The availability of these resources affects the implementation of innovations like technical education. Echoing the same sentiments, Bishop (1985) discussed that any meaningful change and improvement in education rests on the adequacy of resources and job tools. Basic to the success of any attempt at technical education, physical resources, such as land and water, and material resources, such as fencing facilities, workshops, relevant textbooks, and teachers' guides, tools, and other pertinent structures to education are needed for a successful and effective teaching and learning so to achieve desired set goals of the subject.

Design and Technology classroom should provide great opportunities for collaboration among learners; this collaboration does not happen automatically, the teachers have to be trained to provide the environment that fosters collaborative learning in technical education. According to Sadawi (2019), numerous challenges affect the implementation of Design and Technology in the Nigerian education system. These included inadequacies of resources, insufficient number of trained teachers, lack of awareness, and pedagogical instructional challenges. In addition, some of the constraints are lack of funds and policy makers' support. Whilst acknowledging that technical disciplines are vital to future economic growth, however insufficient qualified teachers of Design and Technology are problem in implementing technical education in Nigeria.

Teachers must maintain appropriate teaching strategies employed in teaching and learning technical education subjects to achieve the national goals. Thus if schools have adequate resources, it is easy for teachers to apply methods like demonstration that involves the manipulation of the tools and equipment for a practical guidance in the teaching and learning process. Ngige (2015) conducted a study on the factors affecting skills acquisition among youths in Maranda Division Siaya in Kenya. The finding of this study revealed that many factors had been identified to be affecting skills acquisition among learners. According to the results, learners' attitude hindered skill acquisition; parents felt that vocational and technical education was for standard eight or form four failures and school dropouts. This had led to low enrolment in vocational schools and high dropout rates. Technical education schools were also found to experience financial constraints. Odu (2020) identified poor teaching strategies as another major challenge to Nigeria's vocational and technical education system. The study noted that teaching practical subjects have been too theoretical that most learners now consider such subjects as those in the academic pathway. There is no longer much emphasis on the learners’ practical skill acquisition. Teachers in most cases, use the lecture method only in a programme they are supposed to apply the lecture method and demonstration.

Furthermore, Odu (2020) discussed that many school administrators of the programmes were not trained in vocational and technical education. Hence, they do not seem to understand the subjects' needs regarding the release of funds. This is the more reason vocational and technical education is grossly underfunded. The underfunding affects the supply of modern facilities and equipment needed to teach vocational and technical education to learners. The study showed that the lack of qualified practical teachers, inadequate facilities, and administrators’ misconception of the nature of practical education were some of the major challenges hindering effective implementation of technical education in Nigeria. Therefore, learning institutions should prepare learners with employable skills, and this can only be achieved when schools have appropriate infrastructure, right tools and equipment to ensure learners experience hands-on learning.

Inadequate financing, poor workshop organisation, and inadequate instructional materials are challenges that prevent the successful implementation of vocational subjects in schools. Odu (2020) discussed that the implementation of practical education in Nigerian education had faced various challenges which are synonymous with some of the problems of education in Nigeria, such as poor funding, obsolete facilities, and poor provision of instructional materials for the effective implementation of the subject in schools. Therefore, it can be concluded that adequate and appropriate infrastructure, funding, and instructional materials promote opportunities for teachers and learners to easily put into practice what has been taught and learned in the classroom (Roy, 2012, and Daniel, 2019).

The quality and adequacy of infrastructure and equipment directly affect the acquisition and development of skills. Mayama (2022) carried out a study on the challenges of teaching technical subjects in Ghana. The study reported that the lack of tools, equipment, and infrastructural facilities affects learners' performance, negatively reducing their competitiveness for opportunities whose placement is pegged on performance in vocational subjects. Patrick (2019) conducted a study on the challenges in implementing technical education policies in senior secondary schools in the Sekondi and Takoradi Metropolis in Ghana. A descriptive survey method was used to collect data for the study, and the questionnaire formed the principal instrument for collecting data. The study revealed inadequacy and non-availability of educational and human resources for a successful teaching of practical subjects. These included teachers, funding, tools, and equipment. It also revealed teachers' and learners' negative perceptions of senior secondary schools regarding technical education in Sekondi and Takoradi, which made its implementation difficult. The study recommended vocational training of teachers and providing additional funding and equipment to improve skill acquisition for learners.

Availability of teaching learning resources enhances the effectiveness of schools for good academic performance in learners (Taylor, 2019; McIlrath and Lyons, 2022). Studies on effective teaching learning technologies in Botswana found that lack of relevant teaching materials caused dismal learners' academic performance (Laurillard, 2016). Further, Atieno (2014) recommended that states allocate more funds to improve the status and condition of physical facilities and employ more teachers for the free day secondary education to be effective. In Kenya, there is a direct relationship between the learners' performance and availability of school physical facilities (Wanjala and Malechwanzi, 2016). This is in line with Mwangi and Nyagah (2019) who argued that good academic performance is contributed to by the availability of school buildings and other appropriate plans thus resulting in effective teaching and learning activities. Poor state of school facilities greatly influences the academic performance of learners. Furthermore, teachers' effectiveness should not be sidelined from the teaching learning resources. Thus government should constantly recruit, retain and retrain teachers to promote effectiveness (Mulkeen, Chapman, DeJaeghere and Leu, 2017).

Practical education cannot be complete without adequate facilities. Therefore, successful and effective implementation of Design and Technology requires a lot of resources and careful planning. Puyate (2014) argued that no practical teaching and learning could occur without adequate provision of learning facilities such as textbooks, classrooms, workshops, libraries, tools, and equipment. The introduction of the vocational path should not just be looked at in terms of its desired possible results. Its feasibility in a developing country like Zambia should also be given attention. Without adequate resources, teaching practical subjects would be as theoretical as academic ones. The lack of facilities would negatively affect the quality of education in the vocational pathway as rote learning, instead of actual performance, is likely to result. UNESCO (2016) indicated that the introduction of vocational and technical education is not without challenges; secondary schools prepare learners for entry into the tertiary and labour market. Therefore, vocational education requires more significant investment than academic education due to the need for specialised facilities, equipment, and materials for practical implementation and implementers of the programme.

The rationale for vocational education is to provide learners with survival skills and appropriately prepare them for upward mobility in vocational activities (Zimbabwe Government, 2001). Design and Technology would develop values and cater to the learners' needs and aspirations for self-reliance and entrepreneurship to develop a responsible, productive, and self-sustaining citizen (Tang and Shi, 2017; Mkonongwa, 2017). Furthermore, Matenda and David (2017) discussed that when pupils learn in an environment modelled after the workplace, they are likely to acquire not only trade-related skills but will also develop employable skills required to make an effective transition from school to work, an understanding of career development and planning, an understanding of the importance of becoming an autonomous, lifelong learner to adapt to the skills and knowledge needed in the future.

Practical education can be effective if teachers have successful experience applying skills and knowledge regarding operations and work processes. It is quiet important to point out that Design and Technology subject requires adequate facilities for effective teaching and learning. When schools do not have adequate facilities, the learners cannot acquire the envisaged skills for employment, and their education could then be considered a waste. This is more reason Luhana (2021) indicated that vocational education can be efficient in proportion when the environment in which the learners are learning is a replica of the place in which they must subsequently work; therefore, effective implementation of Design and Technology can only be given to learners when the teaching is done similarly with the same operations, tools, and machines as in the occupation itself.

Vocational education aims to equip learners with knowledge, skills, and or competencies required in particular occupations or more broadly, the labour market (Amechi and Thomas, 2016). Vocational Secondary Education has the role to prepare learners to be ready to work, either working independently (self-employed) or filling job openings that exist in the world of work. Therefore, the direction of development of vocational education is oriented towards the fulfillment of workforce market demand. The success of vocational education is not solely measured by the success of the learners in the learning process, but by the result of these successes, namely in the form of the performance in the working world. This means that the Design and Technology was designed with an orientation according to the needs and types of competence of the learners and industry. Thus the context it is being implemented should be a replica of workshops equipped with tools and equipment to use during the teaching and learning process.

According to Amechi and Thomas (2016) vocational education emphasises the preparation of the learning program using a systems approach that is characterized by the formulation of specific objectives (competencies) as the destination of behavior that must be achieved. The learning process is directed to achieve the objectives. Thus, learning success must be measured by the extent to which learners can master or achieve competency that has been determined. The planning of Design and Technology must respond to the workforce market signal so that learners can achieve the maximum opportunity to compete for jobs that are available and have basic skills that can be used to develop their careers. Design and Technology learning should be developed and be implemented for standardised competency achievement among learners. Imparting practical skills and work readiness are at the core of policies to integrate learners into labour markets and the hallmark of practical education. For this reason, Design and Technology aims to create both vocational and general working life skills among learners.

Design and Technology focus on individual performance in the workplace and special justification on real needs of the society. However, the success benchmark is not only limited to school; sensitivity to the development of the workplace; requires adequate facilities and infrastructures, and environmental support. Generally, practical education can only be given effectively if the learning tasks are carried out in the same way, with the same machine tools and tools as the type of work to be carried out later; Design and Technology will only be effective if learners directly and specifically get used to thinking and working regularly (Bukit, 2014). Design and Technology enhance employability skills among learners. These skills can help develop techniques and strategies that they specifically need for the area of work and ensure that they are prepared to succeed. With skills based education, learners work more directly with their teachers. Thus schools should be well equipped to achieve the Design and Technology objectives in schools.

The knowledge, skills, and behaviors must be possessed, lived, and mastered by teachers and learners when carrying out professional tasks. Without practical teaching and learning the competencies cannot be transferred to learners. Mulyasa (2017) explained that competence is the ability to carry out tasks obtained through education and training. Ayonmike (2020) also pointed out that the non-availability of the practical workshop, inadequate instructional materials, absence of electricity for operating the workshop equipment, and insufficient funding as other challenges against effective vocationalisation of secondary education in Nigeria. Underfunding affects the supply of modern facilities and equipment needed effectively train technical education students of the 21st century. Atsumbe, Raymond and Mele (2017) discussed that teachers' incompetence is another major challenge and reported that the Federal Government of Nigeria that the majority of the present crop of technical teachers handling Technical and Vocational Education (TVE) subjects in secondary schools in Kogi State were grossly incompetent. Thus when teachers have the right competencies in schools, it is easy to help learners acquire the knowledge and develop the practical skills.

The successful implementation of vocational subjects directly relates to the availability of physical facilities and the school's overall atmosphere where learning occurs. School facilities are the enabler of teaching and learning. Leke (2020) explained that school facilities greatly influence learners' academic performance. There is a relationship between the school facility's conditions and learners' achievement. Davis (2014), in his study conducted in Nigeria, found that the condition under which vocational education was implemented was poor. Most schools lacked appropriate equipment; workshops had ill-equipped laboratories due to the low funding for vocational and technical education, which had been a problem in implementing vocational subjects in secondary schools.

Design and Technology require adequate facilities for a successful implementation. Without good facilities, learners would not be able to acquire the expected skills, and their education would be considered a waste. Changwila (2016) justified that vocational education is expensive because schools must ensure that buildings, equipment, and teachers are readily available before implementing the subjects. Therefore, without school facilities, vocational subjects may not lead to significant skill acquisition as most schools are poorly implemented and fail to achieve the objectives of providing skills for the formal and informal sectors. Thus for meaningful practical teaching and learning to take place, school workshops and laboratories including classrooms should be equipped with the inputs for learners to acquire knowledge and develop meaningful practical skills during or after the completion of the school program .

Effective implementation of practical subjects demands the availability of resources and abilities of both teachers and schools to support. Teachers need training to build on their competences and confidence to deliver the intended work to learners. Kanorio (2016) conducted a study on curriculum implementation and strategies for improved learning outcomes in primary schools in Kenya. This study was confined to the primary school curriculum. However, it was not specific on which curriculum truck or vocational subject it focused. In order to effectively implement Design and Technology subject for learners to improve their performance, learning should take place in a conducive environment, thus learners should be able to see and touch the Design and Technology tools, equipment and machines. This enables them to properly comprehend and evaluate their understanding of the learnt content effectively. Practical education system should be well resourced and highly funded (Federal Ministry of Education and Research, 2003). This enables to effective implementation the subject. For an effective implementation of the Design and Technology subject, the context such as workshops and classrooms should be well equipped with appropriate tools and equipment for hands on teaching and learning in schools.

The study by Hahlani et al (2022) analysed the challenges Public universities of Zimbabwe face in implementing the Design Technology curriculum. The study's findings indicated that there was curriculum implementation infidelity that stems from lack of subject-specific training and content, lack of lecturer participation in curriculum planning decisions, low student enrolment, poor funding, lack of collaboration, lack of resources and staff development programs. Thus the study recommended in-service training for lectures, lecturer involvement in curriculum planning decisions, teaching of the Design Technology curricula across all levels of education in the country, government and funding channels, engagement in collaborative activities with other universities and staff development workshops as strategies to ensure faithful implementation of the Design and Technology curricula.

Good pedagogy application is a premise for attaining fine learning outcomes in the subject of design and technology. Teachers who uses good pedagogy, makes it easy for learners to comprehend the concepts in a lesson. As a result, teachers must undergo a rigorous orientation whenever new teaching methods are introduced. This enables the teacher to comprehensively comprehend the newly introduced pedagogies for appropriate application during lesson delivery (Saleh, Rasul & Affadi, 2018). Most of all, this equips the teacher with the knowledge on how to implement the curriculum with expertise. Moreover, pedagogical practices of the teacher trainees of Design and Technology are more often lecture method as opposed to doing a lot of practical activities (Saleh etal, 2018). From this, it is clear that teacher trainers do little to develop skills for teaching Design and Technology in their trainees during training. As a consequence, most of them have challenges with the application of the prescribed pedagogy recommended in teaching design and technology.

The retraining of teachers is however cardinal if the competency-based syllabus is to achieve its intended outcomes. Actually, without retraining, teachers have been facing a lot of challenges in the execution of the syllabus. For instance, the introduction of a Competence-Based Curriculum in Tanzania and Rwanda made them realise that retraining of teachers is important for effective execution of the curriculum (Kafyulilo et al (2016) & Makunja (2015)). This implies that at inception, teachers handled the subject using the previous methods which did not yield the intended results. As a result, the Tanzanian government organized training programs that addressed teachers' inability to use assessment data to identify learners' learning needs and teachers' ability to respond to learners' needs (Ngendahayo & Askell-Williams, 2016). This was done to equip teachers with necessary teacher practices as provided in the curriculum to make them teach better.

2. 5 Implementation of the Design and Technology Subject in Zambia

Implementing the Design and Technology subject requires schools to have all the necessary educational requirements, including infrastructure (workshops, laboratories and classrooms), desks, chairs, text books have to be readily available in the institutions of learning that adopted Design and Technology. Zambia Education Curriculum Framework (2013:58) also guided that:

> *Learning institutions should have appropriate infrastructure such as classrooms, specialised rooms, laboratories, workshops and resource rooms. This infrastructure should be well stocked with adequate equipment and materials needed for effective teaching and learning. They should also have user-friendly facilities for learners. The Library is a very important resource-room in a learning institution. Therefore, it must have adequate and appropriate reading and other learning materials for both learners and staff.*

Inputs of Design and Technology are essential resources for effective implementation of the subject in schools. For an effective implementation to occur, resources should be available during the subject's teaching and learning process. These may enable learners acquire knowledge and practical skills useful after the completion of the program.

The Design and Technology is a practical subject, it demands that learners and teachers should have hands on lessons. The schools should be prepared with appropriate workshops, laboratories and classrooms to ensure an effective and successful teaching and learning of Design and Technology subject. Mubangwe (2016) studied the nature of infrastructure in teaching and learning Design and Technology in Technology Studies at Kitwe College of Education. The result of the study revealed that the four (4) built industrial Arts workshops infrastructure with machinery and equipment were no longer used as were intended. Kitwe College of Education turned its workshops infrastructure for teaching Design and Technology into ordinary classrooms. This implies that the quality assurance practice of training teachers to equip and handle Design and Technology after training remains questionable. Also, the results revealed inadequacy of workshop equipment, the college had no standard rooms or workshops for Design and Technology. The study by Mubangwe (2016) also revealed a significant relationship between the infrastructure for teaching and learning of Design and Technology with the trainee teachers' academic and professional performance.

Pansho etal (2024) studied the teaching of Design and Technology subjects during free education period in selected secondary schools in Kitwe district. The results revealed that that the quality of teaching of Design and Technology as a practical subject was compromised due to the increased enrollment levels and limited or lack of equipment and infrastructure to teach the subject effectively. As a result, teachers resorted to teaching the subject theoretically; thereby, compromising the prescribed methods of teaching Design and Technology. Therefore, schools offering Design and Technology subject should have the appropriate infrastructure and resources for teachers to use the demonstration method common in Design and Technology to support an effective teaching and learning of the subject.

Kasaro (2021) studied the analysis of the implementation of the vocational career pathway of the 2013 curriculum in selected schools in Lusaka district. The study findings revealed that schools did not have facilities or infrastructure specifically for practical subjects and had adequate and qualified teachers to teach vocational subjects as some teachers were misplaced as their area of specialisations were a mismatch. Further, it was learnt that learners had acquired a number of skills from vocational subjects but did not aspire for the expected future jobs for skills acquired. The findings of the study further revealed that the teaching strategies expected to be used by teachers in the teaching of vocational skills were not being used by the majority of the teachers and when they were used, they did not use them appropriately due to lack of teaching and learning resources.

A good learning environment is important for learners' good academic achievement. However, equipping the workforce with relevant job skills is a continuing challenge worldwide. Thus schools should establish infrastructural facilities for practical subjects in secondary schools for effective implementation of Design and Technology subject. Hatiya (2016) also carried out a study on the relationship between a school's infrastructure facilities and learners' outcomes. The study showed that good infrastructure facilities always support the education enterprise and that the shortage of classrooms poses challenges for schools to conduct practical lessons and this eventually denies learners of knowledge and practical skills.

The learners' choice of learning practical subjects depends on the availability of infrastructure, physical facilities, equipment and trained teachers. The lack of the skilled personnel would hinder the effective implementation of Design and Technology in schools. It is important to note that trained and skilled human resources are cardinal inputs for effective Design and Technology implementation in secondary schools; therefore, they should always be available in schools for easy implementation of the subject. Kukano, Hapompwe, Siwale and Chanda (2020) studied the school stakeholders' perception towards implementing the academic and vocational career pathways in secondary schools in Kafue district. The study's findings revealed that the school stakeholders in most secondary schools perceived the vocational career pathway negatively and advised learners not to take it into account, given the lack of infrastructure and facilities and qualified teaching staff to guide learners for quality achievement effectively.

The context and inputs of Design and Technology are highly considered before the school adopts the subject. Thus, for the school to effectively implement design and technology, appropriate context and inputs have to be put in place to help learners acquire practical knowledge and skills. Mwila (2021) carried out a study in Chongwe district on the career path way in secondary schools. The study showed that most schools prefer the academic pathway which seems cheaper than the vocational one, which requires huge amounts for infrastructure and material mobilisation. This is because the cost for vocational subjects was higher than academic subjects. Physical facilities are important that should greatly be considered in implementing Design and Technology. Therefore, considering its high cost, it is unknown how Design and Technology subject is being implemented in secondary schools of Kapiri Mposhi district.

Furthermore, if the tenets of the revised curriculum remain unfamiliar to some teachers teaching vocational subjects they may not effectively teach the skills to learners. Thus infrastructure development and fundings were urgently needed if the revised curriculum should respond to 2030 vision of the country. Kasaro (2021) analysed of the implementation of the vocational career pathway of the 2013 curriculum in selected schools in Lusaka district. The findings of the study showed that schools had adequate and qualified teachers to teach vocational subjects. However, the study findings also indicated that some teachers were misplaced as their area of specialisations were a mismatch. The findings of the study further showed that the teaching strategies expected to be used by teachers in the teaching of vocational skills were not being used by the majority of the teachers, they did not use them appropriately due to lack of teaching and learning resources. However, it not clear of the vocational subject Kasaro (2021) study concentrated on, hence this study aimed to evaluate the context, inputs and processes of Design and Technology in selected secondary schools of Kapiri Mposhi district.

The teaching and learning process requires inputs, therefore to effectively teach Design and Technology schools should be well equipped with resources which includes trained human resources (Design and Technology teachers). Chulu (2018) assessed the challenges that upgraded rural secondary schools face in implementing the 2013 vocational career pathway in the revised curriculum in Kabompo district. The study showed that some of the infrastructure, resources facilities were in a bad state and were too inadequate to accommodate the increasing number of learners. Classroom blocks in all the schools were those previously meant for primary schools and hence very inadequate and not spacious. Equipment, teaching, and learning resources were also in short supply and to some instances they were not available to implement the vocational career pathway effectively. The findings further indicated shortage of specialist teachers to handle vocational career pathway, in some subjects, teachers were seconded to teach without the methodology for an effective implementation of the subject. It is not clear the vocational education subject which did not have trained and specialised teachers.

The consideration of the inputs when adopting the vocational subject is critical. However, Chulu (2018) observed that the adoption of vocational career pathway subjects in upgraded rural secondary schools was done without focusing on the available resources and infrastructure. It was also found that equipments were not available for vocational career pathway, some departments and sections did not have even single equipment and yet the subjects were being offered and learners were expected to perform practicals at the end of the year examinations. Tamil (2021) pointed out that no meaningful teaching and learning occurs without adequate resource materials and appropriate infrastructure. The availability of resource materials and appropriate facilities greatly influence the quality of implementing Design and Technology in schools to help learners acquire practical knowledge and skills.

The teaching and learning resources are critical in the implementation of the Design and Technology subject because they ensure effective and successful teaching and learning. Kakupa (2017) conducted a study on the vocationalisation policy in Zambia's secondary education sector. The study focused on the vocationalisation policy of secondary schools. The study revealed that the programme needed careful planning, and that there was a need to improve the academic pathway before introducing the vocational career pathway. The study recommended a reversal of the program until such a time when the country had enough resources to implement it. It is unclear what vocational subject Kakupa (2017) referred to in his study. Thus, this study assessed the context, inputs, processes and products of Design and Technology subject.

Most vocational subjects lack expert teachers to deliver the content competently, this situation seemed to be a challenge in many secondary schools including in urban areas. Kakupa (2017) indicated that Zambia was still struggling to provide access to and improved quality of education due to inadequate qualified teachers to deliver practical subjects effectively. Thus the study urged the government to consider pursuing a partial vocationalisation, whereby a few vocational subjects could be taught within the existing academic pathway and made compulsory to all learners. However, the study that was conducted by Kakupa (2017) used a literature search method. Therefore, the collected secondary data from various literatures might not provide the true information on what is actually happening in schools concerning the implementation of vocational subjects. Thus this study was conducted to collect the primary data to assess the adequacy of the teaching and learning resources to establish how the Design and Technology subject is being taught in schools.

The study by Kabeta (2022) study highlighted critical challenges in the implementation of the revised 2013 curriculum, particularly in vocational education. The findings suggest that while the intention to integrate vocational subjects into the school system was present, inadequate teacher preparedness hindered effective execution. The lack of proper orientation and retraining for educators raises concerns about whether vocational education was prioritized in policy planning or merely introduced without sufficient support structures. Moreover, the study's failure to specify which vocational subjects were most affected limits its practical applicability. Given that vocational education encompasses multiple disciplines, a more focused analysis could have provided deeper insights into the specific challenges faced in different subject areas. This omission leaves room for further research to identify which vocational subjects require urgent intervention and how best to address the gaps in teacher training and resource allocation. Overall, Kabeta (2022) research underscores the importance of continuous professional development for teachers and the need for a structured approach to curriculum implementation to ensure that vocational education meets its intended goals.

Design and Technology education can be effectively implemented if teachers have successful experience in applying skills and knowledge regarding operations and work processes carried out to enables practical knowledge and skill transmitted to learners. Mwanza (2017) explained that teachers are central to achieving universal access to high- quality and equitable education for all learners because they have first-hand knowledge of the conducive learning environment and the pupils, and how the two relate. The competency-based curriculum may look uncomplicated in design, but it is not as easy as it seems. In theory, it involves teachers being knowledgeable of the curriculum's key principles and appropriately equipped with skills and desirable attitudes to teaching using competency-based approaches

Furthermore, without adequate facilities, the learners cannot acquire the required skills for employment, and their education could then be considered a waste. Luhala (2021) discussed that vocational education, which is a practical form of education requires adequate facilities for effective teaching and learning. Therefore, Design and Technology can be efficient in proportion as the environment in which the learners are learning is a replica of the place in which they must subsequently work. Hence schools should be equipped with appropriate context and inputs to effectively implement design and technology in school to help learners acquire knowledge and develop relevant practical skills.

The learners taking Design and Technology subject are expected to acquire knowledge and develop practical skills on domestic installation, carpentry and joinery, metal fabrication, bricklaying and plastering, graphic communication or geometrical drawing and architectural skills before and after the completion of the programme. This enables learners to become self-reliant and stand on their own in society. Thus learners should have the knowledge and skills of working with materials using hand tools, demonstrate ability to apply geometrical constructions to determine shapes, and produce a portfolio. The teaching and learning of Design and Technology subject should therefore help provide education that would equip learners with vital knowledge and skills. Thus the teaching and learning of Design and Technology should link education to real life experiences that give learners skills to apply knowledge that help gain life skills (Grade 8-9 and 10-12 Design and Technology Syllabus, 2013).

The study by Mbewe (2018) sheds light on significant challenges in implementing the 2013 Revised Secondary School Curriculum in Chipata District. The lack of adequately qualified teachers for vocational pathways suggests a gap between policy formulation and actual execution, raising concerns about whether enough investment was made in teacher training before rolling out the curriculum. Without well-trained educators, the intended benefits of vocational education such as equipping learners with practical skills are unlikely to be fully realized. Additionally, the study highlights the shortage of teaching and learning resources, as well as inadequate infrastructure, which further hindered effective curriculum implementation. These shortcomings not only affected teaching quality but also had a direct impact on student performance in examinations. This implies that curriculum reforms alone are insufficient unless they are supported by adequate resources and infrastructure. The findings by Mbewe (2018) emphasised the need for a more holistic approach to educational reform, where curriculum changes are complemented by investments in teacher training, resource provision, and infrastructure development. Without addressing these foundational issues, the implementation of vocational pathways in Zambia's education system may continue to face setbacks, ultimately limiting students' ability to acquire essential skills for the job market.

Mhango (2021) highlighted critical gaps in the implementation of prescribed pedagogical practices for Design and Technology in Zambian schools, particularly in Chipata District. The findings suggest that while structured teaching methods exist in the syllabus, their effective application is hindered by inadequate teacher orientation. This point to a broader issue in curriculum implementation merely prescribing pedagogical practices is not enough; teachers must be adequately trained to use them effectively in the classroom. The study also emphasizes the need to strengthen teachers' content knowledge, which is essential for delivering high-quality Design and Technology instruction. Without a solid grasp of both theoretical and practical aspects of the subject, teachers may struggle to impart the necessary skills to learners. Additionally, the lack of sufficient teaching and learning resources, including standard workrooms, further limits the effectiveness of these pedagogical approaches. Mhango (2021) provided practical recommendations to address these challenges, including teacher orientation, provision of adequate resources, and upgrading teacher qualifications. These insights underscore the importance of continuous professional development and resource investment. This can ensure also that Design and Technology education achieves its intended outcomes. Without these interventions, the subject may fail to equip learners with the necessary skills for technical and vocational careers, ultimately undermining the purpose of its inclusion in the curriculum.

Furthermore, the implementation of the Outcome-Based Curriculum was done without re-training of teachers; despite changes it came with. This has posed a challenge to teachers in terms of teacher content pedagogy application. Thus, the teachers of Design and Technology must be abreast with the pedagogies outlined in the syllabus if their teaching is to be effective (Lucas, 2015). Teachers must be diligently trained on how to articulate these methods judiciously. Moreover, Competency-Based Curriculum requires teachers to have clarity of focus, reflective designing, setting high expectations for all learners (MoGE, 2013).

Design and Technology subject demands teaching learners knowledge, skills and values. The introduction of the subject was to make it relevant and responsive to current trends. Thus the introduction of Design and Technology was done with a view that upon completion of secondary school, learners acquire skills and an academic certificate (Nkanza, 2014). Thus, the Design and Technology learners are expected to obtain appropriate knowledge, skills, attitudes; values and problem-solving ability to enable them solve the ever-changing needs of society. In this view, suitable use of the prescribed pedagogy is important for teaching skills because it unlocks the learners' minds, consequently applying the knowledge in their daily livelihood (Lucas, 2014).

According to Makunja (2015), teachers need to be retrained if the application of prescribed pedagogies in Design and Technology syllabus is to achieve the set goals. Thus the retraining of teachers is required for the effective execution of the syllabus. The new curriculum emphasised acquiring learners with knowledge, skills, and values (KSV) after the learning period. Therefore, teachers must fully understand the syllabus requirements as they choose pedagogy to apply from those prescribed. It must be realised that the failure to apply competency-based teaching pedagogies deter learner's progression in acquiring necessary skills.

The growth for the need of quality and relevant education is getting popular worldwide. The establishment of Science, Technology, Engineering and Mathematics (STEM) Education in Zambia is a response to the call and in line with the Zambia Educational Curriculum Framework of 2013 to produce learners who are self-motivated, creative, confident and productive individuals, who are holistic, independent learners with values, skills and knowledge to enable them to succeed in life. Magasu (2022) studied the implementation of STEM Education in the Zambian Education System. The study found that STEM education teachers welcomed this programme but had challenges such as a lack of teaching and learning materials, improper training on STEM curriculum, poor internet connectivity for research, and poorly stocked laboratories. Thus, based on the findings, the study recommended to the Ministry of Education (MoE) to be making wider consultations with key stakeholders before a programme is rolled out for implementation in schools.

2.6 Research Gap Identified and it's Justification

From the reviewed literature, studies were conducted on Design and Technology education. However, this study offered a unique perspective on the evaluation of the context, inputs, processes and products of the Design and Technology subject has not been extensively done. This study was therefore the first kind in this area in Zambia as the study focused on the evaluation of the context, inputs, processes and products of the Design and Technology subject to establish the adequacy and effectiveness in the implementation of the subject in selected secondary schools of Kapiri Mposhi district. Other researchers conducted their studies on vocational education; however, they could not spell out clearly the vocational career pathway subject their studies concentrated on. Thus this study was conducted to evaluate the implementation of design and technology in selected secondary schools in the selected secondary schools of Kapiri Mposhi district.

Other studies reviewed employed the literature search to collect secondary data from various countries on the implementation of vocational education. This method could not provide primary data to assess the implementation of vocational subjects, because countries have different conditions and environment, therefore the way the subject is being implemented is quite different from Zambia. Thus the secondary data from other countries cannot be relied on to assess the implementation of a subject in Zambia. This study therefore used mixed method approach to collect and analyse data on the evaluation of the context, inputs and process of the Design and Technology subject in the selected secondary schools of Kapiri Mposhi district in order to establish the adequacy and their effectiveness in the implementation of the Design and Technology subject in the selected secondary schools that offers Design and Technology subject in the district.

2.7 Summary

In this chapter the literature review was discussed according to the following themes: the meaning of curriculum implementation and the description of design and technology. The studies helped identify a research gap in design and technology in evaluating the subject’s context, inputs, processes, and products in selected secondary schools in the Kapiri Mposhi district. The subsequent chapter presented the research methodology.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Overview

In the previous chapter various pieces of literature were reviewed to identify the research gap that needed to be addressed through this study. This chapter contains the research methodology. It is organised under the following sections: research paradigm, ontology and epistemology, research design, research approach, study site, target population, sample size, sampling technique, data collection instruments, validity and reliability, trustworthiness, data collection procedure, data analysis, and ethical research considerations.

3.1 Research Paradigm

Research paradigms are important because they form the philosophical basis of research. Thus they influence how different schools of learning (such as the sciences versus the humanities) undertake their research. Once a research philosophy has been determined, an appropriate methodology can be chosen. Research paradigms derive from research methodologies: positivism, interpretivism and pragmatism. This study employed the pragmatic research paradigm that helped collect qualitative and quantitative data using different methods for a comprehensive understanding of the research problem and findings.

3.1.1 Pragmatism

The researcher employed pragmatic research paradigm. A pragmatist philosophical assumption worldview advanced by Teddlie and Tashakkori (2009) was adopted in this study as Cherry (1992) indicated that pragmatic research paradigm helps draw many ideas including diverse approaches, and valuing both objective and subjective knowledge. Pragmatist paradigm sits on an assumption that clear understanding of a phenomenon is by using both objective and subjective approaches in a single study. The pragmatist's paradigm was adopted to appreciate both objective and subjective knowledge of the respondents and participants on the evaluation of the implementation of the Design and Technology subject in the selected secondary schools of Kapiri Mposhi district.

To achieve pragmatist's philosophical paradigm, the researcher on one hand applied the deduction reasoning (what is unknown) to establish specific known knowledge. On second hand, the researcher applied the known knowledge (induction reasoning) to establish the unknown knowledge before a conclusion was drawn on the evaluation of the implementation of the Design and Technology subject. This research paradigm allowed the use of a combination of quantitative and qualitative research methods and tools to gather comprehensive data. By incorporating both qualitative and quantitative methods, offered a more comprehensive understanding of the research findings. The pragmatic research paradigm enabled to balance the strengths of both research approaches. Thus, allowed the researcher to validate quantitative results with qualitative insights and vice versa, leading to a more understanding of the research problem.

3.2 Ontological Assumption

This refers to the claims and assumptions made about the nature of social reality. Cohen and Manion (2006) discussed that ontological assumptions are concerned with what is believed constitutes social reality. The ontological position of this study was within the approaches of objectivism (positivism) and subjectivism (interpretivism) which helped correct both objective and subjective responses.

3.2.1 Objectivism

Objectivism is an ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors. On the other hand, constructivism asserts that social actors construct social phenomena and their meanings are constructed by social actors. It implies social interactions produce social phenomena (Carson, 2007; Panther and Remenyi, 2005; Schwandt, 1994). Ontology helps researchers recognise how certainly they can be about the nature and existence of objects they are researching on. It is concerned with what exists in the world where humans can acquire knowledge.

Denzin and Lincoln (2011) discussed that ontological matter relates to the nature of truth and its characteristics. Thus, the mixed research approach embraces the idea of multiple realities and researcher reports these multiple realities. The evidence of multiple realities included the use of various methods and proof of data in themes using the actual words of different study participants and presenting many perspectives (Kennedy, 2012). The researcher reported and presented data truthfully using a mixed research approach. Positivist ontology is also called objective ontology because it believes that the world is external and that there is a single objective reality to any research phenomenon or situation regardless of the researchers' perspective or belief (Hudson and Ozane, 1988). Thus the researcher used questionnaires with closed ended questions to help provide objective responses.

3.2.2 Subjectivism

The subjectivist ontology is also called relativist ontology (multiple realities). It views reality as subjective, differs from person to person, and is constructed through interaction. They devote themselves to understanding and interpreting the meaning attached to an action. Subjectivists tend to use qualitative research methods. For this reason, interview method was used to collect different perspectives from the participants on the implementation of Design and Technology subject in the selected secondary schools of Kapiri Mposhi district. Carson et al (2001) discussed that knowledge acquired through qualitative research is socially constructed rather than objectively determined. Instead, it must be observed from the inside through the people's direct experiences. Therefore, the researcher used open ended research questions to provide subjective responses.

3.3 Epistemological Assumptions

Epistemology studies the nature of knowledge and the process by which knowledge is acquired and validated. According to Walker (1988), epistemology studies knowledge's nature, scope and applicability. Denzin and Lincoln (2011) explained that researchers try to get as close as possible to the study participants through the epistemological assumption. Thus, subjective evidence was collected based on personal views of participants. This is how knowledge is known through the subjective experiences of people. Thus conducted the study on Design and Technology subject in the schools where the participants work was essential.

Epistemology deals with how knowledge is gathered and from which sources. Sahaya (2017) explained that epistemology is the theory of knowledge. It is concerned with the nature and scope of knowledge. It inquires what knowledge is, how it is acquired, and the possible extent to which a given subject can be known. The subjective evidence is assembled based on personal views and experiences. This is how knowledge is known through the subjective experiences of people (Denzin and Lincoln, 2011). In order to understand the implementation of Design and Technology, the study used objective and subjective experiences of respondents and participants to evaluate the contexts, inputs, processes and products of the subject.

3.4 Axiological Assumption

In conducting a study on the evaluation of the Design and Technology subject in secondary schools in Kapiri Mposhi district, the axiological assumption outlined emphasised a balanced approach to values in research. The researcher prioritised maintaining objectivity throughout the study. This means ensuring that personal biases or preconceptions about the effectiveness of the Design and Technology subject did not unduly influence the research process or outcomes (Creswell, 2014). When assessing the implementation of the Design and Technology curriculum, the researcher based the conclusions on evidence data from learners, teachers, and education standards officers rather than personal opinions about its success or challenges. While collecting data, the researcher ensured that participants' voices were heard without imposing their own value judgments (Cohen, Manion, & Morrison, 2018). Objectivity was maintained by using systematic methods to analyse the data, such as coding qualitative responses or statistically analyzing quantitative data (Bryman, 2016). By maintaining this axiological balance, the researcher ensured the credibility, impartiality, and integrity of the study, while using insider knowledge to provide detailed and contextually relevant insights. This enhanced the overall value and reliability of the evaluation of the Design and Technology subject in secondary schools (Silverman, 2020).

An etic perspective in research refers to the viewpoint of an outsider who analyses phenomena without being a direct participant (Headland, Pike, & Harris, 1990). Thus to avoid bias in research, an etic researcher must employ strategies to ensure objectivity, minimise assumptions, and remain respectful of the context they are studying. Conducting a thorough literature review helped gain a foundational understanding of the context and avoid misinterpretation of the data (Punch, 2014). This prevented the researcher from making uninformed judgments or assumptions about the participants or phenomena. The use of standardised data collection instruments helped to maintain consistency and neutrality in gathering data. Tools such as questionnaires, interview guides and schedules, and observation checklist reduced the influence of the researcher's personal perspective during data collection (Cohen, Manion, & Morrison, 2018). Collaborating with insiders (emic perspectives) validated the findings and interpretations by involving participants studied. Thus, the collaboration with insiders ensured that conclusions reflected the participants' lived realities and not just the outsider's interpretation (Fetterman, 2019). Triangulation of data helped to cross-verify findings using multiple sources or methods. By comparing data from the questionnaires, interviews, and observations, the researcher reduced the likelihood of biased conclusions and strengthened reliability (Denzin, 1978).

3.5 Mixed Method Research Approach

A mixed method approach is a research methodology in its own right. As stated by Creswell and Plano Clark (2011), a mixed methods research approach has its own philosophical assumptions and methods of inquiry. As a methodology, it includes philosophical assumptions to provide directions for collecting and analysing data from multiple sources in a single study. A mixed research method offers many benefits to approaching complex research issues as it integrates philosophical frameworks of postpositivism and interpretivism (Fetters, 2016) interweaving qualitative and quantitative data so that research issues are meaningfully explained. It also offers a logical ground, methodological flexibility and an in-depth understanding of smaller cases (Maxwell, 2016).

The use of mixed methods enables a researcher collect sufficient depth and breadth data (Enosh, Tzafrir and Stolovy, 2014). The quantitative approach helps to collect the data from a large number of respondents; thus, increasing the possibility to generalise the findings to a broader population. The qualitative approach, on the other hand, provides a deeper understanding of the issue being investigated, honouring the voices of its participants. In other words, quantitative data brings breadth to the study and qualitative data provides depth to it. Moreover, quantitative results can be triangulated with qualitative findings and vice versa. Triangulation, as a qualitative research strategy, is using multiple methods or data sources to develop a comprehensive understanding of a research problem or test validity through the convergence of information from different sources (Carter et al., 2014). A mixed methods approach, therefore, offered the best chance of answering research questions by combining two sets of strengths while compensating at the same time for the weaknesses of each method (Johnson and Onwuegbuzie, 2004).

3.5.1 Justification for the use of Mixed Research Approach

Mixing two methods might be superior to a single method as it might provide rich insights into the research phenomena that could not be fully understood using only qualitative or quantitative methods. A mixed research method helped integrate and synergize multiple data sources, and assist in studying the evaluation of the implementation of Design and Technology subject. Applying mixed research methods allowed seeking a comprehensive view of the study as Shorten and Smith (2017) indicated that a mixed research method enables researchers to view a phenomenon from different perspectives and research lenses. The rationale of employing mixed research methods was to help expand the study. This means that this method widen the study with sufficient depth and breadth by developing a detailed data on the implementation of Design and Technology subject in secondary schools. This enabled the researcher to collect both closed-ended quantitative data and open-ended qualitative data to support understanding a research problem.

Mixing the two methods, therefore, offered the possibility of combining two sets of strengths while compensating at the same time for the weaknesses of each method. Thus mixed research method helped to triangulate the study to help validate results obtained with the individual method. The study aimed at obtaining valid picture on the implementation of Design and Technology subject in secondary schools by evaluating the context, inputs, processes and products of the subject by directly comparing the findings drawn from one method (qualitative or quantitative) to those obtained from another (quantitative or qualitative) for convergence or divergence as Plano Clark and Ivankova (2016) pointed out that collecting diverse types of data offers greater insights on a phenomenon that the methods individually cannot offer, and therefore, provides more valid and stronger inferences than a single method does (Teddle and Tashakori, 2009). Consequently, data triangulation led to a well-validated conclusion and also promotes the credibility of the data obtained from one method (Ventakesh et al., 2013).

3.6 Research Design

The embedded aspect of this design refers to the integration of the quantitative and qualitative components within the same study. A research design is a strategy for a study and the plan by which the strategy is to be carried out. Khan (2006) explained that a research design is a blueprint that outlines each procedure, from research questions to the analysis. It constitutes the blueprint for data collection, measurement, and analysis. Research designs used in mixed research studies include the convergent parallel design, the explanatory sequential design, the exploratory sequential design, the transformative design, the multiphase design, and the embedded design (Creswell, 2012). This study used the embedded research design to allow the other type of data provide a supportive role. The embedded design is a mixed research design in which one data set provides a supportive, secondary role in a study based primarily on the other data type. The embedded research design is used to collect and analyse both types of data simultaneously, but within a larger quantitative or qualitative design, this implies that the qualitative research approach provided a supportive role to the quantitative data. The purpose of the embedded design was to collect quantitative and qualitative data simultaneously, but to have one form of data play a supportive role to the other form of data. The qualitative study complimented the quantitative data by providing a supportive role to maximise the strength and reduce the weaknesses of the quantitative approach. Thus, this study focused on quantitative data collection, and the qualitative data was used to provide context and explain the unexpected findings. Hence the researcher collected both quantitative and qualitative data during a single study. Figure 3.1 is an illustration of how the embedded design was used.

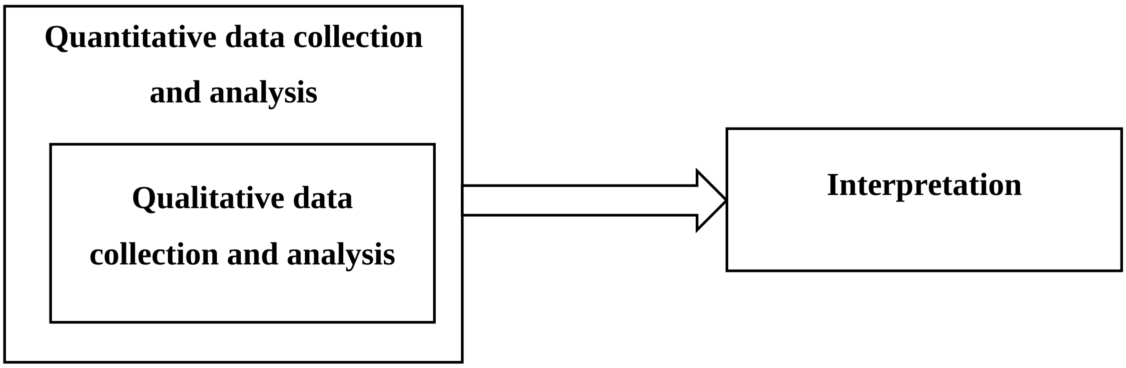

Figure 3.1: Embedded Design

Source: *Creswell (2012)*

There is a need to build the knowledge on pragmatic grounds, because truth is ‘what works’ and researchers settle for approaches, variables and units of analysis which are most appropriate for the research questions and objectives (Tashakkori and Teddlie, 1998; Maxcy, 2003). The principle of mixed methods research is that quantitative and qualitative methods are compatible. Masaiti (2013) also supported this, who indicated that both numerical and text data collected concurrently or sequentially should lead the researcher to understand the research problem.

Quantitative data was used to evaluate the infrastructure of the Design and Technology subject, to assess the teaching and learning resources of the Design and Technology, to establish the adequacy of the teaching, learning and assessment processes in the Design and Technology subject and to analyse the extent to which the knowledge and skills of Design and Technology subject are developed and applied by learners. The qualitative data was used to evaluate the infrastructure of the Design and Technology subject to assess the teaching and learning resources of the Design and Technology, to establish the adequacy of the teaching, learning and assessment processes in the Design and Technology subject by interviewing head teachers, deputy head teachers and practical heads of department, DESO and SESO. This design involved embedding the qualitative data within quantitative data to provide complementary insights. The qualitative data were embedded within a quantitative data to provide context and depth to participants' perspectives regarding the implementation of Design and Technology subject. The results of both qualitative and quantitative approaches were integrated and interpreted before arriving at the conclusion and recommendations.

3.7 Study Area

This research was carried out in the selected secondary schools of Kapiri Mposhi district that introduced Design and Technology subject to help learners acquire vocational and technical knowledge and skills. The schools were coded with letters A, B, C and D secondary schools in order to abide to ethical issue of confidentiality.

3.8 Target Population

Kombo and Tromp (2006) indicated that a population is the total number of objects or individuals from which the sample for a given study is drawn. The target populations for this study were all head teachers, all deputy head teachers, all practical subjects' heads of departments, all Design and Technology subject teachers, and all grade 9 and 12 learners who take Design and Technology in secondary schools of Kapiri Mposhi district that offer Design and Technology subject. The District Education Standards Officer (DESO) and Central province Senior Education Standards Officer (SESO) for practical subjects were targeted because they monitor the implementation of the education curriculum and ensure standards in schools. This type of a population was chosen because of the unique characteristics of participants with knowledge about Design and Technology subject that is offered in the schools and helped the researcher understand the context, inputs, processes and products of the subject. In this research, the study population and sampling techniques were critical components of the successful attainment of the desired goal to solve the research problem.

3.9 Research Sample Size

A sample is the participants selected from a target population (the group interested in). An entire population tends to be too large to work with, so a smaller group of participants must act as a representative sample. According to Khan (2006), the appropriate sample size is determined by the characteristics of the population and the sort of data that needs to be collected and processed. In this study the sample size was eighty eight (88). These included four (4) head teachers, four (4) deputy head teachers, four (4) heads of practical departments, ten (10) Design and Technology subject teachers, and sixty four (64) Design and Technology subject learners, that included 28 from grade 9 and another 36 from grade 12 of the selected secondary schools of Kapiri Mposhi district, 1 District Education Standards Officer (DESO) and 1 Senior Education Standards Officer (SESO) for practical subjects of Central province. The quantitative study's seventy-four (64) respondents were calculated using Yamane's formula from a population of one hundred and seventy-eight (178) learners from the selected secondary schools. The twenty-four (24) participants for the qualitative study were chosen based on their experience in implementing the Design and Technology subject. Using Yamane's formula for a population of one hundred and seventy-eight (178) for a 10 % margin error, the sample size for the quantitative part of the study was sixty-four (64).

$$\boldsymbol{n = \frac{N}{1 + N(e)^2}}$$

n = sample size

N = population size

e = margin of error, e = 0.1 for 10 %

$$\boldsymbol{n = \frac{N}{1 + N(e)^2}}$$

$$\boldsymbol{\frac{178}{1+178\,(0.1)^2} = \frac{178}{1+78(0.01)} = \frac{178}{2.78} = 64.03}$$

$$\boldsymbol{n = \frac{178}{2.78} = 64}$$

3.10 Sampling Techniques

Sahaya (2017) discussed that a research sampling approach is a method of selecting respondents to form a research study sample. The researcher employed probability and non-probability sampling procedures in this study. Under probability sampling, simple random sampling was used and under non-probability sampling, purposive sampling was used to select the respondents to gather in-depth information on issues relating to teachers and learners regarding the context, inputs, processes and products of Design and Technology in the selected secondary schools of Kapiri Mposhi district.

3.10.1 Sampling of Schools

There are four (4) secondary schools that offer Design and Technology in Kapiri Mposhi district. The study was conducted in secondary schools offering Design and Technology subjects in Kapiri Mposhi district. For the sake of confidentiality, these secondary schools were coded with letters A, B, C and D. The schools were purposively picked because the respondents were likely to provide information and their experiences regarding the implementation of Design and Technology subject. The secondary schools were picked because they introduced Design and Technology subject to equip learners with competencies to help them develop technical and vocational skills that they can use before and after the completion of their secondary education.

3.10.2 Sampling of Head Teachers, Deputy Head Teachers, Heads of Department, Teachers, District Education Standards Officer (DESO) and Senior Education Standards Officer (SESO).

Purposive sampling was used to select head teachers, deputy head teachers, practical subjects heads of department and Design and Technology subject teachers. The head teachers and deputy head teachers are the school financial controllers who authorises the release of funds needed to implement Design and Technology in schools. They also monitor the implementation of the subject at the school level. As Beaudry and Miller (2016) discussed that purposive sampling is used to select participants with the knowledge of the problem under study, thus purposive sampling was used to select head and deputy head teachers from the selected secondary schools of Kapiri Mposhi district. The District Education Standards Officer (DESO) and Central province Senior Education Standards Officer (SESO) for practical subjects were also sampled purposively because they monitor the standard of implementing the education curriculum in the districts.

The heads of practical subjects' heads of department (HoDs) are the immediate supervisors and monitors of the Design and Technology subject teachers. They monitor and implement Design and Technology subject in schools as well. In addition, the heads of the practical subjects department helped to provide the information for this study. The practical subjects' heads of department were purposively sampled as Leedy and Ormrod (2005) indicated that purposive sampling ensures that only participants with the needed information and experience about the topic are selected. Thus, purposive sampling was appropriate for selecting head teachers, deputy head teachers, practical subjects' heads of department, DESO and SESO. Kombo and Tromp (2006:83) clarified that "critical case purposive sampling looks for critical cases that can make a point quiet dramatically." In this case, the Design and Technology subject teachers were very critical to this study because of their specialisations and experiences; therefore, they were purposefully picked.

3.10.3 Sampling of Learners

Simple random sampling is a part of the sampling technique in which each sample has an equal probability of being chosen. A sample chosen randomly is meant to be an unbiased representation of the total population. It was believed that the grade 9 and 12 design and technology subject learners had acquired and developed enough knowledge and skills since they were in their final grades of junior and senior secondary education. Thus, they had the information and experiences on the implementation of the subject in schools as they are the direct beneficiaries of the program. Simple random sampling was used to select 64 Design and Technology subject learners who participated in the study. In this study, Design and Technology learners were given numbers written on small papers and put in a box after which numbers were picked randomly untill the required number was reached. The purpose of this sampling technique was to accord a chance to every Design and Technology subject learners to be included in the study and reduce bias in conformity as Ghosh (1992) and Cohen et al (2000) explained that simple random sampling is chosen because it provides for each element in the population an equal chance to be selected as a study sample.

3.11 Research Instruments

Research instruments are tools used to collect data on a specific topic of the study. The researcher used a questionnaire and interview guide to collect primary data to understand the context, inputs, processes and how effectively the Design and Technology subject is being implemented and products of the subject. In this study, questionnaire was used to collect quantitative data from sixty four (64) Design and Technology subject learners and structured interview schedule was used to collect data from ten (10) Design and Technology subject teachers while interview guide was used to collect qualitative data from four (4) head teachers, four (4) deputy head teachers and four (4) heads of practical subjects department of the selected secondary schools, one (1) DESO and one (1) SESO.

3.11.1 Questionnaire for Design and Technology Subject Learners

According to Ghosh (1992: 241) "a questionnaire as a list of questions sent to a number of persons for them to answer." He further discussed that questionnaire secures standardised results that can be tabulated and treated statistically. Kombo and Tromp (2006) argued that questionnaires are better research instruments because they save time, uphold respondents' confidentiality and enables the researcher to collect data from a large sample and diverse regions. The questionnaire that was used in this study had closed-ended questions. The closed-ended questions were meant to collect categorised data where the respondents had no freedom to express their own judgment. A questionnaire as a research instrument gathers data over a large sample (Kombo and Tromp, 2006), thus to collect data from learners, a questionnaire was used. Closed-ended questions were used on learners of Design and Technology subject to assess the context, inputs, process and products of the subject.

The study used questionnaires which were distributed to 64 learners. The learners are the recipients and beneficiaries for implementing Design and Technology subject in schools. Thus, they have the knowledge of the environment in which teaching and learning of the subject takes place, resources used, and take part in the teaching learning processes including in assessment of their understanding of the learnt content, the learners have to see, touch or manipulate the tools and other equipment in the teaching and learning process, thus learners were able to answer research questions such as; how conducive is the infrastructure of the Design and Technology subject in influencing effective implementation?

Furthermore, learners take part in the teaching and learning process and assessment of Design and Technology, hence they were able to answer research question; How adequacy are the teaching and learning resources of the Design and Technology subject? How adequacy is the teaching, learning and assessment processes of Design and Technology subject? To what extent are the knowledge and skills of Design and Technology subjects are developed and applied by learners? During and after learning design and technology, learners are expected to acquire knowledge and develop practical skills. Thus, they were able to answer research question. Using the five point likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree), questionnaires were administered to each respondent in the same way and minimize the role of the interviewer. Furthermore, results collected by this tool were easily objectively compared with responses from other respondents.

3.11.2 Interview Guide for Head Teachers, Deputy Head Teachers and Practical Heads of Department and District Education Standards Officers

An interview guide was used to collect data from the head teachers, deputy head teachers and practicals heads of department. According to McMillan and Schumacher (2006), interviews and responses to questions are used to obtain data from participants about how they conceive and give meaning to their world and how they explain events in their lives. This helped uncover how the head teachers, deputy head teachers and practical subjects heads of department feel, think, and make sense of their experiences regarding the implementation of the Design and Technology. Interview guide was also used to collect data from the District Education Standards Officer

(DESO) and Senior Education Standards Officer (SESO) for practical subjects in Central province.

Interview guides are used because they give high response rates. Thomas (2009) argued that an interview guide provides an enormous deal since they take action to the interviewer in boldly, unlike how they would react to a questionnaire. The data collection task was undertaken by interviewing four (4) head teachers, four (4) deputy head teachers and four (4) practical heads of department from each selected secondary school, one (1) DESO and one (1) SESO. Thus four (4) interviews were conducted per secondary school and one (1) interview at the DEBS office and one (1) at Provincial Education Office of Central province. The interviews helped produce comparable data from the head teachers, deputy head teachers, practical subjects' heads of department, DESO and SESO but emphasis was uniform interpretation rather than uniform wording, which eventually allowed gaining access to insight information.

The head teachers and deputy head teachers are financial controllers at the school level. They are responsible for the release of funds to procure the teaching and learning resources and ensure favorable teaching and learning environment. Thus, they were able to answer research questions; how conducive is the infrastructure of the Design and Technology subject in influencing effective implementation? Furthermore, head teachers, deputy head teachers and practical heads of department by nature of their responsibilities, are standard officers, hence they were able to answer research question; How adequacy are the teaching and learning resources of the Design and Technology subject? How adequacy is the teaching, learning and assessment processes of Design and Technology subject? The DESO for Kapiri Mposhi district and SESO for practical subjects are standards officers who ensure effective implementation of the subject only responded to two research questions; how conducive is the infrastructure of the Design and Technology subject in influencing effective implementation? How adequate are the teaching and learning resources for the Design and Technology subject? According to Ezeh (2015), the data collected a fresh and for the first time happens to be original. Thus, the researcher asked the questions orally to the participants, transcribed and recorded their responses.

3.11.3 Interview Guide for Design and Technology Subject Teachers

An interview guide with open ended questions was used to collect data from Design and Technology subject teachers. According to Kombo and Tromp (2006: 94), Semi-structured or unstructured interviews allow flexibility in questioning. This was used to ten (10) Design and Technology subject teachers to help assess the context, inputs and processes of Design and Technology. It also gave in-depth information on the assessment of infrastructure, resources, teaching and learning and knowledge and skills learners acquire and develop from Design and Technology subject. Semi structured interviews therefore enabled the researcher gather complete and detailed understanding of the environment in which the teaching and learning of the Design and Technology subject takes place, teaching and learning resources, teaching and learning process and the acquired knowledge and practical skills of the subject. In addition, it is a time saving because respondents were simply answering what they were asked by the researcher as Sahaya (2017) indicated that semi structured interviews are used in a research where researchers are looking for facts. Thus interview guide enabled the researcher gather qualitative data from the Design and Technology subject teachers.

Design and Technology subject teachers are the implementers of the subject. Thus, they have the knowledge of the environment in which teaching and learning takes place, resources used, and take part in the teaching and learning processes including in assessment, thus used semi structured interviews, Design and Technology subject teachers were able to answer research questions such as; How conducive is the infrastructure of the Design and Technology subject in influencing effective implementation? Furthermore, teachers take part in the teaching and learning process and assessment of Design and Technology, hence they were able to answer research question; How adequacy are the teaching and learning resources of the Design and Technology subject? How adequacy is the teaching, learning and assessment processes of Design and Technology subject? To what extent are the knowledge and skills of Design and Technology subjects are developed and applied by learners?

3.12 Observation Check List

An observation checklist is a research tool used to systematically record observations and data about a particular subject, process, or situation. The observation checklist has listed items that the researcher is looking for in the context of the study (Ghosh, 1992; Sahaya and Selvam, 2017). The observation checklist contains specific aspect in which the observer has to concentrate and collect the information. This research tool helps ensure that important details are not overlooked and provides a structured data collection framework.

In assessing the availability of the teaching and learning materials of the Design and Technology subject requires a comprehensive observation checklist. Thus, with the use of the observation checklist, observation becomes more accurate. In this study, the researcher used the observation checklist to determine the availability of the equipment, machineries and tools for carpentry and joinery, metal and fabrication, building and plastering, and graphical communication to establish the adequacy of the teaching and learning materials for the subject.

3.13 Validity and Reliability

Research findings are valid if the research carried out reflects and brings out the exact information the researcher intends to bring out. In order to validate findings in this study, the researcher asked for permission from the respondents to record some of the interviews to counter-check some of the information given but it was not a must for respondents to have the interviews recorded. The researcher was able to compare the findings from the interviews and questionnaires in order to check whether the data represented the topic under study. Mulenga (2015) explained that validity is the degree to which results obtained from the analysis of data represent the phenomena under study. The validity for this study was achieved through the use of different data collection method and respondents, known as triangulation. Patton (1990) supported triangulation by expressing that when methods are combined inconsistencies are taken care of thus valid and reliable data is gathered.

Mugenda and Mugenda (1999) explained that reliability is the degree to which a research instrument yields consistent results or data after repeated trials. For this study, some questionnaires and interview guide were piloted in selected schools in Kapiri Mposhi district to assess whether the questionnaires would yield the desired responses. This was done by piloting twenty five (25) questionnaires with grade eleven (11) and interviewed three (3) Design and Technology subject teachers at secondary school A. The exercise helped to check if the questions phrased could draw a response from the respondents and participants and if the sentences read well, as well as transmitting the same message to the respondents. After the piloting exercise, the questionnaire and interview guide were evaluated and corrections were made to develop good research instruments.

3.14 Trustworthiness of the Research Instruments

Trustworthiness builds on the credibility of the research findings' descriptions, conclusions, explanations, and interpretations. According to Lincoln and Guba (cited in Creswell, 2014: 224) and Rule and John (2011:107), there are many ways of establishing the "trustworthiness" of a study's findings, and they are listed as "credibility, transferability, dependability, and confirmability." McMillan and Schumacher (2001) discussed that trustworthiness of a study is the level of confidence in results collected, interpretation, and approaches used to ensure the quality of a study. It also refers to how interpretations and concepts reveal mutual meanings between the participant and the researcher. Trustworthiness in this study was established by credibility, dependability, transferability and confirmability.

3.14.1 Credibility

Credibility is the self-assurance that can be placed in the truth of the research findings. Credibility helps to establish if the research findings represent plausible data obtained from the respondents and the correct interpretation of the participants' original views. Triangulation uses several approaches or data sources in qualitative research to develop a complete appreciation of occurrences (Patton, 1999). Triangulation was used as a research strategy to test validity through converging information from different sources to ensure credibility. The study triangulated with the type of respondents who included head teachers, deputy head teachers, practical subjects' heads of department, teachers, leaners, ESO and DESO. Credibility was also achieved in this study by conducting interviews, audio recording of the interviews, and confirming evidence with respondents by allowing them to review the transcripts, the use of direct quotations of participants in the presentation of findings to enhance respondents' meaning, and teacher debriefing by allowing an independent researcher to review raw data.

3.14.2 Transferability

Transferability implies how the qualitative researcher demonstrates that the study findings apply to another similar study area, populations and phenomena should produce the same results. Study findings can be transferred to other environments or settings with other participants. The transferability of the findings is the extent to which they can be applied in other contexts and studies. According to Davis (1995), transferability can be enhanced by providing what is often referred to as thick description: giving enough details for readers to decide for themselves if the results are transferable to their contexts. Thus, transferability in this study was achieved through providing detailed contextual background information and the selection of participants such that they enhance information for the research.

According to Guba and Lincoln (1985: 295), transferability is the burden of demonstrating the applicability of one set of findings to another context. Transferability is the extent to which it is possible to generalise from the information and context of the study to broader populations and settings. Transferability was established by describing the research context and the assumptions central to the research so that other researchers who wish to transfer the results to a different context are then responsible for judging how sensible the transfer is. Thus transferability was established by providing readers with evidence that the research findings could apply to other contexts, situations, times, and populations through transcribed responses from the research participants. Thick descriptions was also used for data to be transferable, thus by providing thorough and detailed descriptions not only enhanced credibility but also contributed to the transferability of the research findings.

3.14.3 Dependability

Dependability is the consistency and reliability of the research findings and the degree to which research procedures are documented, allowing someone outside the research to follow, audit, and critique the research process (Guba and Lincoln, 1985). To be accepted as trustworthy, data analysis was conducted precisely, consistently, and exhaustively through recording, systematising, and disclosing the analysis methods with enough detail to enable the reader to determine whether the process is credible. Davis (1995) explained that dependability is significant to trustworthiness because it establishes the findings as consistent and repeatable. The researcher therefore verified that the findings were consistent with the collected raw data.

An effective technique for assessing dependability was a dependability audit, in which an independent auditor reviews the researcher's activities recorded in field notes, archives, and reports. This audit aimed to test how the standards of credibility and transferability have been followed. If only the researcher does not maintain any audit, dependability cannot be assessed. Hence, consequently, the dependability and trustworthiness of the study are diminished. In this study, participants' dependability were achieved by engaging in a debriefing process with an independent researcher on the research process, maintenance of audit trails, and including in the study a detailed description of the study steps taken from the start of the research to the reporting of findings, such as examination of results, transcripts of interviews and audio tapes of the interview will be done. In this study, the face to face interviews were recorded and transcribed so that a thick description would be given while embodying the methodology used. This research included description of the research methods so that the findings would be dependable. Furthermore, a dependable action and analysis method was employed to ensure dependability of the research findings.

3.14.4 Confirmability

Confirmability is determined by whether another research could confirm the study's results following the data's evaluation (Guba and Lincoln, 1985: 296). In this study, the research process was double checked conducting confirmability audit to ensure the rules of the discipline were followed accurately. This is also called consistency, which is the alternative to reliability and refers to the extent to which the findings are consistent if the study is repeated in similar contexts or with the same subjects (McMillan and Schumacher, 2006). Confirmability is the degree to which other researchers could confirm the study's findings.

Lincoln and Guba (1985) pointed out that confirmability is also established when credibility, transferability and dependability are established. An audit trail highlighting every step of data analysis was followed. This was done by detailing the process of data collection, data analysis, and interpretation. Conformability is the last criterion of trustworthiness that a qualitative researcher must establish. This criterion concerns the confidence level that the research study's findings are based on the participants' narratives and words rather than potential researcher biases. Confirmability was used to verify that participants shaped the findings reflected in the study. The use of triangulation by employing multiple data sources (interviews and questionnaires) and participants to ensure consistence of the research findings from diverse sources strengthened the confirmability of the interpretations of the findings.

3.15 Data Collection Procedure

Before proceeding to the field, permission was obtained upon getting an authorisation letter and ethical clearance from the University of Zambia. Before the research began, permission was obtained from the Provincial Education Office (Central province) and District Education Office (Kapiri Mposhi). Consent and an explanation of what the study was all about were sought from respondents. The appointments were scheduled with respondents to notify them and request permission to conduct the study in their schools and workstations, as well as request their consent.

3.16 Data Analysis

Data analysis refers to "examining what has been collected in a survey or experiment and making deductions and inferences" (Kombo et al., 2000:117). Kombo explains that data analysis involves uncovering underlying structures and extracting important variables. The researcher's choice of data analysis began during data collection. Data analysis involves analysing raw data to make conclusions about that information. Data analysis is essential in research because it makes studying data much simpler and more accurate. It helps the researchers straightforwardly interpret the data so that researchers don't leave anything out that could help them derive insights from it. All the data collected were analysed both quantitatively and qualitatively.

3.16.1 Quantitative Data Analysis

Data collected through questionnaires were analysed using descriptive analysis with the use of Statistical Package for Social Sciences (SPSS) software. Quantitatively, all questionnaire items were organised, quantified, categorised and then subjected to statistical analysis. The data analysis for the study was carried out using SPSS software to generate and present descriptive statistics, which were displayed in tables. The normality of continuous variables was checked visually using pp plots to determine if the data followed a normal distribution. For continuous variables like age, which did not follow a normal distribution, the Mann-Whitney test (ranksum test) was used. This test helped summarise the data by reporting the median value along with its associated interquartile range (IQR), providing a clear picture of the central tendency and variability.

Cross-tabulations were conducted for categorical variables to compare levels of agreement (agree, strongly agree, disagree and strongly disagree) when examining whether adequate teaching and learning materials were available, the responses were summarised and reported as proportions. The results were presented in tables for easy interpretation and comparison. Additionally, the weighted mean was calculated to measure overall perceptions on specific questions, with results interpreted based on whether scores fell above or below the weighted mean. The weighted mean was obtained by averaging the responses and dividing by the total number of questions. This mean was then used as a decision criterion. Scores below the weighted mean were interpreted as indicating a low perception of the issue, while scores above the mean indicated a high perception among the respondents. This approach helped clearly identify trends and levels of agreement within the data.

3.16.2 Qualitative Data Analysis

The data analysis from the interviews followed a thematic analysis. The researcher transcribed all interview responses from the respondents to make descriptive representations of the findings that emerged from the study. Data analysis in qualitative studies help to inspect, clean, change, and model data to discover essential data, informing conclusions, and support decision-making (Ghosh, 1992, Sahaya, 2017., Kombo and Tromp, 2018). The researcher documented and recorded the responses to avoid any loss or distortion of qualitative data. Thus, the researcher audio recorded and transcribed the interviews soon after the data collection began. This enabled the researcher to familiarise with the data while considering possible ways it would be analysed and reported.

Once all transcriptions were done, the researcher did all the analysis manually, using the constant comparative method (Maykut and Morehouse, 1994; Neuman, 2003; Strauss and Corbin, 1998). Neuman (2003) explained that the constant comparative method involves mainly making three passes through the data. The first step (open coding) involved carefully reading through the data to identify recurring themes or categories, labeled as *codes*. This step helped the researcher start categorising the data and identifying initial patterns. The second step (Axial Coding) involved reviewing the data again to explore the relationships between the categories identified in the open coding stage. This stage helped the researcher group the categories into major and sub-categories and understand how they are connected. In the final step (Selective Coding), the researcher focused on synthesising the themes and categories into a cohesive narrative or framework. This step helped to determine how all the themes or categories fit together and relate to the overarching research questions or objectives. This process could be visualized as in figure 3.2

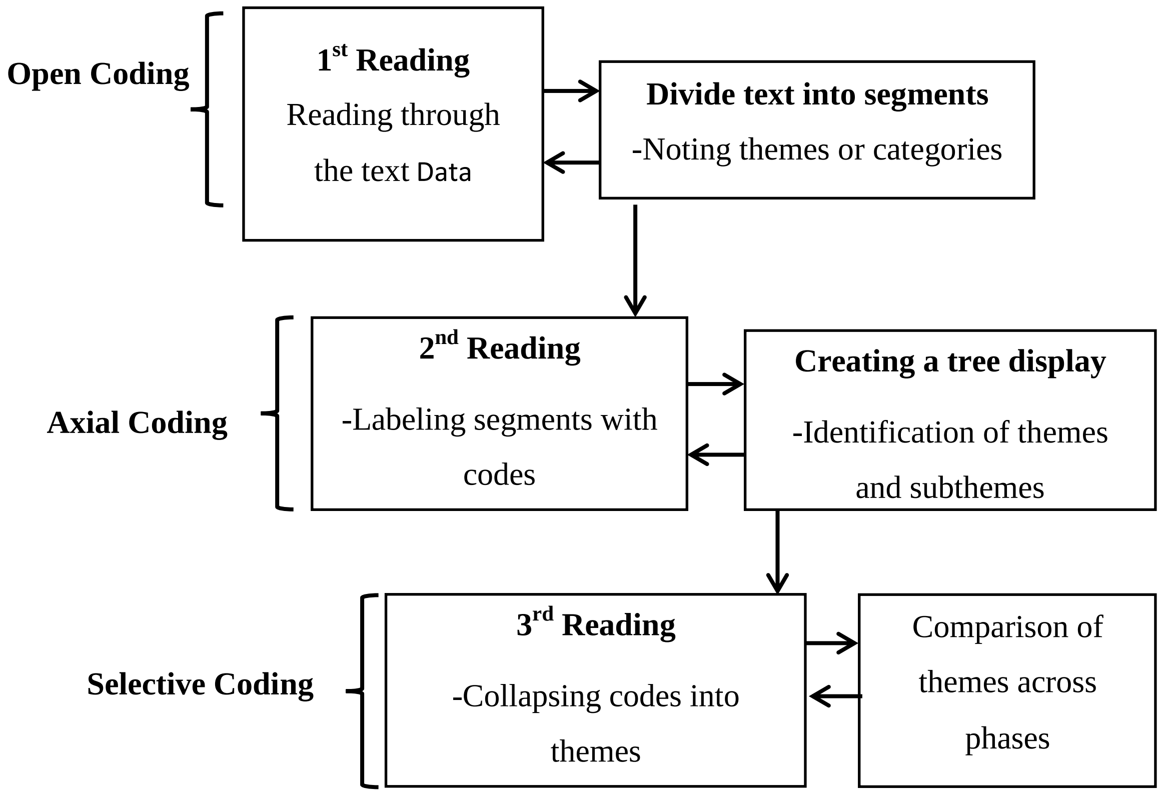

Figure 3.2: Visual model of the Constant Comparative Method of Qualitative Data Analysis

Source: *Newman, 2003*

Each transcript was thoroughly reviewed multiple times. This repetitive engagement allowed the researcher to immerse in the data, making it possible to identify recurring themes and patterns. Through careful reading, the researcher began relating the identified themes. These themes served as a foundation for organising the presentation and discussion of results in the study. To substantiate findings, the researcher incorporated verbatim quotes from participants. These direct quotes provided evidence for the themes, enhancing the credibility and authenticity of the analysis. The researcher searched for commonalities or patterns in the data. These patterns were crucial in grouping similar responses and understanding overarching trends or phenomena. Moving beyond a descriptive summary of the data, the researcher interpreted the meanings underlying the patterns. This step transformed empirical observations into insights, connecting the data to the research objectives and theoretical framework. This approach ensures that the analysis was both systematic and grounded in the data while allowing space for deeper interpretation and meaning-making.

3.17 Research Ethical Considerations

Wellington (2000) discussed that an ethic is a moral principle or a code of conduct that guides people’s actions. Considering the significance of ethical issues in every research, responses from respondents in this study were treated with maximum confidentiality as the data was used purely for academic purposes. The respondents in this study were head teachers, deputy head teachers, practical subjects’ heads of department, Design and Technology subject teachers and learners from the selected secondary schools. The researcher obtained the ethical clearance with reference number HSSREC-2023-SEP-22 from the University of Zambia to collect data from human beings on the topic: An Evaluation of the Implementation of the Design and Technology Curriculum in Selected Secondary Schools in Kapiri Mposhi District: A Context Input Process Product (CIPP) Evaluation Model. The following were among cardinal things the researcher considered as ethical concerns which were taken into consideration.

3.17.1 Informed Consent

Informed consent is communication between the researcher and the respondent. Informed consent was sought from respondents by informing them about the study and its benefits. It helps guide the respondents in deciding whether to participate in the study or not (Cohen et al., 2007). Permission was sought from the Provincial

Education Officer for Central province and District Education Board Secretary for Kapiri Mposhi for the researcher to freely visit the selected secondary schools and interact with head teachers, deputy head teachers, heads of practical department, Design and Technology subject teachers and learners, Senior Education Standards Officer for practical subjects and District Education Standards Officer.

3.17.2 Research Description

The researcher introduced himself to the respondents and then told them the purpose of the study so that they could be clear about the study they were going to get involved in.

3.17.3 Risks

The risks associated with participation in the study were minimal. A small risk to them was that some of the interview questions were likely to make them feel uncomfortable. However, they were guided to skip uncomfortable questions and continue with other questions.

3.17.4 Benefits

There were no direct benefits to respondents and participants for participating in the study. However, the information they provided might enrich the knowledge on the effective implementation of Design and Technology in secondary schools in Zambia and beyond. Respondents were therefore told that their constructive contributions to the study would bring suggestions to improve the implementation of the subject in secondary schools and benefit their children and future generations.

3.17.5 Anonymity and Confidentiality

The respondents were asked to participate in the study in an anonymous manner because of the practices done by them. Therefore, all respondents were told not to write any name on the research instruments, for no name of the respondent or school were expected to be mentioned in the study, and every response concerning the study would be treated with a high level of confidentiality besides being used only for the study.

3. 17. 6 Voluntary Participation

The respondents were informed that their participation in the study would be completely voluntary and that they were expected to feel free to refuse or withdraw from the study at any time.

3.18 Summary

Chapter three presented the research paradigm, ontology and epistemology, research design and mixed research approach, study area, target population, sample size, sampling techniques and data collection instruments. Validity and reliability, trustworthiness of the research instruments, data collection procedure, data analysis, and ethical considerations were presented and discussed. The subsequent chapter presents the research findings.

CHAPTER FOUR: PRESENTATION OF RESEARCH FINDINGS

4.0 Overview

The previous chapter presented the research methodology that was employed in the study. This chapter presents the respondents' demographic background, including gender and category. It also presented the research findings according to research objectives which were; to evaluate the infrastructure of the Design and Technology subject, to assess the teaching and learning resources of the Design and Technology subject, to establish the adequacy of the teaching, learning and assessment processes in the Design and Technology subject and to analyse the extent to which the knowledge and skills of Design and Technology subject are developed and applied by learners.

The findings of this study were generated through questionnaires administered to Design and Technology subject learners, interviews conducted to head teachers, deputy head teachers, heads of practical subjects department, Design and Technology subject teachers, DESO and SESO. The researcher collected the pictorial information through observation. Data presented in this chapter were also collected through observation. Thus the data was presented in line with the research objectives and emerging themes in order to provide a clear presentation, analysis, and interpretation of the findings. The quantitative and qualitative findings were presented. The quantitative data from the questionnaire were presented first, followed by the qualitative data (transcribed data) from the interviews and pictorial data thereafter.

4.1 Demographic Background of Respondents

According to Dierck (2013), demographic data is information regarding the characteristics of the human population and the information giver. Bio-data was presented in terms of gender, age, and categories of the respondents. This data is important to know more about the information given in the field. Thus, the demographic background of the respondents has been presented in terms of their gender and categories.

The demographic profile of the learners reflects a representation of gender, with girls constituting 58% of the sample and boys 42%. The majority were in Grade 12, indicating they were likely preparing for final examinations. Conversely, teachers were predominantly male (88%), with most possessing at least a bachelor's degree. While a third of the teachers specialised in Design and Technology, the remaining held diverse qualifications in related and unrelated fields, such as Industrial Arts, Physics, and Civic Education. Leadership roles were well-distributed among teachers, with positions such as department heads and head teachers indicating strong administrative oversight in the schools surveyed.

4.1.1 Descriptive Characteristics of Learners

Table 4.1: Descriptive Characteristics of Learners

Variables		**Total**
Age, Median (IQR)	18 (14, 23)	64
	Frequency (%)	
Gender		
Girls	37 (58)	
Boys	27 (42)	64
Grade		
Grade 9	25 (39)	
Grade 12	39 (61)	64

Key: IQR = Inter quartile range

Source: *Field Work, 2023*

4.1.2 Descriptive Characteristics of Teachers

Table 4.2: Descriptive Characteristics of Teachers

Variables		Total
Age, Median (IQR)	45 (36, 52)	24
	Frequency (%)	
Gender		
Female	03 (13)	
Male	21 (88)	24
Qualifications		
Bachelors' degree	10 (42)	
Masters	07 (29)	
Diploma	07 (29)	24
Subject Specialization		
Business studies	01(4)	
Civic Edu & RE	01(4)	
Design and Technology	07 (29)	
English and Geography	02 (8)	
English and History	01 (4)	
Geography and History	01 (4)	
History and Civic Education	01(4)	
History and RE	01(4)	
Industrial Arts	07 (29)	
Mathematics and Geography	01 (4)	
Physics and Chemistry	01 (4)	24
Position		
Deputy Head Teacher	04 (17)	
Standards Officer	02 (8)	
Head of Practical Department	04 (17)	
Head teachers	04 (17)	
Subject Teacher	10 (42)	24

Key: IQR = Inter quartile range, RE = Religious Education

Source: Field Work, 2023

4.2 Presentation and Interpretation of Findings

This section presents the study findings gathered through structured questionnaires and interviews. The findings are organised and interpreted in line with the research objectives. After quantitative data was presented, then it was followed by qualitative data (verbatims and pictorial data).

4.3 The Infrastructure for Design and Technology Subject

It is essential to know the environment or context in which the subject is being implemented to know if it influences the acquisition of knowledge, development of practical skills, and eventually, standards among the learners. Thus the first research objective was meant to evaluate the infrastructure of the Design and Technology subject. This was done by evaluating the adequacy and space of the workshops and classrooms for the Design and Technology subject in schools that offer the subject. This research objective was attended to by the following research question; *How conducive is the infrastructure of the Design and Technology subject in influencing effective implementation?*

4.3.1 Adequacy of Infrastructure for Design and Technology Subject in Schools

Learners revealed a concerning picture regarding the infrastructure provided for the Design and Technology subject in schools. The findings indicate a lack of adequate workshops, as reflected by a low mean score of 2. This inadequacy directly impacts practical lessons, which are core to mastering the subject. Similarly, the limited space in both workshops and laboratories was highlighted as a significant issue, as these facilities could not accommodate all learners effectively, resulting in low perception score (mean = 2). Interestingly, perceptions about classroom adequacy were highly positive, with a mean score of 4. Learners believed the classroom spaces could sufficiently support their learning, though with limitations in resources for hands-on activities. A critical revelation was the absence of libraries, as unanimously reported by all learners (mean = 5). This gap limits access to supplementary resources and underscores the lack of holistic academic infrastructure, which is essential for fostering independent learning.

Table 4.3: Perceptions of learners on the Infrastructure for the Design and Technology Subject in Schools

Items	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	σ	Decision
We have enough workshops for DT	19 (29.69)	31 (48.44)	11 (17.19)	2 (3.13)	1 (1.56)	1.984	0.864	Low Perception
We do not have enough laboratories	-	-	-	21 (32.81)	43 (67.19)	4.672	0.473	High Perception
We have enough classrooms for DT	-	-	-	37 (57.81)	27 (42.19)	4.422	0.498	High Perception
Library is not available	-	-	-	-	64 (100)	5	0	High Perception
Spaces in the workshops accommodate all learners	06 (9)	45 (70)	02 (3)	08 (13)	03 (5)	2	1	Low Perception
Spaces in the laboratories for DT do not accommodate all learners	41 (64)	08 (13)	-	06 (9)	09 (14)	2	2	Low Perception
Spaces in the classroom for DT accommodates all learners	-	-	02 (3)	13 (20)	49 (80)	5	5	High Perception
Spaces in the school library does not accommodate all learners	-	-	-	28 (44)	36 (56)	5	1	High Perception

Key: *SD = Strongly Disagree, D= Disagree, N= Neutral, A = Agree, SA= Strongly Agree.σ = Standard deviation*

Decision (weighted average) $=\frac{29.672}{8} = 3.709 = 4$

4.3.1.1 Adequacy of the Workshops for the Design and Technology Subject

The participants were engaged in interviews to elicit their perspectives on the adequacy of infrastructure dedicated to the subject of design and technology. Through these interviews, it became evident that the participants deemed the workshops designed for Design and Technology inadequate. This was evidenced by the responses below:

> *For the workshops, in terms of if you want to carry out practicals, with learners; the rooms are not adequate because the rooms that were meant for workshops were turned into classrooms. So we only have one workshop at now which is working as a work room and we have a lot of things to keep as items we make as artifacts as well, which make it inadequate for the teaching and learning of Design and Technology subject. We do not have adequate rooms for Design and Technology subject for us to do practicals, so I can say the rooms or work rooms are not adequate for the learners. The dimensions for the rooms are just very okay, but the room that was meant for the workshop has been turned into classroom, hence we only remained with one workshop against all the components of the subject. The same room we are supposed to keep our materials for practicals is the same room that the children have to use for learning, which is what makes not to be adequate for teaching and learning as well as practicals to be conducted. We do conduct practicals, but the space is not adequate to accommodate learners and other things inside (*TR2 A).

Teachers expressed the views that the workshops designated for the Design and Technology curriculum were insufficient to adequately impart practical skills to learners. This viewpoint was articulated through the following remarks made during the interviews:

> *We have the workshop for the subject. But I feel it is not conducive to teaching and learning about Design and Technology. It was initially a classroom which was later turned into a workshop. I therefore feel the room was not meant for a practical subject like Design and Technology subject. Therefore, I would say it's not so adequate for the teaching and learning of the subject. The classroom is small, so I would not say the space is enough because imagine all what our learners come up with are kept in the same room. I wish these products or artifacts that our learners come up with have a spare room they are kept, and imagine it is the same room the teaching and learning of the*

*subject take place. What I'm trying to say is that the room is so congested (*TR1 C).

The other teacher from school D also indicated that:

> *The way I see it, we do not have a workshop fit for teaching and learning the components of the design and technology subject in school. Before the introduction of the Design and Technology subject at this school, the workshop was meant for a single component of the subject, which is wood work. I'm saying so because of the availability of the tools for wood work found in the workshop, most of the tools are for wood work there. Now, the workshop is not adequate. By not adequate I simply mean that it is very small for all the 3 components of the subject. Imagine, it is the same workshop where the teaching and learning of the components of the Design and Technology subject take place, it is the same workshop where we store the artifacts, it is the same workshop the benches are. I can simply say the workshop do not have enough space for an effective teaching and learning of the practical subject (*TR3 D).

The majority of heads of practical subjects department, as revealed through interviews, the inadequacy of workshops for the Design and Technology subject in schools. This consensus was supported by several key indicators that emerged during the interviews, serving as evidence of the perceived insufficiency of workshop facilities for the subject.

One of the heads of practical subjects department felt that:

> *For Design and Technology subject, we have just transformed one classroom into a workshop; therefore we just improvised the room for the subject. The design of the school was not meant for Design and Technology subject. It was meant just for ordinary school because where the school is supposed to have Design and Technology subject, the workshops should be designed for that. Now this secondary school was not designed for that. But all the same plans are underway to put up a workshop for learners who are doing Design and Technology subject (*HoD B).

The other head of practical subjects department explained that:

> *First of all, we need to understand that the Design and Technology subject has several components: bricklaying and plastering, metal and fabrication, carpentry and joinery, graphical communication and electrical installation. In order for the subject to be taught well, each of the components mentioned should have atleast its own workshop*

> *with required tools and other resources. Therefore, what I can say is that all these components of Design and Technology subject are taught in the same workshop, and when I look at the workshop that we have I feel it is not adequate for the subject. The space is too small and congested. I think we need a bigger workshop if the subject is to be effectively taught in school (*HoD D).

The Head teachers were interviewed to get their perspectives on the adequacy of workshops for teaching the Design and Technology in schools. This provided valuable insights into the views and experiences of head teachers regarding the facilities available for Design and Technology education. During the interview, the Head teachers expressed their views that the workshops for teaching Design and Technology subject were in adequate. This viewpoint reflects the head teacher's assessment of the existing workshop facilities based on their observations and experiences within the school environment. For instance, one head teacher had the following to say:

> *We can say the workshops for the Design and Technology are not adequate. We only have one workshop for Design and Technology subject. Now, we have grade 8-12 leaners taking Design and Technology subject. I therefore feel that one workshop we have is not adequate against all learners in school (*HTR B).

The other Deputy Head teacher from school D submitted that:

> *The workshop is there, but it was not meant for the Design and Technology subject. It is a classroom that was just turned to a workshop. On the workshop, I can simply say that it is just oke, only that the workshop is too small for the practical subject. All the same the teaching and learning of the Design and Technology subject go on well. But what I can say is that the space is too small inside and we are in the process of trying to put up a workshop with the recommended dimensions. This will motivate of course both teachers and learners of the Design and Technology subject. In short, the space in the workshop is not enough, it is a challenge because it is in the same space the teaching and learning of the subject takes place. Besides this, the tools, and other resources are kept there including what learners come up with or the artifacts. So, I would not say that the space in the workshop is adequate when I look at how squeezed thing are inside (*DHTR D).

The Education Standards Officers (ESOs) were also interviewed to establish their views on the adequacy of the workshops for teaching and learning Design and Technology subject in schools. The responses from the interviews showed inadequacy of workshop facilities for the subject in schools. This was evidenced by the following expressions during the interview:

> *In terms of adequacy, I think they are fair as the case is in most of the practical subjects. They may have the basic workshops of the practical subjects. But I strongly feel that they are not adequate as required in an ideal set up (*ESO 2).

The responses gathered from the interviews provide valuable insights into teachers', heads of practical subjects department, head and deputy teachers' and standards officers' perspectives regarding the adequacy of workshops for the Design and Technology education. It becomes evident from their viewpoints that the existing workshop facilities as inadequate.

4.3.1.2 Adequacy of Space in the Workshops for the Design and Technology Subject

The participants were asked to find out about the adequacy of the space in the workshops for the Design and Technology subject. The data collected through interviews shows inadequate spaces in the workshops for the Design and Technology subject in secondary schools where the subject is taught. The inadequacy of space was felt by most of the participants. For example, one of the teachers from school B indicated that:

> *Since we only have few classes, each time a class comes into this single room, the space is not enough because we keep on changing since they are things that do not go well, you will find that others which are for system technology are found in the same room. Only the children who move out of the workshop and come back, but things are just kept under one roof. The space is not enough and we have decided that whenever the learners make*

*a product, we allow them to buy so that we can create room and then the money that comes out there is used to buy other materials for other projects to be used, that is how we have tried to maintain the space in the small classroom turned into a workshop for Design and Technology subject (*TR1 B).

Figure 4.1: Design and Technology Workshop - Secondary School B

Source: *Field Work, 2023*

At school B, one teacher was convinced that the space in the workshop was inadequate, he therefore revealed that:

So far, I think this school do not have a standard workshop, just a make shift that we have since I came I was just introduced to a workshop which is just a room turned into a workshop, though I believe that there is more to be done. When I look at the standard of the workshop maybe it was meant for a subject possibly wood work, where metal work and graphical communication go on. I do not see much of the metal work tools there, indicating it was meant for wood work. The workshop is quiet big, but by space I mean, there should be some areas designated for different subjects; metal work, wood work and graphical communication, but it is clustered into one area. Nowadays, we do not just teach wood work, metal work and graphical communication, we teach plastic, ceramics, composite materials we call smart materials. There are different materials involved. Now where you have metal work, wood work, it is not enough. That is why the space in the workshop is not enough for me (TR3 B).

One of the HoDs interviewed from school C also said that:

The space in the workshop is not enough for the learners because there are many children who are showing interest in the Design and

*Technology subject, and the workshop is too small to cater to 50 learners per class who are doing the Design and Technology subject. You know Sir! There is an issue of having benches and tools in the workshop, so the workshop itself is not very big. No wonder we have just put them in groups during practicals to carter for everyone or every child who is doing Design and Technology subject. During the time of doing practicals, we put them in groups after doing the normal teaching since the room is too small to carter for every child. The same room is used for other non-practical subject (*HoD C).

Figure 4.2: Design and Technology Workshop - Secondary School C

***Source:** Field Work, 2023*

Furthermore, in trying to justify the inadequacy of the workshops for the Design and Technology subject in secondary schools, one HoD from school C shared that:

*According to my own analysis, the workshop is there at this school, but I feel that it is not very adequate for the teaching and learning of the Design and Technology subject. Due to the inadequacy of the classrooms, other non-practical subjects are taught in the workshop. You would find the other furniture not supposed to be in the workshop is found there. When it comes to space in the workshop, the room is so congested because of the fact that it is in this same room where the teaching of metal work, wood work, electrical and graphical communication takes place. The place is so congested with also what learners make and other resources for the subject. The space is not also adequate as expected on how a standard workshop for the practical subject should look like (*HoD C).

Another Education Standards Officer revealed that:

The space is not adequate. Most of the workshops that we have around the district are classrooms, and a classroom space is not adequate for *workshop's space because once the benches have been put there, it means only a limited number of learners will have to access those working benches. So that hinders somehow the learning in that learners who can access those resources will be limited, and they have to exchange. The situation would have been better if bigger workshops were to be constructed just for that purpose so that when a bigger number of learners goes to the workshops, the teacher will be able to attend to so many at a go (*ESO 2).

It was also established that with the presence of desks, the other information subjects were taught in the same workshop meant for Design and Technology subject as in figure 4.3.

Figure 4.3: Design and Technology Workshop - Secondary School D

Source: *Field Work, 2023*

The responses from the head and deputy head teachers indicated that the space in the workshops for the Design and Technology in schools that teach the subject was inadequate. This is why one head teacher pointed out that:

*We have the workshop in place for the Design and Technology subject. But I would not say that it is adequate considering the number of Design and Technology subject learners that we have. The adequacy in this case can be in terms of how big the room is where the teaching and learning of Design and Technology subject takes place. What I can say is that the room is small and we definitely need atleast a bigger workshop for the subject that can accommodate a bigger number of learners including machines and other artifacts Design and Technology learners come up with (*HTR B).

Another Head teacher from school A lamented that:

> *The space in the workshop is not adequate. It is too crowded because in the very workshop you see activities of wood work, you see activities of metal fabrication, so it is too crowded, and so the space is needed for the subject to be taught well. The rooms that we are using currently, I think the space is not adequate because the machineries are squeezed in one place (*HTR A).

The nature of the workshop where the Design and Technology is taught at secondary school A had limited space as shown in figure 4.4.

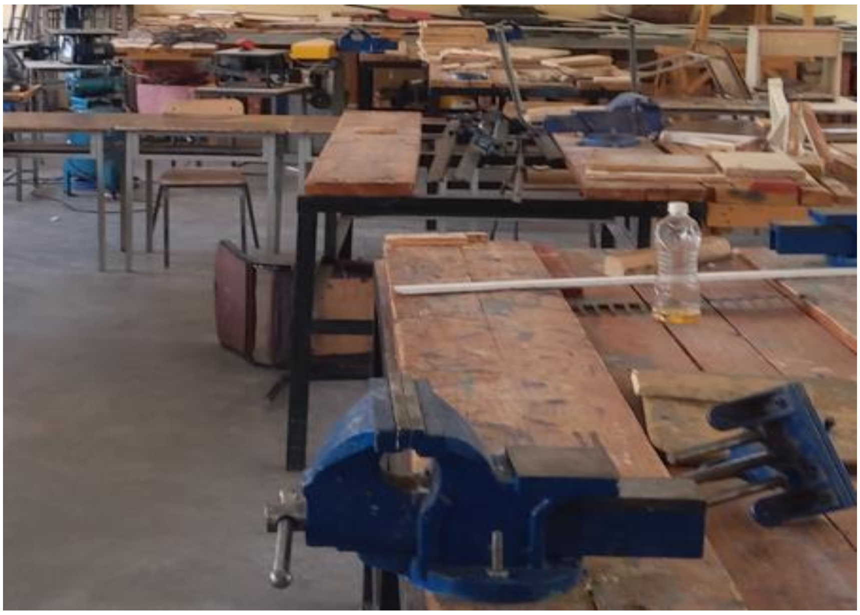

Figure 4.4: Design and Technology Workshop - Secondary School A

Source: *Field Work, 2023*

One of the deputy head teachers was convinced that the space in the workshop for the Design and Technology subject was inadequate. This is why he revealed the following:

> *We have a workshop which was initially a classroom. Now, I would not say the workshop is adequate for Design and Technology subject at this school. The room was not specifically meant for the teaching and learning of the subject. What I can say is that the room is small but even if the room is not enough, the teaching and learning of the subject goes on. Considering the number of components that make up Design and Technology subject, I think the space is not adequate. The teaching and learning resources for all the components are kept in the*

> *same room. You can imagine in a small room is not conducive for the subject to be taught well (D*HTR C).

Another Deputy Head teacher submitted that:

> *I would say that the space in the workshop is not adequate. When I go there, I see areas for each component of the subject congested with what learners for Design and Technology subject come up with which does not look well with me. This you know contributes a lot to the reduction of the space in the workshop because each area has its own things that learners make that also contribute to reduction of the space I think with the component of the Design and Technology subject, I would say the room may not be so adequate, but it is big as it is able to accommodate all the learners. Again the turning of one workshop into a classroom somehow affected the other rooms because all components are now taught under one room and all the resources for all the components and what learners make are kept in the same room. This therefore contributes to the reduction of the space in the workshop (D*HTR B).

It was observed that the workshop at secondary school B was congested, hence space reduction as shown in figure 4.5.

Figure 4.5: Design and Technology workshop – Secondary School B.

Source: *Field Work, 2023*

The Education Standards Officers who were interviewed also revealed the inadequacy of the space in the workshops for the Design and Technology in schools that teach the subject. One of the Education Standards Officers opined that:

> *The nature of the subject needs an environment which has enough space. Now, when you talk of space, it is very inadequate especially with the advent of free education. Free education has brought about*

> *over enrolment, so because of that, the space in the workshops is not adequate (*ESO 1).

4.4 The Teaching and Learning Resources of the Design and Technology Subject

The second research objective was meant to assess the teaching and learning resources of the Design and Technology subject. In order to attend to the research objective, the both the respondents and participants for this study were asked the question; *To what extent are the teaching and learning resources adequate for the Design and Technology subject?*

4.4. 1 Availability and Usage of Teaching and Learning Materials

Learners' experiences with the availability of teaching and learning materials for Design and Technology underscore systemic shortcomings. A significant majority expressed that tools and equipment were inadequate, with learners often waiting for their peers to complete practical sessions before accessing the same resources. This inefficiency, captured in high mean scores for perceptions such as waiting to use the tools (mean = 4) and machinery inadequacy (mean = 4), disrupts the continuity of practical learning. Moreover, textbooks were distributed in groups rather than individually, which limited each learner's access to critical learning resources, leading to a lower perception score of 3. These findings reveal how resource scarcity hampers not only practical skills development but also theoretical comprehension. Table 4.4 presents the perception of learners on teaching and learning materials for design and technology subject.

Table 4.4: Perception of learners on Teaching and Learning Materials for Design and Technology Subject

Items	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	σ	Decision
We are put in groups and wait for the others to use the tools in DT	04 (6)	07 (11)	-	24 (38)	29 (45)	4	1	High Perception
The equipment needed in DT are not adequate	02 (3)	03 (5)	-	38 (59)	21 (33)	4	1	High Perception
We always wait for our friends to use the machineries needed in DT	04 (6)	-	-	28 (44)	32 (50)	4	1	High Perception
DT text books are distributed in groups for us to make use of them during the teaching and learning process	10 (16)	15 (23)	-	29 (45)	10 (16)	3	1	Low Perception

Key: *SD = Strongly Disagree, D= Disagree, N= Neutral, A = Agree, SA= Strongly Agree.σ = Standard deviation*

Decision (Weighted average) $=\frac{15.72}{4} = 3.930$*,= 4*

4.4.2 Sufficient Tools and Machines in the Implementation of the Design and Technology Subject

The data collected from the participants revealed a shortage of necessary tools and machinery essential for the teaching and learning of the Design and Technology subject in schools. One teacher observed the following:

> *We have a challenge when it comes to tools, equipment and machineries. I would say is almost not there especially machinery, we do not have the machinery. The tools are there but they are of substandard, they are there in good numbers, but they cannot perform the tasks children are supposed to perform, they are of low standard. By low standard, I mean tools get wasted instead of the material, making it difficult for learners to use them during practicals. The tools*

> *are not of good quality as they were just donated, that is why they are of low standard (*TR3 A).

Another teacher from secondary school B highlighted a similar concern, stating that *the tools and machines needed for teaching Design and Technology are not enough for our learners to fully engage in hands-on learning activities (TR2 B).*

The reasons given by the participants above shows that the tools and machines required for teaching Design and Technology in schools are insufficient. This indicates that there is a lack of essential teaching and learning resources necessary for conducting effective lessons and practical activities in the Design and Technology curriculum. This was also echoed by one teacher who explained:

> *I think we have a challenge when it comes to resources needed in the teaching and learning of the Design and Technology subject. The tools, equipment and other machines for the subject are not so adequate. The tools and equipment are inadequate; they are there, but not enough for all learners. But when it comes to machinery, we only have 1 welding machine against all the learners in school that take Design and Technology subject. It is a challenge when we need them at the same time. However, timing is made on the timetable to avoid such collision (TR3 D).*

Regarding the inadequacy of tools and machines, the other teacher pointed out that:

> *The workshop does not have the machinery that we usually teach that are covered in the syllabus. Can I even cite an example? If you are talking about lathe machines, mostly the workshop does not have these machines. So, it is difficulty for a learner to know what you are talking about because what I know Design and Technology subject basically depend on hands on and whatever you teach, learners should see what you are talking about in the actual sense than just imagining that this is how it looks like, they should see the actual machinery you are talking about. Mostly, we are having challenges when it comes to machineries and equipment, shortage of tools; some tools are not available (*TR1 C).

In addition to the adequacy of the teaching and learning resources, the other teacher of another school added that:

> *When it comes to tools and machines, I think that is where we have the challenge. There are some equipment which we do not have, but for the tools, these small hand tools, I think we have those. But for the big equipment, that is where we have the challenge, for example lethal machines, bench saws, drilling machines, especially the bench drilling machine we do not have them. I think we have enough hand tools and other equipment. The only challenge we do not have enough machines to carter a good number of learners like the welding machine. We need more of such resources if the subject is to be taught as expected in school. Therefore, to some extent I may say we do not have adequate teaching and learning resources for the Design and Technology subject (*TR1 D).

The lamentation of the other teacher from different schools shows the inadequacy of tools and machines for the Design and Technology subject by saying that:

> *We do not have enough because we only have one, one; one grinder, one circular saw, one driller and one small welding machine. So our interest is to see it that we have enough so that whenever there is work, children should not struggle to keep on asking each other the tools which they are using, so we do not have enough tools so to put it apart from the chisels which are enough, the rest are inadequate. We need enough machines and equipment to enable us to teach learners well because when we lack them it means even the explanation becomes inadequate, but the explanation plus the tools combined can make a child understand the lesson well (TR1 B).*

Figure 4.6 shows the available welding machine at secondary school B.

Figure 4.6: Welding Machine – Secondary School B

Source: *Field Work, 2023*

The other teacher had the following to say:

> *Attention should be paid on this area of materials for the Design and Technology subject. Most of the materials are not available for the subject to be taught well as guided by the 2013 curriculum. Again the few tools are there, but not to the expected standard because they easily worn out. We have a very big challenge there. We have a welding machine, but it give us challenges of up and down during the teaching and learning process, and it is not up to the expected standard. We need an industrial welding machine if the component for metal and fabrication is to be taught well to help our learners have practical skill of welding* (TR2 D).

The revelation from the HoDs indicates the inadequacy of the teaching and learning resources for the Design and Technology subject in school critical in implementing the subject. Hence, one HoD discussed that:

> *When it comes to tools, equipment and machinery for Design and Technology subject, is where we have serious challenges. You know our subject is hands on, all the lessons should have the hands on, but again you will find that maybe you have only one grinder and one welding machine against all learners per grade that is from grade 8-12. Sure! Can you offer proper lessons? Or can you impart surely good knowledge and skills into these learners? It is very difficult. So the tools, equipment and machinery are very inadequate at our school. Schools offering Design and Technology subject is supposed to have surface plainer, not only one welding machine, but we are supposed to have minimum of 10 welding machines with a good number of hand tools and equipment. The ratio of tools with learners is not all that good* (HoD A).

Figure 4.7: Welding Machine – Secondary School A

Source: *Field Work, 2023*

Another HoD from a different school indicated that:

> *For the tools, I think they are not enough to carter for all the children, there are very few tools for Design and Technology subject in the department. Even when we talk about metal fabrication, we only have one welding machine that is to carter for all grades and these other tools are not adequate for the children we are here. But we are buying as a school, but as at now, the tools, equipment and machineries are not adequate for the teaching and learning of Design and Technology subject in school. I can say the materials for teaching and learning the Design and Technology subject are not enough to ensure each child has a hand on type of learning to fully help him or her have the practical experience of the subject. I'm trying share Sir, that we do not have enough tools for the subject (*HoD B).

It was found that at secondary school B, there was inadequacy of tools for the Design and Technology subject as shown in figure 4.8.

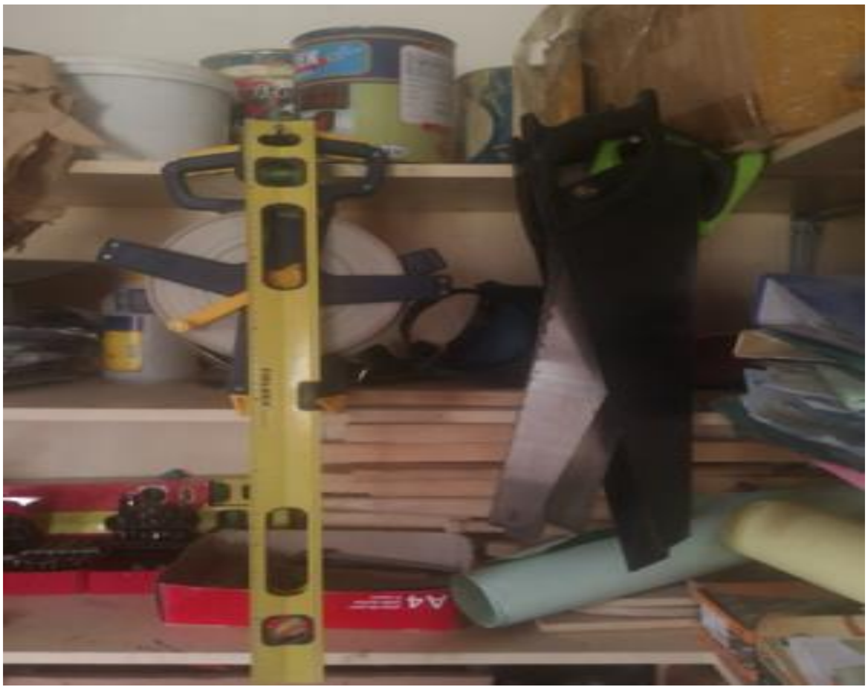

Figure 4.8: Spirit Level and Bench saws – Secondary School B

Source: *Field Work, 2023*

Furthermore, the other HoD of another secondary school pointed out that:

> *There are so many tools that are required because design and technology is a composition of metal fabrication, woodwork, graphic communication and building science that is bricklaying and plastering. So for the tools that are required, we need to have enough wheelbarrows and grinders for metal fabrication. In wood work, we need to have lethal machines and these are big machines that consist of other requirements that are supposed to be present for the learners. Anyway, it is wider on this one (*HoD C).

At secondary school C, inadequacy of the Design and Technology subject was noted as only one machine was found as shown in figure 4.9.

Figure 4.9: Circular Saw for cutting Miters - Secondary School C

Source: *Field Work, 2023*

The recommendation put forth by the other Head of Department (HoD) regarding the provision of necessary tools, equipment, and machines for the teaching and learning of the Design and Technology subject highlighted a critical shortage of resources for the subject by saying that:

> *So, I would say we need more teaching and learning materials for metal fabrication and electrical components of the subject for the benefit of the learners. I would recommend the school have in place the welding machine, tools, and other equipment for metal and fabrication so that the subject can be effectively taught. You know, these learners need to have hands on type of learning in order for them*

to develop real practical skills and enable them become self-reliant in future (HoD D).

The responses from both head and deputy head teachers underscores a common concern that schools lack sufficient resources crucial for effective teaching and learning in the Design and Technology subject. One of the head teachers articulated this shortage of resources, noting that they face a shortage of essential resources for the Design and Technology subject. This statement reflects the broader challenge encountered by schools in providing adequate resources to support the teaching and learning requirements of the Design and Technology curriculum. It implies a deficiency in the availability of tools, machinery and materials essential for delivering comprehensive education in this subject area. This is why one of the head teachers indicated that the school had shortage of resources for the subject by saying that:

> *In terms of the teaching and learning resources for the Design and Technology subject, we are not adequately equipped as a school. The subject has carpentry and joinery, metal and fabrication, electrical and graphical communication. We have more tools for carpentry and joinery, and we are planning now to procure other materials for these other components. I'm not saying that these other areas don't have, what I'm trying to say is that the resources for the subject are there, but not adequate and balanced in all components of the subject (*HTR A).

The inadequacy of the tools for the Design and Technology subject was also noted at secondary school D as indicated in figure 4.10.

Figure 4.10: Table Circular Saw – Secondary School D

Source: *Field Work, 2023*

The other head teacher from another school revealed a shortage of the tools and machines needed in the teaching and learning of the Design and Technology subject in secondary schools by indicating that:

> *I think with us here, the teaching and learning resources for Design and Technology subject are there, but I would not say they are adequate or enough because there are certain components of the subject that do not have enough tools, equipment and machines, for example we have only one welding machine which I would not say it is enough considering the number of learners that take Design and Technology subject here. In short, I can only say that the resources are there, but they are not adequate. I would recommend the provision of other machines that we cannot afford as a school using the school grant, like the like the industrial welding machine, modern electrical tools and equipment (HTR B).*

Figure 4.11 shows a welding machine secondary school D has for the Design and Technology subject.

Figure 4.11: Welding Machine – Secondary School D

Source: *Field Work, 2023*

At secondary school B, the tools were not adequate to carter for all the Design and Technology subject learners. Figure 4.12 shows the available saws at the school.

Figure 4.12: Bench saws – Secondary School B

Source: *Field Work, 2023*

The insights provided by Education Standards Officers shed light on a prevailing issue: schools offering the Design and Technology subject lack the necessary tools and machinery for effective imparting of knowledge and skills. It is evident that schools are facing a deficiency in the tools and machines necessary for delivering quality education in the subject of design and technology subject. One Education Standards Officer articulated this concern by stating:

> *The tools, equipment and machineries are very inadequate as I said earlier on, they may have the basics tools, even in cases where they have the basics, they are not adequate because of the over enrolment. Of course there may be some exceptional schools that have everything and all the necessary equipment, but these are very few. The general view is that our schools are inadequately, can I say in term of equipment, they do not have enough equipment. The learners may not develop practical knowledge and skills because Design and*

*Technology is a practical subject, hence it requires hands on. So if we do not have the equipment for the learners to have hands on activities, definitely they will not acquire the practical skills because it is like even when they do the practicals, it is not adequate practice because of the lack of equipment or inadequate equipment. They may not be adequate for their future (*ESO 1).

The planes that were found at secondary school C were not adequate and not in good condition because of the missing parts as shown figure 4.13.

Figure 4.13: Smoothing and Jack Planes – Secondary School C

Source: *Field Work, 2023*

The observation made by the other Education Standards Officer regarding the shortage of teaching and learning resources for the Design and Technology subject is indicative of a significant concern in the implementation of the subject. Thus, the standards officer revealed that:

The tools, equipment and machineries are not adequate. It is a relatively new subject area as I area indicated, so for schools that were never supplied with tools for example that were initially not meant to have Design and Technology subject, now because of the demand, the subject has been introduced in those schools, so you will find a number of tools, equipment and machines are still not available, for example, we had one school where they were taking TEVETA *exams, so there were a number of tools that were missing especially for Carpentry and Joinery, they would have a few here and there, but carpentry tools were lacking (*ESO 2).

These statements above underscore the overarching challenge that secondary schools face in meeting the requirements of the Design and Technology curriculum implementation. It suggests a shortfall in the availability of tools, machinery, and equipment crucial for facilitating hands-on learning experiences and practical skill development in learners.

Secondary school B was found that it had inadequate carpentry tools as shown in figure 4.14.

Figure 4.14: Tenon Saws – Secondary School B

***Source:** Field Work, 2023*

Furthermore, secondary school D had more tools as compared to secondary school B. However, they were not adequate for all the learners of the Design and Technology subject as depicted in figure 4.15.

Figure 4.15: Ternon saws – Secondary School D

Source: *Field Work, 2023*

Table 4.5: Observation Checklist

The observation checklist enabled the researcher to systematically document the availability and adequacy of resources across different schools. The use of codes facilitated efficient data organization and analysis, allowing for comparisons and insights into resource provisions. By employing observation as a means of assessment, researchers gathered firsthand information on the tangible resources available to support Design and Technology education. This approach provided valuable insights into the practical realities of resource provision within educational contexts, shedding light on areas of deficiency or inadequacy that might impact teaching and learning experiences. The observation was used to assess the adequacy of tools, equipment and machines for the subject of design and technology. The schools were coded with letters A-D. The unavailability of the tools was marked with a cross and inadequacy with tick as shown in Table 4.5.

Table 4.5: Observation Check List

Resources	A	B	C	D
Angle grinder	✓	✓	X	X
Domestic welding machine	✓	✓	✓	✓
Industrial welding machine	X	X	X	X
Domestic regular saw	✓	✓	✓	✓
Metal bench vice	✓	X	X	✓
Measuring tapes	✓	✓	✓	✓
Steel rule	✓	✓	✓	✓
Try square	✓	✓	✓	✓
Hand shield	X	✓	X	✓
Flip front welding googles	✓	✓	✓	✓
Tin snips	✓	X	X	✓
Drill bits	✓	✓	✓	✓
Files	✓	✓	✓	✓
Bench wood vice	✓	✓	✓	✓
Hand vice	✓	X	✓	✓
Sash clamp	X	X		X
Rip saw	✓	✓	✓	✓
Copying saw	✓	✓	✓	✓
Jack plane	✓	✓	✓	✓
Ten saw	✓	✓	✓	✓
Instant grip	X	X	X	X
Wood chisel	✓	✓	✓	✓
Claw hammer	✓	✓	✓	✓
Gentleman’s saw	X	X	✓	X
Carpenter’s saw	✓	✓	✓	✓
Tester	✓	✓	X	X
Multi metre	X	X	X	X
Builder’s trowel	X	X	X	X
Internal angle trowel	X	X	X	X
Plastering trowel	X	X	X	X

Source: *Field Work, 2023*

Table 4.5 reveals significant gaps in the availability of essential resources for teaching and learning of the Design and Technology subject in schools. Figure 4.2 summarises the inadequacy of the teaching and learning materials for each school studied.

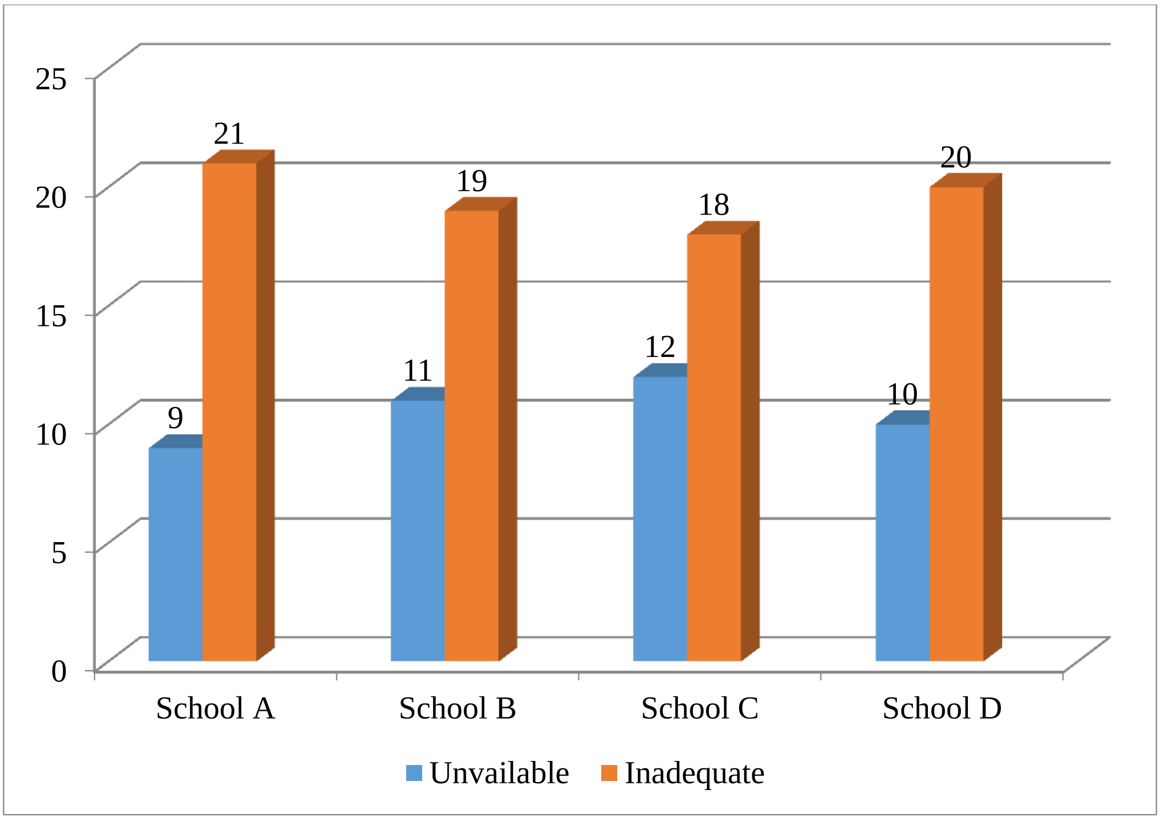

Figure 4.16: Availability of the teaching and learning resources for the DT

Source: *Field Work, 2023*

Figure 4.2 shows that many schools lack crucial resources necessary for effective teaching and learning in this subject. Even in schools with some available resources, they often fall short of meeting the expected standards for teaching and learning the Design and Technology. This shortage of resources poses significant challenges for teachers and learners in implementing the subject.

4.5 The Teaching, Learning and Assessment Processes in the Design and Technology Subject

The third research objective was meant to establish the adequacy of the Design and Technology subject's teaching, learning and assessment processes. The learners and teachers for Design and Technology subject in this study were asked the question:

How comprehensive is the adequacy of the teaching, learning, and assessment processes in the Design and Technology subject?

4.5.1 Teaching, Learning and Assessment Practices in Design and Technology Subject

The teaching methods and assessment practices in Design and Technology appear to focus heavily on theoretical instruction, with learners acknowledging consistent theoretical lessons (mean = 5). Practical lessons and demonstrations were provided but were insufficient to meet the expectations of hands-on learning. For example, while hands-on learning was rated positively (mean = 5), learners noted limited opportunities for manipulating tools and machinery, with a low perception score of 3. This imbalance between theoretical and practical elements raises concerns about the effectiveness of skill acquisition in the subject. Assessments followed a similar pattern, with theoretical evaluations being more common than practical ones. This emphasis on theory could lead to disconnection between learners' knowledge and their ability to apply it in real-world scenarios. Table 4.6 shows the perception of learners on teaching, learning and assessment processes in Design and Technology Subject

Table 4.6: Perception of learners on Teaching, Learning and Assessment Processes in Design and Technology Subject

Items	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	σ	Decision
We do have practical lessons in DT	-	-	-	17(27)	47(73)	5	0.4	High Perception
We do have theoretical lessons in DT	-	-	-	23(36)	41(64)	5	0.4	High Perception
We do have both practical and theoretical lessons in DT	-	-	-	23(36)	41(64)	5	0.4	High Perception
We have demonstration lessons with tools, equipment and machineries in DT	06 (9)	15(23)	-	16(25)	27(42)	4	1	High Perception
We do have hands on type of learning DT	-	-	-	21(33)	43(67)	5	0.4	High Perception
We have more theoretical learning than practical in DT	36(56)	15(23)	-	10(16)	03(5)	2	1	Low Perception
Demonstration method is used in the teaching and learning process of DT	05(8)	12(19)	01(2)	19(30)	27(42)	4	1	High Perception
DT teacher spend most of the time giving us the information	11(17)	09(14)	-	30(47)	14(22)	3	1	Low Perception
We always touch and manipulate the tool, equipment and machineries in DT	18(28)	15(23)	-	13(20)	18(28)	3	2	Low Perception
We are given individual tasks to work on in DT	22(34)	28(44)	-	09(14)	05(8)	2	1	Low Perception
We are given activities to work on in groups in DT	05(8)	04(6)	-	25(39)	30(47)	4	1	High Perception
We do not have practical assessment in DT	04(6)	09(14)	03(5)	37(58)	11(17)	4	1	High Perception
We do not have theoretical assessment in DT	-	-	-	24(38)	40(63)	5	0.4	High Perception
We do not have both practical and theoretical assessment in DT	03(5)	05(8)	02(3)	37(59)	17(27)	4	1	High Perception
We do not have hands on type of assessment in DT	05(8)	12(19)	-	29(45)	18(28)	4	1	High Perception
We have more theoretical assessment than practical in DT	50(78)	07(11)	01(2)	04(6)	02(3)	1	1	Low Perception

Key: *SD = Strongly Disagree, D= Disagree, N= Neutral, A = Agree, SA= Strongly Agree.σ = Standard deviation*

Decision (Weighted average) $=\frac{58.0639}{16} = 3.629$, = 4

4.5.1.1 Reduction in the Number of Periods for the Design and Technology Subject in Schools

The sentiments shared by most of the teachers during the interviews regarding the adequacy of the teaching and learning of the subject showed the inadequacy of the implementation of the subject as they indicated the reduction of the allocated number of periods for the Design and Technology subject against the 2013 curriculum framework underscore notable concerns and felt that:

> *The periods or sessions allocated for Design and Technology subject to my analysis, are not enough per week due to the content that Design and Technology subject required to teach the children. It requires a lot time and personally, I feel the 12 periods we have been given are not enough. I say so because sometimes we even us in our time we create to catch up with the syllabus. The periods are not enough in the sense that DT is bulky for a lack of a better term, I can say it is because it has a good number of components we have to teach the children. At the end of the program, children are supposed to know all the components that the syllabus requires us to teach. I am saying that the 12 periods are not enough because the content is a lot and demands another teacher to teach to finish the lesson (TR2 A).*

The other teacher from a different school pointed out that:

> *According to the 2013 curriculum, the periods allocated to the Design and Technology subject are enough. But the challenge is that we have so many subjects in school that have their own allocation. Now you will discover that we do not get the 12 periods that are required instead the periods have reduced the least is 9 periods per week. Now! Imagine reducing from 12-9 periods. That is a serious down grade in terms of the session. So as for Design and Technology subject, learners to be trained in that kind of the subject area because in a session that you are supposed to in a week, you would not have enough time for, say practicals. Learners cannot do practicals perfectly if time is not enough; if you are going to conduct practicals, you will do it within a short period. It is not possible to finish practicals within a short period of time. Because of that, the periods given to Design and Technology subject are not sufficient (TR2 C).*

The response from the other participant regarding the variation in the reduction of periods per week from 12 reflect complex perspective on the changes in the teaching and learning time allocated to the Design and Technology subject. One teacher's indication of a reduction from 12 periods per week suggests a significant alteration in the scheduling of teaching and learning. One teacher therefore revealed that:

> *The periods allocated for Design and Technology subject are not enough because the subject require that we should have at least three consecutive periods running concurrently. So now, in this case because of the inadequate space in the workshop, and that we do not have enough tools, equipment and machineries, we are only given 2 periods per day, so 8 periods per week, 4 sessions per week which are not enough, they are not enough we need to have atleast minimum of 12 periods per week. Due to the inadequacy classrooms in the school, the number of periods reduced from 12-8 periods per week, so this is what compelled the school planners, our administrators to reduce the periods (TR1 B).*

4.5.1.2 Sufficient Training of Teachers in the Design and Technology Subject

Design and Technology education encompasses theoretical knowledge and practical skills, integrating these elements from disciplines such as building and plastering, metal fabrication, electrical and carpentry and joinery requires teachers to possess not only a deep understanding of content but also proficiency in pedagogical strategies and technological applications. The concerns raised by most teachers regarding the insufficient training of teachers in the Design and Technology subject reflect a critical issue within the implementation of the subject that:

> *We may also need teachers to be refreshed in terms of courses because most of the teachers just did wood work, or metal work or technical drawing, and Design and Technology subject is a new concept to them. There are many things which we do not have as capacity. Therefore, there is need to build capacity through trainings. It is very difficult to teach Design and Technology subject when a teacher just specialised in a single component of the subject. Most teachers shun from teaching the science aspect of Design and Technology subject. So mostly, they call upon other teachers to do that for them (TR3 C).*

The other teacher suggested components of the Design and Technology subject should be stand-alone subjects by discussing that:

> *The time I was in school; we used to call it Industrial Arts, whereby for me I only specialised in wood work. So it was very easy for me to know all the things that are required for me to become a wood worker, or*

even teaching way back was very interesting because even when you are teaching you know what you are talking about. I would like to recommend to those specialists responsible for the planning and development of the curriculum to go back to the old curriculum whereby each component of Design and Technology subject to become a stand-alone subject. This will enable learners to choose the subject of their choice from the 3 components of Design and Technology subject (TR1 D).

The viewpoint expressed by the participant from another school regarding the inadequate training of teachers in the Design and Technology subject highlights a pressing concern in the teaching and learning of the subject by indicating that:

Sometime back, it was very interesting as a teacher when you are teaching because you really know what you are talking about. So apa, it means for us who majored in one of the components of Design and Technology, that is wood work or metal work or Technical Drawing, we are disadvantaged. Apa, we are planning to go back to school so that we can advance more about Design and Technology subject, more especially in the components we are not trained in. This will help us to know what we are talking about. It is very cumbersome, you are in class talking about metal work which you did not do way back, like ku college. That is when they introduced this Design and Technology subject whereby they just merged everything. For the materials, the materials for the components; metal work, wood work, and graphical communication, so when you are talking about, you are not even sure what you are teaching the learners is the truth kayili you are just book lifting, whereby if you have the experience and the knowledge about it way back, it is very easy for you to flow even when you teaching. Personally, I did wood work which is carpentry and joinery. Therefore, I find it a challenge to teach other components, but have adapted with other components. I'm planning to go to either Kabwe Institute of Technology or TVTC to fully specialise in the Design and Technology subject (TR1 C).

The revelation made by the teacher underscores the significant impact that teachers' education and professional development have on learners' development of practical skills within the Design and Technology subject. This insight sheds light on the critical role of teachers in shaping learners' abilities and competencies in hands-on activities.

The sentiment echoed by another teacher from a different school regarding the adequacy of training for teachers in the Design and Technology subject further underscores the pressing need for comprehensive professional development in this domain. The concern raised regarding inadequate teacher training in the Design and Technology subject resonates with several significant issues that:

> *Some teachers lack adequate training in the Design and Technology subject, being proficient only in specific components of it, raises important concerns about the breadth and depth of teachers' preparedness to deliver comprehensive teaching to learners. This fragmented knowledge base can present challenges when teachers are required to teach topics outside of their area of expertise. Instances where teachers invite colleagues to assist in teaching topics they are not familiar with highlight the need for a more holistic approach to teacher training and subject delivery (TR2B).*

4.5.1.3 Grouping of Learners in the Teaching and Learning of the Design and Technology Subject

The experiences shared by the other teacher regarding the shortages of resources required in teaching of the Design and Technology subject shed light on a significant challenge in the teaching and learning of the subject that:

> *We sometimes use theoretical questions, question and answer method, and demonstration method to teach the learners. We usually manage to teach learners using demonstration method because we want the skills to be enhanced in learners, so we do not just sit because we do not have enough tools, equipment or machines, then we stop, no! We make it with the little tools that we have so that we can enhance skills in them. We do just struggle to just make things do by way of grouping the children, putting them in groups so that atleast in groups each one can try here there, here there and so on, but it is not adequate to practice in groups, it is not very, very adequate (*TR1 B).

The revelations shared by the interviewed participants shed light on the perceived benefits and effective strategies associated with implementing group work in Design and Technology education that:

> *It is not always that we have to conduct practicals in Design and Technology subject, but I feel with limited teaching and learning materials, group work method is employed. Therefore, when the other learners are using the tools or operating a welding machine, the other learners observe the friends and by doing so they acquire the knowledge apart from the practical part of the subject which requires learners develop the skills (TR1 C).*

Regarding the use of group work, the other teacher opined that:

> *In times when we do not have enough tools, equipment and machines and other materials, the group work is employed. I feel this is also an effective way of teaching Design and Technology subject when the teaching and learning resources are not enough. Therefore, we group them due to limited resources as you know the goal is to make every learner acquire the knowledge and develop expected skills (TR1D).*

The insights provided by the other teacher regarding the teaching and learning of the Design and Technology subject offered valuable perspectives on the challenges experienced in implementing the subject that:

> *Because sometimes resources are not always enough, learners are taught the subject as theory, and when the time for the final examinations is near, the tools, and other materials are bought. How can you ensure learners acquire the necessary knowledge and skill, and how do you conduct practicals when examinations are near. We cannot just sit simply because what to use is not there or not enough. Grouping of learners is done when the section do not have the necessary teaching and learning materials for practicals (TR2 B).*

The insights from the interviews with Design and Technology subject teachers shed light on approaches and challenges associated with assessing learners' progress and achievements in the Design and Technology subject. One prevalent observation among the interviewed participants is the recognition of the nature of assessment in Design and Technology subject was that:

> *Design and Technology subject, just as the nature of the subject is a hand on subject most of the time. So we do practicals, there is also a part for theory, the designing itself. I think those are the methods. In terms of practicals, instead of testing them individually we test them as a group so that the tools are sufficient for them because if we say each*

child should carry a practical on her own, it means will not do that practical in a day, it will require us to do more than one day (TR2 A).

Furthermore, the other Design and Technology subject teachers from another school further revealed that:

*When it comes to testing of learners in the subject, we use both theory and practicals. But it is very easy to test learners in theory part as opposed to practicals. In practical assessment we need to have in place the necessary tools, equipment and machines and other resources. Now with the inadequacy of these resources, according to me, learners are not adequately assessed to determine their levels of knowledge acquisition and skills development. Therefore, I can say that we need more resources in the teaching and learning of the Design and Technology subject in school. In Design and Technology subject, we assess the learners 2 times per term, but there is also an ongoing assessment for the portfolio in term 1 and 2. The inadequacy of the materials for the subject has got a bearing on the way the assessment of the learners in the subject is done. It is because of this that we assess our learners in groups of 5. I don't think if learners are adequately assessed in the subject amid limited resources and infrastructure for the practical subject (*TR3 D).

4.6 Learners' Acquisition of Knowledge, Development and Application of Skills

The fourth research objective was meant to analyse the extent to which the knowledge and skills of Design and Technology subject are developed and applied by learners. In order to attend to the research objective, learners and teachers for Design and Technology subject in this study were asked the following question: *To what extent are the knowledge and skills of Design and Technology subject are developed and applied by learners?* The same research question was subjected to design and technology subject teachers in order to compare the data.

The data paints a mixed picture of learners' ability to develop and apply the knowledge and skills taught in the Design and Technology curriculum. While learners reported a high understanding of electrical and electronics concepts (mean = 4), they struggled with applying their knowledge in practical tasks such as domestic electrical installation (mean = 3) and carpentry skills (mean = 3). Notably, bricklaying, plastering, and metal fabrication skills were perceived as underdeveloped despite exposure to these topics in the curriculum. This gap between theoretical understanding and practical skill highlights the need for more immersive, hands-on learning opportunities. Table 4.7 presents the perceptions of learners on knowledge and skills of design and technology subject are developed and applied

Table 4.7: Perceptions of learners on knowledge and Skills of Design and Technology Subject are Developed and Applied

Items	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	σ	Decision
I learnt domestic electrical installation but cannot install a circuit	14 (22)	05 (8)	01(2)	34 (53)	10(16)	3	1	Low Perception
I have the knowledge on carpentry and joinery but lack the skill	10 (16)	06(9)	-	43(67)	05(8)	3	1	Low Perception
I do apply knowledge of electrical and electronics in solving problems	02 (3)	06(9)	-	13(20)	43(67)	4	1	High Perception
I have the Design and Technology knowledge but fail to apply it	-	-	-	03(5)	61(95)	5	0.2	High Perception
I have the graphical communication skill/geometric drawing skill	20(31)	28(44)	-	12(19)	04(6)	2	1	Low Perception
I have not developed the bricklaying and plastering skill	02(3)	05(8)	-	41(64)	16(25)	4	1	High Perception
I have not developed metal fabrication skill	03(5)	09(14)		29(45)	23(36)	4	1	High Perception

Key: *SD = Strongly Disagree, D= Disagree, N= Neutral, A = Agree, SA= Strongly Agree.σ = Standard deviation*

Decision (Weighted average) =$\frac{26.283}{7} = 3.755.$ *= **4***

4.6.1.1 Ability of the Learners to Develop Practical Skills

The concerns raised by most of the Design and Technology subject teachers shows inability of learners to develop practical skills due to inadequate teaching and learning resources reflect a critical issue in the implementation of the subject by indicating that:

> *When you talk of electrical installation, it is a component as well in the Design and Technology subject. In order to ensure that learners have the knowledge and develop the installation skills requires the needed materials to be in place always during the teaching and learning process of the subject. So I would not say they develop these skills, maybe just the basic skills of it. This is the full acquisition of practical knowledge and skills demand the availability of the tools, equipment and machines for the subject. Otherwise without these materials in place, I would say learners do not fully develop these skills in school (TR3 C, TR2 A, and TR1 D).*

The other Design and Technology subject teacher explained that:

> *What I can say is that some learners partially develop domestic electrical installation skill. I'm saying so because this component is so demandful for resources when it comes to its implementation as the teaching and learning resources have to be readily available. Now with the inadequacies of the materials as I indicated earlier, learners partially develop the domestic electrical skill. By partially I simply mean that learners may only develop the practical skills only in those components of the Design and Technology subject that are adequately stocked with the machines, tools and equipment (TR3 A).*

The concerns expressed by Design and Technology subject teachers regarding learners' inability to develop practical skills due to inadequate teaching and learning resources highlight the urgent need for action. The teachers' observations underscore the critical role that access to resources plays in facilitating practical skill development in the implementation of the Design and Technology subject by saying that:

> *The learners have partially developed the carpentry and joinery, metal and fabrication skills. I would not say that they fully develop the practical skills because of the challenges I earlier shared which we face in the teaching and learning and assessment of the learners in the Design and Technology subject. For a proper teaching and learning of the subject to help learners develop the skills and acquire the knowledge, I would suggest that proper workshops, tools, equipment and machines have to be available in school because these can only be achieved when the subject is well implemented (*TR2 C).

The insights provided by the other teacher from a different school shed light on the challenges that hinder learners' skills development within the Design and Technology subject. These challenges represent barriers to effective learning experiences and practical skill acquisition that:

> *With challenges of tools, equipment and machinery, I can say that learners partially develop the practical skills. But with the theoretical part of the subject, we have no doubt that learners acquire theoretical knowledge of Design and Technology subject. I think we be real here that learners have acquired more knowledge of the Design and Technology subject as opposed to skills development. This is as a result of the inadequacy of the teaching and learning resources. I'm not saying that they do not have any skill, they have but not as expected (TR3 D).*

The concern expressed by the other teacher against learners' development of practical skills adds an important dimension to the discourse surrounding Design and Technology education. This perspective highlights potential challenges or reservations regarding the emphasis on practical skill development in the implementation of the Design and Technology curriculum that:

> *The main aim of Design and Technology subject is to help children develop skills that which enable sustain themselves in life even when they are not employed by anyone. The children are expected to develop skills like electrical installation, bricklaying, graphical communication and fabrication skills. However, learners of Design and Technology do not fully develop these skills due to challenges of proper workshop, tools, equipment, and machines which are not enough for practical teaching and learning of the subject (TR1 B).*

The study's findings regarding learners' inability to develop practical skills in the Design and Technology subject prompted a response from another teacher of a different school. This provides valuable insights into the implications of the study's findings associated with practical skill development in Design and Technology education.

> *Basically, the means are there for teachers want learners acquire the knowledge and develop the practical skills, but the will towards it may not be available because for you to accomplish that goal, you need to*

> *have standard workshop adequately stocked with tools, equipment and machines for Design and Technology subject. So far for me, I think those that are going out of grade 9 and 12 today, no one so far can show that they have really acquired the skills looking at the projects. Their products are below par, may be because of the same issues of inadequacies of the workshops, tools, equipment and machinery (TR1 B).*

The perspective offered by the other teacher suggests that learners in the Design and Technology subject encounter difficulties in developing practical skills. This viewpoint sheds light on the specific challenges learners face in acquiring hands-on abilities in the Design and Technology curriculum implementation. Therefore, one teacher made the recommendation that:

> *I would recommend to go back to the old curriculum whereby pupils will be divided into groups whereby others will be doing metal and fabrication and others carpentry and joinery while others graphical communication because the Design and Technology curriculum we have right now it's very vast and there is always a challenge whereby learners would not adapt to all the three components of the subject, it is like we are putting pressure on them (*TR2 C).

4.6.2 Learners Acquisition of Knowledge in the Design and Technology Subject

The opposing perspective offered by some of the interviewed teachers, arguing against learners' development and application of practical skills, presents a contrasting viewpoint in the implementation of the Design and Technology curriculum in schools. Therefore, one of the Design and Technology subject teachers was of the view that the learners have not developed the expected skills through the following revelation:

> *Basically, the only thing I can share is that Design and Technology subject is a very important subject if the government really took it upon themselves to develop and equip schools; we will do better because what we need are the skills for the learners to come out. By the time they complete grade 12, they will have something to do. Unfortunately, most of them are graduating without any thing to talk about. They will just have the paper. On the certificate, there is Design and Technology, but they do not have any skill because they pass through an empty vacuum (*TR3 C).

The affirmation echoed by other teachers further emphasises the critical role of the teaching and learning resources in fostering the development of practical skills among learners in the Design and Technology subject. For this reason, one of the teachers opined that:

> *The way I see, our learners have acquired more knowledge as compared to skills development. Personally, I don't see them applying what they have learnt from the Design and Technology subject. I feel because of the challenges have earlier alluded to. This is the more reason why our learners take the subject for sake of passing it and not for skills development. A lot need to be put in place to ensure learners acquire the practical knowledge and skills for them to stand on their own in future. I would recommend a good workshop to be built specifically for the Design and Technology subject. The tools, equipment and machines should be available to ensure smooth teaching and learning of the subject. When these resources are readily available will be very easy for the learners to develop the practical skills expected of them (*TR1 D).

4.7 Suggestions to Improve the Teaching and Learning of Design and Technology Subject

The findings suggest several areas for improvement in the Design and Technology curriculum. The lack of adequate infrastructure, teaching materials, and practical assessments limits learners' ability to engage fully with the subject and hampers their skill acquisition and application. The theoretical dominance in teaching and assessments suggests a need for curriculum reforms that emphasise practical, experiential learning. Furthermore, addressing resource inadequacies, such as increasing workshop and laboratory spaces and providing more textbooks and equipment, could significantly enhance the learning experience. Lastly, investing in teacher specialisation and professional development can ensure more effective delivery of the curriculum.

Figure 4.16 illustrates the perspectives of respondents regarding the provision of resources for Design and Technology education in schools. The data highlights several key suggestions from respondents to improve the teaching and learning of Design and Technology. The most common suggestion, chosen by 39.1% of respondents (25 out of 64), is the establishment of modern workshops. This high percentage suggests that many saw updated facilities as crucial for enhancing practical learning in Design and Technology. Following this, 28.1% (18 respondents) recommended the provision of tools for practical work, indicating a significant demand for adequate resources to facilitate hands-on learning experiences. Provision of more machines is the third suggestion, with 23.4% (15 respondents), suggesting a recognised need for equipment to support practical skills development. Lastly, 9.4% (6 respondents) believed that having teachers with expertise in Design and Technology was necessary, reflecting a view that specialised knowledge among teachers could benefit them. Thus, the data clearly emphasised improving resources and infrastructure (workshops, tools, and machines), with a smaller but notable call for enhanced teacher expertise. This distribution suggested that respondents prioritised physical resources as the primary means to enhance learning in Design and Technology subject. Figure 4.16 presents the suggestions to improve the teaching and learning of the design and technology subject.

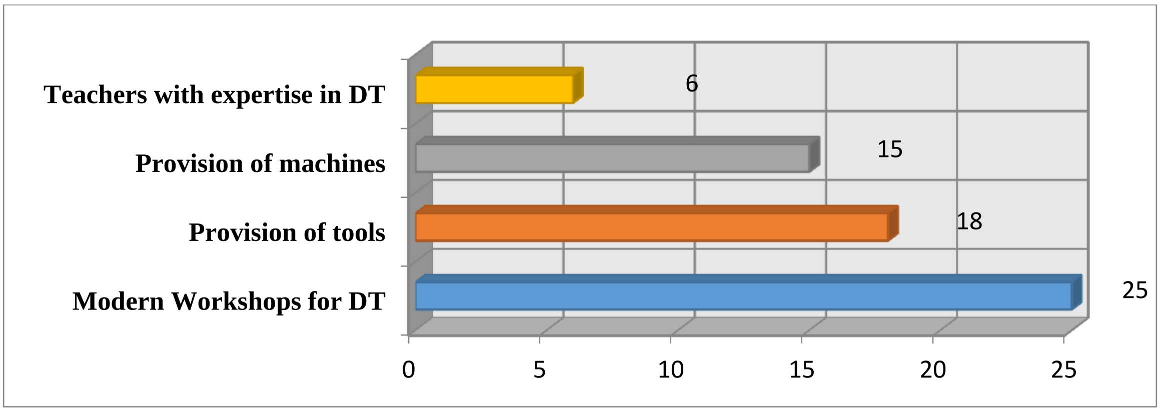

Figure 4.17: Suggestions to Improve the Teaching and Learning of the Design and Technology Subject
Source: *Field Work, 2023*

The participants were asked on the areas that need improvements for an effective teaching and learning of the Design and Technology subject in schools. Most of the participants indicated the provision of workshops, tools, machinery, and teachers specialised in the subject of design and technology.

One of the Design and Technology teachers interviewed suggested that:

> *When it comes to areas of improvement, I think the first one is just the machinery part. Therefore, if enough machines can be brought in school for DT, is likely to enable the subject to be taught well. When we have adequate machines can help to enhance skills development in learners because you would find that due to lack of machines, some skills may not be attained by learners to their full potential (TR1 A).*

Another teacher from a different school pointed out that:

> *On areas of improvement, if we are to be given enough tools, adequate rooms like workshops, work rooms I think it will improve the learning of DT subject in school, and will motivate the learners as well to learn the subject because some learners are discouraged because of the way they are put in groups, share tools, given time to come and do practicals, some learners get discouraged, so given an opportunity to have adequate rooms, sufficient tools, equipment and machineries, it will really improve the teaching and learning of DT subject in school (TR3 B).*

The other teacher opined that:

> *The tool I would recommend as a DT subject teacher is maybe whatever tool is being covered in the syllabus should be available in the workshop so that the teaching and learning can go on smoothly. As a school, we should have the lethal machine, then nowadays, DT has really improved from way back whereby you would want to like there is this course graphic communication whereby you have to do it graphically. So, we are in need of ama projectors for the learning and teaching to take place effectively not whereby drawing the whole thing on the chalkboard, that consume most of our time (TR3 B).*

When the participants were asked about the areas that need improvement in the implementation of the Design and Technology subject, one of the HoDs discussed that:

I think the area that need improvement for the effective teaching and learning Design and Technology subject in schools are workshops, equipment and machineries. These are the only things that we need of course teachers are there. However, we may also need teachers to be refreshed in terms of courses because most of the teachers just did wood work, or metal work or technical drawing, and Design and Technology subject is a new concept to them. There are many things which we do not have as capacity. Therefore, there is need to build capacity through trainings (HoD A).

Concerning the areas that need improvement in the implementation of the Design and Technology subject, the other HoD from a different school added that:

I would recommend the school to have in place the welding machine, tools and other equipment for metal and fabrication for the subject to be effectively taught. You know, these learners need to have hands on type of learning in order for them to develop real practical skills and enable them become self-reliant in future (HoD D).

The deputy head teachers who were interviewed on areas that need improvement in the teaching and learning of the Design and Technology subject shared that:

What I can just share is for who would be helpers to help us especially with tools, equipment and machineries. These tools are needed so that we can help our learners because there is a lot of interest from the learners for the subject. Then besides that, the government through CDF is helping schools in building infrastructure, so if that can be done at this school, that can be of help. We have tried our best to apply for CDF so that infrastructure in terms of workshops can be done to help out the situation at our school (DHTR B).

The other deputy head teacher of another school suggested the need for the Design and Technology textbooks though indicated the components of the subject to appear as stand-alone subjects by saying that:

We need textbooks, current textbooks from Curriculum Development Centre; these are needed very, very much at all levels from grade 8-12. We need books on electrical, bricklaying and plastering, carpentry and joinery, entrepreneurship, graphic communication and safety. All these books are needed (DHTR B).

The head teachers also indicated the areas they felt should be attended to in the implementation of the Design and Technology subject. One of the head teachers indicated that:

We only have 2 teachers for Design and Technology subject. So one is the HOD and one is the subject teacher. So if we can have 2 more teachers that can be okay for us here. We are still asking through the relevant authorities to help us with human resource in terms of teachers since we only have 2 teachers for Design and Technology, 1 HOD and 1 subject teacher. So we feel the need for 2 more teachers to help with the current situation we have (HTR B).

The other head teacher from a different school suggested that:

I would also recommend the government through the Ministry of Education to help with the workshop specifically for Design and Technology subject, tools, equipment and machines for the subject. We appreciate for the government that we receive the termly grant, but it not adequate to even help procure all the tools, equipment and machines needed in the teaching and learning of the Design and Technology subject as you know that this money come tied with percentages to be used specifically for a certain purpose. As a school, we are also trying to ensure we are well stocked with these resources but we still need help, more especially with the construction of a new and modern workshop. (HTR D).

The ESOs who were interviewed indicated the need for the provision of tools and machines in schools for the effective teaching and learning of the Design and Technology subject by saying that:

The general suggestion will be may be the tools that will bring about them having the basic skills not for advanced skills or advanced technological tools, but just the basic tools so that at least as they exit the education system, they have the few basic skills to get them started (ESO 1).

Furthermore, the other education standards officer suggested that:

I would recommend that the text books be made available to the learners, especially for grade 10-12, then maybe also the phones or computers be made available for learners because certain information the learners are able to read first on their own from the internet before they can go to practice (ESO 2).

4.8 Summary

The results indicate that secondary schools offering Design and Technology face significant challenges due to inadequate workshops and limited spaces for practical lessons. Transcribed verbatim responses consistently highlighted that available workshops are small and unsuitable, negatively impacting the implementation of the subject. Additionally, SPSS analysis revealed a shortage of teaching and learning resources, forcing learners to share tools, equipment, and machines in groups. The subject is also broad, encompassing components such as carpentry, bricklaying, metal fabrication, and graphical communication, which creates a challenge for teachers trained in only one area. As a result, teachers often rely on colleagues to cover topics beyond their expertise, further affecting the quality of teaching. Furthermore, the study found that schools reduced the allocated 12 periods for Design and Technology to accommodate other subjects, preventing teachers from adequately covering the syllabus. Practical lessons are conducted in groups due to resource limitations, and learners develop only partial skills in most components, except graphical communication, which requires fewer materials. The primary goal for schools appears to be ensuring that learners pass final exams rather than developing practical skills applicable beyond school. This challenge is worsened by a shortage of trained teachers, inadequate tools, and limited learning materials, ultimately affecting learners' ability to gain hands-on experience in Design and Technology. The subsequent chapter discussed the research findings.

CHAPTER FIVE: DISCUSSION OF RESEARCH FINDINGS

5.0 Overview

The previous chapter presented the research findings. This chapter discusses the research findings according to the research objectives as follows; to evaluate the infrastructure of the Design and Technology subject, to assess the teaching and learning resources of the Design and Technology subject, to establish the adequacy of the teaching, learning and assessment processes in the Design and Technology subject, and to analyse the extent to which the knowledge and skills of the Design and Technology subject are developed and applied by learners. The findings were discussed in line with the research findings.

5.1 The Infrastructure of the Design and Technology Subject

The first research objective was meant to evaluate the infrastructure of the Design and Technology subject. This was evaluated in terms of availability and adequacy of space of workshops for the Design and Technology subject. Schools implementing practical subjects should have adequate workshops (Khuwaja, 2001; Stufflebeam, 2001). Therefore, the context in which the Design and Technology subject is being implemented should be a replica with the working environment (workshops) conducive with available tools and equipment for an effective implementation of the subject. However, the findings of the study were that schools that offer Design and Technology subject had inadequate workshops and those available had inadequate space.

5.1.1 Inadequacy of Workshops for the Design and Technology Subject

The study established that secondary schools where the Design and Technology subject is taught have inadequate workshops as shown in Table 4.3 on page 112. The findings indicate a lack of adequate workshops, as reflected by a low mean score of 2.

This inadequacy directly impacts practical lessons, which are core to mastering the subject. A significant pattern arises where many respondents express dissatisfaction with the workshops designated for the Design and Technology subject in secondary schools. This dissatisfaction reflects a concern among respondents regarding the effectiveness of the current workshop facilities in meeting the needs of the Design and Technology curriculum. Moreover, the data reveals a striking absence of laboratories and libraries in these secondary schools with a high mean score of 5, despite the inclusion of the Design and Technology subject as shown in Table 4.3. This absence highlights a systemic lack of infrastructure essential for promoting hands-on learning and utilising informational resources, which are critical for achieving the educational goals of the subject. The absence of libraries and laboratories creates a gap that limits access to supplementary resources and underscores the lack of holistic academic infrastructure. The inadequacy of the workshops for the Design and Technology subject is also evidenced by what the participant at one of the schools said:

> *For the workshops, in terms of if you want to carry out practicals with learners; the rooms are not adequate because the rooms that were meant for workshops were turned into classrooms. So we only have one workshop as at now which is working as a work room and we have a lot of things to keep as items we make as artifacts as well, which make it inadequate for the teaching and learning of Design and Technology subject. We do not have adequate rooms for Design and Technology subject for us to do practicals, so I can say the rooms or work rooms are not adequate for the learners. The dimensions for the rooms are just very okay, but the room that was meant for the workshop has been turned into classroom, hence we only remained with one workshop against all the components of the subject. The same room we are supposed to keep our materials for practicals is the same room that the children have to use for learning, which is what makes not to be adequate for teaching and learning as well as practicals to be conducted. We do conduct practicals, but the space is not adequate to accommodate learners and other things inside (*TR2 A).

The Design and Technology education stand as a cornerstone for fostering innovation, creativity and technical proficiency among the learners. Central to this discipline is the hands on experience gained through workshops, where theoretical knowledge should be translated into practical application. Therefore, the inadequacy of workshop facilities poses substantial challenge to the comprehensive implementation of the Design and Technology subject in schools. According to Valerie etal (2014), learners need to benefit from what the good infrastructure (context) can offer to teach and learn practical subjects in schools. For this reason, schools that do not have adequate infrastructure for the Design and Technology subject are likely to face challenges when it comes to the practical teaching and learning as learners are most likely to be denied the opportunity for practical acquisition of knowledge and development or improvement of the practical skills essential for their learning process. As discussed by Robert (2015), the learning context establishes the foundation for the development of the learning expectations and learning processes for the school. Therefore, the context should be a replica of the working environment such as industries and workshops where trained teachers should apply their acquired knowledge and practical skills for effective implementation of the subject.

Paliwe, Siphelo, Veronica and Maria (2015) explained that schools should have laboratories, workshops and classrooms for practical lessons for the Design and Technology subject to be effectively implemented and achieve its intended objectives. Therefore, workshops are the primary spaces where learners should engage in hands on learning and practical application of design principles. The workshop facilities' inadequacies in schools restrict learners' ability to work with tools, materials, and machinery relevant to the Design and Technology subject in schools. Hence this limitation hampers learners' practical understanding of concepts, impeding their capacity to translate theoretical knowledge into real world applications. In other words, workshops serve as pivotal spaces for experiential learning within the area of the Design and Technology subject. When schools lack essential infrastructure for the subject, learners encounter limited opportunities to translate theoretical knowledge into practical applications. The inadequacy of such facilities limits learners' experiential learning, thus hindering the comprehensive understanding of the Design and Technology principles. For this reason, Nyamumbi (2023) recommended that suitable infrastructure should be available to support the implementation of practical subjects in schools. Therefore, the workshops (context) for the Design and Technology subject should be a well-furnished classroom, equipped with tools, equipment and other learning resources for effective teaching and learning for learners to easily acquire the knowledge and develop practical skills for the subject.

The inadequacy of workshops for the Design and Technology subject limit the learners' hands on learning opportunities. This is because workshops serve as an environment where theoretical concepts are transformed into tangible creations (Scot, 2015; Shamsa and Munazza, 2018). For this reason, the inadequacy of workshops limits learners' exposure to practical experiences, hindering their ability to grasp the aim of learning the Design and Technology subject in schools. Hence without hands on learning, the development of critical practical skills and the application of theoretical knowledge become stunted, impeding the essence of the Design and Technology education for learners. The inadequacies of workshops significantly impact the implementation of the subject of Design and Technology. This is the reason why David (2018) suggested the need for specific infrastructure such as workshops, classroom blocks, and laboratories to support the effective implementation of the Design and Technology subject in secondary schools. This is likely to enable learners to be exposed to practical experiences, acquire relevant practical skills, and change their attitudes towards the subject without any hindrance.

Furthermore, the study found that workshops for the design and technology subject were inadequate evidenced by the expression made by one of the heads of practical subjects department that:

> *For Design and Technology subject, we have just transformed one classroom into a workshop; therefore we just improvised the room for the subject. The design of the school was not meant for Design and Technology subject. It was meant just for ordinary school because where the school is supposed to have Design and Technology subject, the workshops should be designed for that. Now this secondary school was not designed for that. But all the same plans are underway to put up a workshop for learners who are doing Design and Technology subject (*HoD B).

The inadequacy of workshop facilities implies learners have limited access to hands on experience, which is essential for understanding concepts and developing practical skills. The discrepancy of the workshops for the design and technology subject disrupts the relationship between theoretical discourse and practical application. The inadequacy of workshops for design and technology was also submitted by the Deputy Head teacher from school D revealed that:

> *The workshop is there, but it was not meant for the Design and Technology subject. It is a classroom that was just turned to a workshop. On the workshop, I can simply say that it is just oke, only that the workshop is too small for the practical subject. All the same the teaching and learning of the Design and Technology subject go on well. But what I can say is that the space is too small inside and we are in the process of trying to put up a workshop with the recommended dimensions. This will motivate of course both teachers and learners of the Design and Technology subject. In short, the space in the workshop is not enough, it is a challenge because it is in the same space the teaching and learning of the subject takes place. Besides this, the tools, and other resources are kept there including what learners come up with or the artifacts. So, I would not say that the space in the workshop is adequate when I look at how squeezed thing are inside (*DHTR D).

The inadequate workshops for design and technology subject challenges the core pedagogical principles underpinning the implementation of the Design and Technology subject. The study is consistent with the findings by Puyate (2014) that no practical teaching and learning could occur without adequate provision of learning facilities such as classrooms, workshops, tools, and equipment. The practical teaching and learning cannot be complete without adequate facilities. Thus the successful and effective implementation of the Design and Technology subject require adequate workshops in schools. This is the reason why Kumazhege and Egunsola (2020) explained that the inability to provide right facilities can force the introduction of undesirable alternative measures that may undermine the standard of the overall set goals of the practical subjects in schools. This therefore implies the need for the provision of relevant and adequate school facilities, trained teachers and infrastructures to achieve the objectives of the Design and Technology subject in secondary schools.

The inadequacy of workshops for the Design and Technology subject as shown in Table 4.3 on page 112 is likely to constrain creativity and innovation among learner; this is because the heart of Design and Technology subject determines the cultivation of creativity and innovation for learners. For this reason, workshops are the playgrounds where learners should experiment and bring their ideas to practical sense. Therefore, inadequate facilities curtail the scope of exploration, and confine learners to restricted set of tools or materials. Kanorio (2016) also explained that to implement Design and Technology subject effectively help the learners improve their performance, the learning should therefore take place in a supportive environment where learners are able to see and touch the tools, equipment and machines. This enables them to properly comprehend and evaluate their understanding of the learnt content effectively. The shortage of workshops is therefore a great challenge that affects the practical teaching and learning in schools. Thus this limitation stifles learners' ability to ideate freely, inhibiting the fostering of inventive thinking and innovative ideas that are fundamental in the Design and Technology subject (Andeleke, 2016; Bandele & Faremi, 2022).

The inadequacy of workshops for the Design and Technology subject restrict creativity and innovation among learners in schools that offer Design and Technology subject. The subject should therefore encourage creativity and innovations in learners through practical engagements in the teaching and learning process. Thus practical work is one of the aspects of technical education, it is in this type of education system where without practical work learners definitely fails to reflect the true nature of Design and Technology education. Thus Carbonilla (2016) indicated that in practical education learners learn best if they are given the opportunity to observe what they are taught in an environment where they can manipulate the tools and equipment. For this reason, a practical education environment should be nicely equipped with the necessary resources that promote tactile teaching and learning.

When schools lack workshops, resources or space, learners' ability to explore diverse design ideas becomes constrained. Therefore, this limitation stifles creative expression and inhibits the development of innovative problem-solving solutions, hindering the essence of the Design and Technology education in schools. Mkonongwa (2017) explained that practical education produces substantial returns, offering learners the chance to develop skills that are unlikely to be developed if the standard infrastructure that support practical learning does not exist in schools. When the workshops are not adequate in schools learners are likely unable to develop job-oriented skills, participate fully in society, take control of their own lives, and continue learning. Thus, Design and Technology education can be efficient in proportion when the environment in which the learners are learning is a replica of the place in which they must subsequently work; therefore, effective implementation of the Design and Technology subject can only be given to learners when the teaching is done similarly with the same operations, tools, and machines as in the occupation itself (Pamies, 2015; Psacharopolos, 2016).

Furthermore, the study found limited spaces in the workshop as evidenced in Table 4.3 showing limited space in workshops with low perception score (mean = 2). Limited space in a Design and Technology workshop can significantly impact both teaching and learning of the subject. The subject is hands-on that requires ample space for practical activities such as woodworking, metalworking, and electronics. A cramped workshop limits learners' ability to work efficiently and safely. Thus limited space makes it difficult to store tools and equipment properly. If the workshop is too small, there may not be enough room for essential machines like lathes, and saws. Learners might have to take turns using equipment, leading to delays and reducing hands-on learning opportunities. Crowded spaces make it harder for teachers to monitor and assist learners effectively. This leads to discomfort, affecting learners' concentration and motivation. Collaborative projects become challenging when learners do not have enough room to move freely and share ideas, and eachers may struggle to conduct effective demonstrations if students cannot gather around comfortably to observe

This limitation impedes the cultivation of innovative thinking, for this reason hinders the potential for ground breaking solutions within the Design and Technology subject. Consequently, learners are likely to become nervous about engaging fully in practical academic activities, which undermine their confidence and impede their learning process. Workshops often involve the use of tools and machinery. Hence the inadequacy of it could lead to reluctance to engage fully in practical activities, impacting the depth of learning as Kilinc (2018) pointed out that the non-availability of the practical workshop; inadequate instructional materials are challenges against the effective practical secondary education. Thus the insufficient workshops and resources hinder learners' ability to develop proficiency in using tools and technology relevant to the Design and Technology education. Luhana (2021) also discussed that the nature of workshop activities often involves using tools and machinery, demanding stringent requirements. The Design and Technology subject aims to foster technical and vocational skills essential for learners' future careers. This deficit in skill development creates a gap between theoretical understanding and practical application, impacting learners' academic performance, readiness for higher education or careers in Design and Technology fields.

Kirbirg (2021) explained that the implementation of practical subjects depends largely on several factors, such as workshops and other physical facilities that are well equipped with practical tools and equipment. The subject of design and technology aims to equip learners with the technical skills essential for future endeavors. Thus the insufficient workshop resources hinder the acquisition of proficiency in using tools and equipment pertinent to learners' fields of study. This deficiency can also impair learners' readiness for careers or further education in the Design and Technology related areas, creating a gap between theoretical knowledge and practical application. Design and Technology aims to help learners develop technical and vocational skills. Therefore, without adequate workshop facilities, learners might lack the opportunity to develop proficiency in using tools and equipment. As Hahlani (2022) discussed, the condition of the school's learning environment has an important impact on teachers' effectiveness and learners' academic performance. Therefore, the quality of infrastructure or the learning environment strongly influences the academic standard, which is an index of quality assurance in implementing the Design and Technology subject in the teaching and learning process.

The inadequacy of workshops with limited spaces reported in Table 4.3 may impinge upon learners' preparedness for design, engineering, or technological professions. For this reason, Okebuka (2022) also discussed that without adequate and appropriate structures to create a supportive infrastructural base, implementation of practical subjects including Design and Technology subject would be a mockery to learners and society at large. Thus the availability of a good infrastructural base is an important contributor to the successful and effective implementation of the Design and Technology subject in secondary schools. This is because the subject requires good and supportive infrastructural facilities and material resources for practical teaching and learning to help learners acquire knowledge and develop practical skills. Valerie etal (2014) also explained that learners need to benefit from what the good infrastructure can offer to teach and learn practical subjects. Thus the schools that do not have the infrastructure for the Design and Technology subject are likely to face challenges when it comes to the practical teaching and learning of the subject in schools because learners are likely to be denied the opportunity for practical acquisition of knowledge and development or improvement of their skills.

The inadequacy of the workshops compromises the implementation of the Design and Technology curriculum in schools. The condition of the school's learning environment including infrastructure has an important impact on teachers' effectiveness and learners' academic performance. Kekeya (2014) further explained that the quality of learning facilities in educational institutions should have a positive relationship with the quality of teaching and learning activities leading to the attainment of the practical set goals and understanding of learners in the subject. Therefore, the quality of the school buildings and furniture determine how long such last while comfortable workshops and adequate provision of resources facilitate teachers' instructional task performance and learners' learning practical outcomes.

The inadequacies of workshops for the Design and Technology subject are likely to force teachers to adapt the curriculum, potentially diminishing the practical components or substituting them with theoretical lessons. This compromise is likely to dilute the intended holistic learning experience, depriving learners of the opportunity to bridge the gap between theory and practice. This is why Okebukola (2016) cited the lack of adequate infrastructure and large classes, as the major challenges to effective teaching and learning of the Design and Technology subject in the institutions of learning. In addition, the nature of infrastructure in the teaching and learning of the Design and Technology subject plays a crucial role in the subject's practical teaching and learning process. Hence, the inadequacy of workshops significantly undermines the effective implementation of design and technology in schools. In essence, workshop inadequacy profoundly affects the implementation of the Design and Technology subject by impeding practical learning, curbing creativity, limiting exposure to modern resources, hindering practical skills development and eventually compromising the educational quality.

Moreover, the inadequacy of workshops might compel the Design and Technology curriculum implementers to change their way of teaching and learning Design and

Technology subjects in schools. This may have the potential to reduce the practical components or substitute them with theoretical lessons. This shift might compromise the holistic learning experience intended in the Design and Technology curriculum, affecting learners' ability to apply theoretical knowledge practically. Mufanti (2019) explained that the nature of infrastructure in the teaching and learning of the Design and Technology subject is of great importance in the development and making of learners. Therefore, the workshop inadequacies are likely to make teachers adapt the Design and Technology curriculum to accommodate the limitations. The Ngwenya and Shange (2019) argued that insufficient infrastructure is a dominant hindrance to practical teaching and learning. For this reason, the adaptation might reduce the emphasis on hands-on experiences and eventually compromise the depth of practical learning of the subject. Consequently, the quality of design and technology education suffers, depriving learners of a comprehensive understanding of the subject and its application. Teachers are compelled to adapt their teaching approaches when faced with workshop inadequacies. This adaptation will likely involve compensatory measures that emphasise theoretical instruction over practical application by teachers, thus compromising the intended balance between theoretical learning and experiential engagement.

Olagboye (2014) viewed the utilisation of school infrastructure and learning environment as the extent of usage of school buildings, and that the infrastructure therefore should be an integral component of the learning and teaching of the Design and Technology subject as it enable learners and teachers to access a wide range of tools, service and resources to support learning and teaching within the environment it is being implemented (Odu, 2020 and Obwawo, 2021). On the one hand, the lack of infrastructural facilities and under-resourced workshops are directly associated with the academic failure of practical subjects among learners in schools. Thus the lack of resources is also a critical factor in education as it may negatively affect the design and technology curriculum's practical teaching and learning processes in schools. Douglar et al. (2023) asserted that lacking learning resources significantly impacts learners’ performance in the context of school infrastructure. Therefore, schools must prioritise the provision of learning resources to enhance the teaching and learning process. The implementation of design and technology education should focus on learning outcomes and the quality of the teaching and learning process. Quadri, Ogunjide, and Oladejo (2018) pointed out that investing in school resources and infrastructure positively impacts learner performance in schools.

In the 21st century, the quality of education must align with life’s evolving needs. Adequate school infrastructure is identified as a vital element in creating conducive learning environments. Physical and psychological involvement should be emphasised for active learning because it is crucial for the learners’ engagement, as highlighted by (Hyun, Ediger, and Lee (2017). The influence of school infrastructure on learners’ activeness in the learning process is essential, reflecting on how facilities and infrastructure impact the teaching and learning process of Design and Technology subject. Thus the state of the school infrastructure, such as workshops and classrooms for the Design and Technology subject, significantly influences the comfort and enthusiasm of learners, as noted by Lawanson and Gede (2021). Effective control and management of facilities and infrastructure are necessary to optimise the learning environment. The influence of infrastructure on the teaching and learning activities is evident, impacting overall academic performance and the achievement of learning objectives.

5.1.2 Inadequacy of Space in the Workshops for Design and Technology Subject

Limited space in the workshops was highlighted as a significant issue, resulting in low perception score (mean = 2) as shown in Table 4.3 on page 112. The study shows that the space in the workshop where the Design and Technology is implemented does not have adequate space while the space in the classrooms where the theory part of the subject is conducted is adequate. Furthermore, schools where Design and Technology is taught do not have libraries and laboratories for the subject hence lack of space in the laboratories and libraries. Therefore, Table 4.3 shows that the space for the Design and Technology subject workshops was inadequate in the implementation of the subject so that learners could effectively do practical lessons related to the subject. This means learners might not get enough opportunities to learn hands-on skills and explore things by doing. However, there is enough space for teaching in classrooms where they teach the theory part of the Design and Technology.

Table 4.3 shows something interesting also with high perception (mean=5) that schools teaching Design and Technology subject do not have libraries or laboratories specifically for the Design and Technology subject. This means learners might not have the right places to do research, and experiments, or get the information they need for their lessons. Not having libraries and laboratories makes the problem of insufficient space even worse. This shows that these secondary schools face a big challenge in providing the right spaces and resources for teaching Design and Technology well. The results from the transcribed verbatim also consistently indicated that schools have inadequacies of workshops with small and inappropriate spaces in the available workshops. The inadequacy of the space in the workshop for the Design and Technology subject was also submitted by one participant who indicated that:

*According to my own analysis, the workshop is there at this school, but I feel that it is not very adequate for teaching and learning about the subject of design and technology. Due to the inadequacy of the classrooms, other non-practical subjects are taught in the workshop. You would find the other furniture not supposed to be in the workshop is found there. When it comes to space in the workshop, the room is so congested because of the fact that it is in this same room where the teaching of metal work, wood work, electrical and graphical communication takes place. The place is so congested with also what learners make and other resources for the subject. The space is not also adequate as expected on how a standard workshop for the practical subject should look like (*HoD C).

The workshops for Design and Technology subject in schools should be a replica of the working environment such as industries; workshops, trained personnel to apply their acquired knowledge and skills (Roberts, 2015; Paliwe, Siphelo, Veronica and Maria, 2015). Thus schools should have workshops and laboratories for practical lessons on the subject of design and technology to effectively implement and achieve their intended objectives. This is why Todd and Dunbar (2018) pointed out that the context in which Design and Technology subject should be taught has to be conducive for the teaching and learning of the subject.

The inadequacy of space in the workshop facilities profoundly impacts the implementation of the Design and Technology subject, leading to significant implications. These implications stemming from inadequate workshop space profoundly impact the implementation of the Design and Technology subject, shaping consequential challenges within the school. Thus the inadequacy of space in the workshop for Design and Technology subjects limits the scope for practical learning; hence affect the implementation of Design and Technology in secondary schools that offer the subject. Todd and Dunbar (2018) explained that the inadequacy of space in the workshops constraints and directly curtails the breadth and depth of practical learning experiences in secondary schools' Design and Technology subject.

Therefore, with limited spaces, learners are likely to face challenges in manoeuvring, setting up equipment, or working on larger-scale projects. This limitation restricts learners' ability to explore and experiment with different materials and design concepts, hindering the comprehensive understanding of the practical application of the Design and Technology principles which are acquisition of practical knowledge and skills. Hooker (2017) also discussed that inadequate and poor workshop organisations with inadequate instructional materials are challenges in the implementation of practical subjects. These challenges prevent the successful implementation of the practical subjects in schools. Therefore, it can be concluded that inadequate and inappropriate infrastructure does not promote opportunities for learners to easily put into practice what has been taught and learnt in the classroom.

Puyate (2014) argued that no practical teaching and learning can occur without adequate provision of learning facilities such as workshops, textbooks, classrooms, tools, and equipment. Thus practical education cannot be completed without adequate infrastructural space. It is essential therefore to indicate that for a successful and effective implementation of the Design and Technology subject, it requires enough space in workshops and a lot of teaching and learning resources. Thus the teaching of the subject should not just be looked at in terms of its desired possible results or benefits. Thus without adequate workshop space, resources, teaching and learning of Design and Technology subjects would be as theoretical as academic ones. For this reason, the lack of adequate space in the facilities may negatively affect the quality of the subject as rote learning is promoted, instead of the actual practical performance. This is why Ayonmike (2020) also explained that quality learning facilities should have adequate space to mark a positive relationship with the quality of teaching and learning activities, leading to the attainment of the set goals. Therefore, the quality of the school buildings and furniture determine how long such last while comfortable workshops and adequate provision of the resources facilitate teachers' instructional task performance and learners' learning outcomes.

Mbewe (2018) explained that the nature and the role of infrastructure in the teaching and learning of the Design and Technology subject are basically the enhancement of the knowledge acquisition and attainment of quality assurance. Thus school facilities directly affect the teaching and learning of Design and Technology subject. The poor conditions of school workshops are likely to make it difficult for teachers to teach learners or provide an adequate practical education to them. This is because design innovation thrives on an environment conducive to creative exploration just like Matenda and David (2017) indicated that when pupils learn in an environment modelled after the workplace, they are likely to acquire not only trade-related skills but will also develop employable skills required to make an effective transition from school to work, an understanding of career development and planning, an understanding of the importance of becoming an autonomous, lifelong learner to adapt to the skills and knowledge needed in the future.

Charles et al (2021) indicated that practical education can be efficient in proportion when the environment in which the learners are learning is a replica of the place in which they must subsequently work; therefore, effective implementation of Design and Technology subject can only be given to learners when the teaching is done similarly with the same operations, tools and machines as in the occupation itself as the Design and Technology education aims to equip learners with knowledge, skills and or competencies required in particular occupations or more broadly, the labour market. Therefore, the teaching of the Design and Technology subject has the role to prepare learners to be ready to work, either working independently (self-employed) or filling job openings in the world of work. Therefore, the direction of development of practical education is oriented towards the fulfillment of workforce market demand. Just like Amechi and Thomas (2016) put it, the Design and Technology subject emphasises the preparation of the learning program using a systems approach that is characterized by the formulation of specific competencies as the destination of behavior that must be achieved. The learning process is directed to achieve the objectives. Thus, successful learning must be measured by the extent to which learners can master or achieve competencies that have been determined. This can only be achieved when the Design and Technology subject is taught in a supportive workshop environment with adequate space to allow learners to move freely during the practical engagements.

The school facilities greatly influence learners' academic performance. There is a very strong relationship between the adequacy of space in the workshops and learners' practical academic achievement. Successful implementation of the Design and Technology curriculum directly relates to the availability and adequacy of space in the workshop in schools. This is because the workshops enable practical teaching and learning processes. This resonates well with what Bukit (2014) who explained that practical education can only be given effectively if the learning tasks are carried out in the same way, with the same machine tools and tools as the type of work to be carried out later. Thus the teaching and learning of the Design and Technology subject can only be effective if learners directly and specifically get used to thinking and working regularly to make the implementation of the Design and Technology subject enhance skills development among learners. Therefore, schools should be well equipped to achieve the objectives of the Design and Technology subject in schools. The study had similar results to those of Davis (2014), who found that schools that lack appropriate workshops with ill-equipped laboratories for vocational and technical education had problems implementing practical subjects in secondary schools. This is the reason why Kukano (2020) explained that the learners' choice of learning practical subjects depends on the availability of infrastructure, physical facilities, equipment and trained teachers. Thus the inadequacy of space in the workshops and trained teachers hinder the effective implementation of the Design and Technology curriculum in schools. It is important to note that the adequacy of space in the workshops is a cardinal input for effective implementation of the Design and Technology subject in schools.

Luhana (2021) indicated that vocational education can be efficient in proportion when the environment in which the learners are learning is a replica of the place in which they must subsequently work; therefore, effective implementation of the Design and Technology education can only be given to learners when the teaching is done similarly with the same workshops and operations as in the occupation itself. For this reason, as the small workshop spaces shown in Table 4.3 restrict learners' ability to engage in hands on learning experiences. Thus limited room for maneuverability and workstations hampers the learners' exploration of tools, materials and machinery. This constraint diminishes the depth and breadth of practical engagement, hindering the development of tactile skills crucial in implementing the design and technology subject. In other words, limited workshop spaces restricts learners' capacity to engage in hands on learning experiences essential in the Design and Technology subject. Therefore, the insufficient room of the workshop impedes learners' ability to explore with the tools, materials, and machinery. This eventually curtails the depth and breadth of practical engagement during the subject's teaching and learning process.

Valerie etal (2014) explained that the successful implementation of the Design and Technology subject directly relates to the availability and adequacy of space in the workshop where the practical teaching and learning of the subject takes place. It is therefore important to point out that spaces in the workshops are also enabler of the practical teaching and learning of the subject. The study established that with the presence of desks, the other information subjects were taught in the same workshop meant for Design and Technology subject as in Figure 4.3; this limits the space for the workshop. Therefore, a school with inadequate space or ill-equipped workshops for practical education prevents the effective implementation of the subject in schools. This is because the subject of Design and Technology often involves collaborative projects where learners work together to solve problems and create innovative designs. Kekeya (2014) discussed that the quality of learning facilities in educational institutions should have a positive relationship with the quality of teaching and learning activities leading to the attainment of goals set. The quality of the school buildings facilitates teachers' instructional task performance and learners' learning outcomes. Thus the inadequate space limits the capacity for collaborative work, inhibiting group dynamics and the exchange of ideas among learners. This limitation stifles the development of teamwork, communication skills, and the ability to engage in group-based problem-solving, a crucial aspect of the Design and Technology curriculum implementation.

The inadequacies of workshop space hinder the practical execution of Design and Technology education projects. Thus learners face challenges in undertaking larger-scale or complex design projects due to space limitations. This constraint limits learners' ability to explore diverse design concepts, constraining the scope and depth of their practical learning experiences. This is because the teaching and learning in the

Design and Technology education often require ample space for practicals. Hence small workshop spaces restrict the size and complexity of projects that learners should undertake. These limitations are likely compromise learners' ability to work or construct their projects, eventually constrain the scope of their practical learning experiences. Ignasia (2018) also discussed that most schools have challenges in creating a conducive environment for learning knowledge and practical subjects. Therefore, the inadequacy of space in the workshops for Design and Technology subject curtail creativity and innovation in learners. This is because space constraints impose boundaries on creative exploration as the subject often demand ample space in the workshops. Learners' ability to experiment with diverse design ideas and fabrication techniques is stifled when confined. This limitation impedes the cultivation of innovative thinking and problem solving skills critical in the Design and Technology education. This is because the design innovation thrives on space for creative exploration. Thus when learners are confined to small workshop areas, they are likely to encounter limitations when experimenting with diverse design ideas or fabrication techniques. This constraint stifles their creativity, hampering their capacity to innovate or come up with new ideas for their self-reliance (Roberts, 2015; Ramli, 2017).

Figure 4.1 on page 117 showed congested workshop with many products. Thus, schools that do not have adequate infrastructural space for the Design and Technology subject may face challenges when it comes to teaching and learning of the subject because learners are likely to be denied the opportunity for practical acquisition of knowledge and development or improvement of their practical skills. Learners need to benefit from what the good infrastructure can offer to teach and learn practical subjects. Andeleke (2017) explained that infrastructural space is an integral component of the learning and teaching of Design and Technology subject in schools because it enables learners and teachers to access a wide range of tools, service and resources to support learning and teaching within the environment it is being implemented. Therefore, inadequate space necessitates inefficient resource management, which might become challenging. Hence the storage space for tools, equipment, and materials becomes limited, potentially leading to disorganization and difficulty in accessing the necessary resources. This limitation therefore hampers the smooth execution of projects and inhibits learners' ability to explore a wide array of materials and tools in the teaching and learning process of the subject.

Design innovation thrives on enough space for creative exploration and experimentation. Thus small workshop areas limit learners' ability to explore diverse design ideas (Nginge, 2015; Mwiria, 2016). This limitation affects their creativity, hindering the capacity to innovate and iterate through various design solutions. For this reason, acquiring knowledge and developing practical skills thrives on space. Therefore, when the learners are confined to a small workshop, they are likely to encounter limitations in the teaching and learning process of the subject. This is why Todd and Dunbar (2018) pointed out that the context in which the Design and Technology subject is being taught should be conducive for the teaching and learning of the practical subjects. Therefore, the dimension of the workshop for the subject should be designed in such way to allow for a free exchange of ideas, thoughts and skills to achieve the expected educational goal by considering the physical and psychological needs of the learners.

Ramji (2017) explained that the physical environment includes features a project-based physical learning environment should have to enable learners to access technology. Teachers may need to modify the curriculum to adapt to space limitations, reducing the scope of practical components or altering project requirements. This compromise may dilute the intended learning outcomes of the subject, thereby diminishing the depth of practical experience and eventually affect the overall quality of the Design and Technology education in schools. Therefore, teachers must adapt their teaching methods to accommodate limited space, potentially altering practical demonstrations or hands-on activities. This adaptation might compromise the depth of learning experiences, shifting the focus away from practical application and move towards theoretical instruction during the teaching and learning process. (Rahman, 2019; Roy, 2022). This adaptation might also necessitate the alterations in practical demonstrations or hands-on activities, potentially compromising the depth and breadth of learners' learning experiences. Therefore workshops with inadequate space do not support the practical education enterprise and eventually denies learners of knowledge and practical skills of the Design and Technology education. Thus a good learning workshop with adequate space is critical for learners’ practical academic achievement in the subject of design and technology.

The results revealed that that the quality of teaching of Design and Technology as a practical subject was compromised due to the increased enrollment levels and limited or lack of equipment and infrastructure to teach the subject effectively. As a result, teachers resorted to teaching the subject theoretically; thereby, compromising the prescribed methods of teaching Design and Technology. This is why Pansho (2024) indicated that the interplay between learning resources, school infrastructure, and the teaching and learning process is involved and complex. The elements’ adequacy and proper utilisation are crucial for enhancing learner performance, promoting active learning, and ultimately achieving quality education in the 21st century. The importance of school infrastructure facilities in creating conducive learning environments cannot be overstated, and their impact extends beyond physical spaces to influence overall academic achievement. Kekeya (2014) discussed that the quality of learning facilities in educational institutions should have a positive relationship with the quality of teaching and learning activities, leading to the attainment of goals. The quality of the school buildings and furniture determine how long such last while comfortable classrooms and adequate provision of institutional resources facilitate teachers' instructional task performance and learners' learning outcomes. Amechi and Thomas (2016) discussed that the adequacy of well-equipped workshops that offer modern technological resources, facilitate two-way learning experiences that enable learners explore theoretical concepts through practical applications. This allow teachers have the flexibility to employ diverse teaching methods, including visual aids, hands-on demonstrations and collaborative projects to enhance the learners' understanding of theoretical concepts.

David (2018) indicated the need for specific infrastructure such as workshops, classroom blocks and laboratories; influence an effective implementation of Design and Technology subject. Therefore, in schools where the classrooms are inadequate prevents the exposure of the learners to practical experiences, acquisition of relevant skills and change of their attitudes towards the subject without any hindrance. The quality of the workshop and learning environment strongly influences the academic standard, which is an index of quality assurance in implementing the Design and Technology subject in schools. Mkonongwa (2017) discussed that inadequate physical facility leads to poor school curriculum implementation, and compromises the implementation of the subject because topics meant to be taught practically are taught theoretically due to a lack of supporting physical facilities and equipment. For this reason, adequacies of workshops foster a good environment for learners' engagement, leading to improved retention and understanding of theoretical concepts. Thus adequate workshops encourage learners develop the hands-on skills critical in design and technology, preparing them for practical applications in the field.

Okebukola (2016) discussed that major challenges to effective teaching and learning of the subject are lack of good learning environments which stimulate creative thinking, encouraging learners to think critically and practical solving of problem in an effective way within the realm of Design and Technology subject. The nature of the classrooms in the teaching and learning of the Design and Technology subject plays a crucial role in the teaching and learning process. However, Figure 4.4 shows limited workshop space. Thus, schools with inadequate classrooms imply that schools have inadequate environments where theoretical knowledge is imparted to learners. This therefore, can be a clear indication that schools are likely to have challenges when imparting theoretical knowledge to learners in the subject of design and technology. In other words, well-equipped classrooms provide learners with the necessary tools and space to foster exploration and innovation among learners.

The quality and adequacy of the infrastructure as reported in Figure 4.5 may not help learners acquire and develop skills. Therefore the nature of the infrastructure in teaching and learning the Design and Technology subject has a role to play in the teaching and learning process as Okebukola (2016) explained that sufficient space allows for the integration of practical activities, practicals or hands-on projects essential for comprehending design and technology concepts. The space therefore promotes theoretical learning environment. Adequate classroom space allows teachers to employ diverse teaching methodologies, including collaborative work and fostering holistic learning experiences. Thus adequate space allows for adaptable classroom layouts that accommodate various teaching methods. It therefore allows for the arrangements that facilitate group discussions, presentations and knowledge exchange among learners during the teaching and learning process of the subject. Therefore spacious workshops enable learners to move freely, and engagement with theoretical principles translated into practical applications. Spacious workshops encourage active participation, allowing learners to move freely, and fostering engagement in theoretical concepts through practical application and exploration (Bell etal, 2017; Ayonmike, 2020).

Furthermore, Figure 4.2 on page 118 shows inadequate infrastructural space that may not promote creativity, and allow learners to ideate and foster innovative thinking skills. It is therefore important to point out that space nurtures a good environment for creativity and innovation, empowering learners to ideate projects. For this reason, the quality of the workshop or the learning environment strongly influences the academic standard, which is an index of quality assurance when implementing the Design and Technology subject in schools. Thus, Okebukola (2016) explained that lack of adequate infrastructure and large classes are major challenges to effective teaching and learning of Design and Technology subject. Therefore, sufficient space supports the design process as it allow learners to visualise, modify, and refine their designs as they progress through various stages of development. Hence, a well-spaced classroom environment accommodates the creation of products and experimentation, facilitating the exploration of theoretical concepts into tangible forms. Moreover, sufficient space in the classroom supports project-based learning, providing learners with the room to plan, construct, test, and refine their designs, translating theoretical knowledge into practical products. Therefore, a well-sized classroom allow for dedicated learning spaces in the Design and Technology subject.

Hatiya (2016) explained that a good learning environment is important for learners' good academic attainment. Thus schools should have enough classrooms with adequate spaces for the effective teaching and learning of the Design and Technology subjects. This is because the spacious environment encourages collaborative efforts among learners; hence promote teamwork and peer-to-peer learning which is also crucial in design and technology education. In other words, the adequate space in the classroom allows for the arrangements that facilitate group discussions, presentations, and critiques, promoting dialogue and knowledge exchange among the learners. Kwangu and Muzata (2019) indicated that the inadequate classroom space for the practical subjects was a challenge. Thus workshops with inadequate spaces discourage collaboration among learners, and do not promote teamwork, peer learning, and sharing of ideas essential in Design and Technology education.

The implication of inadequate workshops and space in Design and Technology affect the teaching and learning of the subject. Without well-equipped workshops, learners cannot practice hands-on skills, making it difficult for them to apply what they learn in theory. Crowded and poorly designed spaces limit movement and make it unsafe to use tools and machines. Teachers struggle to demonstrate practical lessons effectively, leading to a shallow understanding of the subject. Additionally, limited space result in fewer learners getting the opportunity to work on projects, reducing engagement and interest in the subject. This lack of practical experience leaves learners unprepared for technical careers, as they may graduate without the necessary skills. In the long run, inadequate workshops and space lower the quality of education, making it harder for learners to succeed in Design and Technology.

5.2 Teaching and Learning Resources for Design and Technology Subject

The second research objective was to assess the adequacy of the teaching and learning resources in schools offering Design and Technology subjects. A significant majority expressed that tools and equipment were inadequate, with learners often waiting for their peers to complete practical sessions before accessing the same resources. This inefficiency, encapsulated in high mean scores for perceptions such as waiting to use tools (mean = 4) and machinery inadequacy (mean = 4) as shown in Table 4.4 on page 123, disrupts the continuity of practical learning. Moreover, textbooks were distributed in groups rather than individually, which limited each learner's access to critical learning resources, leading to a lower perception score of 3.

5.2.1 Inadequacy of Resources in the Teaching and Learning of the Design and Technology Subject

The MoE (2013) indicated that institutions should expose learners to various teaching and learning resources they can use in the teaching and learning process. Thus the teachers must make the learners appreciate the need to maximise the bricklaying and plastering, metal fabrication, electrical tools and machines in the teaching and learning process. However, the data in Table 4.4 on page 123 shows the inadequacy of tools, equipment and machines needed in the subject's practical teaching and learning process. The study revealed that during the teaching and learning process, learners often experience delays as they wait for their turn to use tools, equipment, and machines. Additionally, textbooks are distributed among learners in groups rather than individually. These findings collectively highlight a deficiency in essential teaching and learning resources within the implementation of the Design and Technology curriculum in schools where the subject is taught. The data suggests that there are insufficient access to tools, equipment, and machines necessary for hands-on learning experiences in Design and Technology classes. This limitation could impede learners' ability to actively engage with practical aspects of the subject as Patrick (2017) indicated that inadequate resources for teaching and learning has the potential to hinder skills development among learners. Thus, the practice of distributing textbooks in groups rather than individually may indicate challenges to ensuring equitable access to learning materials among learners. This approach may limit learners' opportunities for independent study, affecting their ability to deepen their understanding of the Design and Technology concepts outside of the classroom.

Most of the participants also indicated the inadequacy of the teaching and learning resources for Design and Technology subject in schools that offer it. For example, one participant submitted that:

> *We do not have enough because we only have one, one; one grinder, one circular saw, one driller and one small welding machine. So our interest is to see it that we have enough so that whenever there is work, children should not struggle to keep on asking each other the tools which they are using, so we do not have enough tools so to put it apart from the chisels which are enough, the rest are inadequate. We need enough machines and equipment to enable us to teach learners well because when we lack them it means even the explanation becomes inadequate, but the explanation plus the tools combined can make a child understand the lesson well (TR1 B).*

The inadequacy of the inputs in teaching and learning the subject of design and technology presents complex challenges that impact the learners' pedagogy, skills development, and holistic understanding of the subject. Design and technology education relies heavily on practical application, innovation, and problem-solving, making the availability and quality of tools pivotal to their efficacy. Thus, the inadequacy of tools profoundly impacts the efficacy and richness of teaching and learning in the subject of design and technology. This inadequacy of the tools presents multifaceted challenges, substantially impeding the holistic development of learners' skills, their creative aptitude, and ability to engage meaningfully within the subject matter (Kwangu and Muzata, 2019). According to Pamies et al (2015), the learners and teachers should be able to see and touch or manipulate the teaching and learning resources to ensure the practical lessons take place. These resources are regarded as the most important support structure because the implementation of the Design and Technology subject depends largely on resources available in schools. Therefore, without the relevant resources to use in the practical teaching and learning process, it would cause stress and strain leading to dire consequences and impact on the teachers' and learners' morale to implement the subject effectively.

The study established inadequate teaching and learning resources for design and technology subject with high perception (mean=4) as shown Table 4.4 on page 123 that learners wait for others to use the tools and machines such as welding machines, saws, building levels and planes. The inadequate training facilities for hands-on-experience for teachers and learners as discussed by Dasman (2015) leads to ineffective and inefficient training of learners while emphasis is placed on passing final examination. This inadequacy in preparation for the job market brought workplace challenges to the graduates. Therefore, the inadequate use of the tools necessary for the execution of teaching and learning is likely to inhibit the effective implementation of the subject of design and technology. This is because the implementation of the subject requires schools to have the necessary educational requirement, including workshops and classrooms, benches, tools, equipment machines and even text books readily available in the teaching and learning process.

Furthermore, it is important to note that schools that adopted Design and Technology should ensure workshop with enough space and adequate necessary tools and equipment are available. The lack of hands-on tools and equipment is likely to contribute to the ineffective implementation of the subject of design and technology in schools. Constantino and Mariana (2015) explained that learners' ability to explore, experiment, and innovate gets constrained when workshops lack the necessary tools, equipment, or space. The learners might be limited to working on theoretical aspects without practical implementation, thus restricting their creative potential. Furthermore, insufficient or outdated tools limit the breadth and depth of practical experiences learners have to engage in because the Design and Technology subject demands hands on learning experiences to foster design thinking, creativity and technical skills. Therefore, when tools are inadequate, learners are deprived of opportunities to explore diverse materials, techniques, and manufacturing processes. This directly impedes their ability to grasp fundamental concepts and limits their exposure to practical learning of the subject, and subsequently their academic performance is affected.

The Design and Technology education emphasises hands on, experiential learning, blending theoretical knowledge with practical application. The insufficiency or obsolescence of tools inhibits learners' capacity to engage in a diverse range of design processes, experimentation with materials, and the realisation of creative concepts. Consequently, this limits their understanding of fundamental principles and stymies their ability to innovate effectively. This study supported Danmole (2021) who discussed that suitable infrastructure with tools and equipment should be put in place to support the implementation of practical subjects. The workshops and classrooms should be well-furnished and equipped with modern tools, equipment and other learning resources for the subject's effective theoretical and practical teaching and learning. For this reason, for the practical teaching and learning of the subject to take place, the teaching and learning materials should be adequate to enable teachers and learners effectively use them in the implementation process of the subject.

Furthermore, for successfully implementing the Design and Technology subject, infrastructure and resources should be appropriately available for learners' practical experiences. Gloria, Terry and Kanyan (2022) discussed that challenges exist in various aspects, as the subject in the early implementation stage need great consideration of inputs. Thus, the provision of quality teaching and learning tools ensures the subject's effective practical teaching and learning. The practical education requires workshops, tools, equipment, and materials for demonstrations and practical works if effectiveness of the implementation of the subject is to be achieved. Therefore, a successful teaching and learning of the Design and Technology subject in secondary schools greatly depend on the availability and adequacy of the infrastructure and resources. Diana et al (2021) argued that the learners cannot improve their performance without facilities, tools, and equipment. The hands on activities substantially affect knowledge and the development of relevant skills in a school with available resources. Thus, when schools have inadequate and outdated tools, learners fails to align with technological advancements and industry standards.

The mismatch between available tools and contemporary technological advancements poses critical issue in the practical teaching and learning process of the Design and Technology subject in schools. The inadequacy of tools in the teaching and learning of the subject therefore significantly compromises the quality and inclusivity of the practical education. Foster (2017) the effectiveness of implementing process of subjects depend largely on several factors such as workshops and other physical facilities well equipped with practical tools and equipment. Most of all, consensus and involvement of all actors are needed in the process. The inadequacy of equipment poses complex challenges that intersect with the teaching and learning dynamics of the Design and Technology subject, profoundly impacting both pedagogical approaches and learners' practical skills development. The inadequacy of equipment profoundly impacts the teaching and learning landscape within the Design and Technology subject, creating multifaceted challenges that hinder the comprehensive development of learners' skills and knowledge.

Papernek (2019) explained that the best way to teach the subject of design and technology is through exposure to any field of human activity and the equipment used. The learners must therefore acquaint themselves with the mechanical systems involved in the teaching and learning process of the subject. Thus the inadequacy of equipment significantly compromises the depth and quality of teaching and learning in the subject. Furthermore, the inadequacy of equipment significantly impedes the depth and efficacy of practical teaching and learning in the subject of design and technology. At the core of the Design and Technology education, the emphasis is the application of theoretical knowledge into practical skills. Therefore, when confronted with insufficient or outdated equipment, learners are constrained in their ability to engage in diverse design processes, hands on experimentation and material exploration. This limitation significantly curtails their capacity to comprehend fundamental principles and inhibits the cultivation of innovative thinking and problem-solving skills. Borhene (2018) discussed that central to the Design and Technology education is the fusion of theoretical knowledge with the practical application. However, with the scarcity or obsolescence of equipment critically impedes the hands on learning experience essential for learners to comprehend, internalise, and apply concepts. Thus insufficient equipment restricts the breadth and depth of practical experiences, limiting learners' exposure to diverse materials and design processes. Consequently, this curtails learners' ability to develop an understanding of fundamental principles and stifles the cultivation of essential practical problem solving skills and creativity.

Khunyakari (2015) explained that without adequate funding to procure the needed equipment, books, and inputs for appropriate structures to create a good infrastructural base, the implementation of practical subjects including the Design and Technology subject would be a mockery to learners and society. As Jalbani (2014) discussed, unavailability of school facilities, lack of teaching and learning materials, and inadequate financial resources and funding are major impediments to curriculum implementation. Thus the availability of supportive equipment is an important contributor to the successful and effective implementation of the subject of design and technology in secondary schools. Schneider (2022) discussed that practical subjects require infrastructural facilities and material resources that influence the practical teaching and learning to help learners acquire knowledge and develop practical skills for self-reliance. Furthermore, the gap between available equipment and current technological advancements compounds the challenge. Thus outdated equipment impedes learners' exposure to technologies and processes, leaving them ill prepared to navigate the demands of contemporary industries upon completion of secondary education.

Kersh and Juul (2015) explained the lack of tools, equipment, and an infrastructural facility affects learners' performance; negatively reducing their competitiveness for opportunities whose placement is pegged on performance in practical subjects. Thus the quality and adequacy of infrastructure and equipment directly affect the learners' acquisition and development of practical skills. The mismatch between available equipment and evolving technological advancements compounds the challenge. The rapid evolution of technology across industries demands an educational framework that aligns with current practices. Thus the outdated equipment not only hinders learners' exposure to modern tools but also fails to prepare them for the dynamic requirements of the contemporary industries, thereby undermining their competitiveness in their future careers.

The inadequacy of machines profoundly impacts the pedagogical framework and learning outcomes in the teaching and learning of the Design and Technology subject in schools, presenting multifaceted challenges that hinder the acquisition of knowledge, practical comprehension, and innovation. The inadequacy of machines profoundly impacts the educational landscape within the Design and Technology subject, presenting multifaceted challenges that hinder the learners' effective utilisation of pedagogy, skill development, and holistic learning experiences. Mcgrawth (2018) argued that the competencies cannot be transferred to learners without practical teaching and learning. This is because at the core of design and technology education is the fusion of theoretical knowledge with practical application, where machines serve as pivotal resources for experimentation and the realisation of design concepts. However, when faced with inadequate or outdated machines, learners' hands on learning experiences are severely restricted. This limitation impedes their ability to engage in diverse design processes and experiment with materials, thereby hindering the learners' development of critical problem-solving skills and inhibiting their creativity.

Fundamentally, the Design and Technology education is grounded in the integration of theoretical knowledge with hands on practical application. In this arrangement, machines plays pivotal roles in facilitating this practical application by enabling learners to engage in design processes, prototype creation, and material manipulation. However, Magasu et al (2022) indicated that teachers had challenges due to a lack of teaching and learning materials, and poorly stocked laboratories. Thus when faced with insufficient or outdated machines, learners' ability to experiment, innovate, and explore various design iterations becomes severely constrained. This limitation directly affects learners' practical skill development inhibits their capacity to comprehend complex design principles, and stifles the development of critical problem-solving abilities.

The inputs for the Design and Technology subject are essential resources for the effective implementation of the subject in schools. Therefore, to effectively implement the subject of design and technology, schools should be well equipped with appropriate inputs if learners are to acquire knowledge and develop practical skills (Claudia, 2015; Alexandre, 2015). To effectively implement the Design and Technology subject, the machines such as welding, building spirit levels, saws and electrical tools, should be available during the subject's teaching and learning process. These may enable learners acquire knowledge and practical skills useful before and after the completion of the program, and eventually become self-reliant. However, Table 4.4 shows the gap between available machines and contemporary technological advancements worsens the challenge in the implementation of the subject.

Furthermore, Bell (2017) explained that schools with acute shortage of machines and workshops to conduct practicals tend to compromise the quality of education given to learners. Thus to implement the Design and Technology education, appropriate practical machines and tools should be available in an appropriate workshop to support the practical implementation of the subject in schools. This is why Okoye (2017) guided that schools should put teaching and learning materials in place to effectively support the practical implementation of the subject of design and technology. Thus, doing so may help promote an effective implementation of the subject and motivate teachers and learners to smoothly implement it. Therefore, effective teaching and learning of the Design and Technology subject can only occur where the teaching and learning is done in the same way with the same operation and machines as in the occupation itself.

Kasaro (2021) explained that the teaching strategies expected to be used by teachers in teaching and learning vocational skills were not being used by most of the teachers. They did not use them appropriately due to the lack of teaching and learning resources. Thus the tenets of the Design and Technology curriculum remained unfamiliar to some teachers teaching the subject, thereby not effectively teaching the practical skills. Therefore, the inadequacy of resources for the subject limits learners' exposure to modern machines and fails to prepare them with expected knowledge and practical skills. This significantly impedes the depth and efficacy of teaching and learning within the subject of design and technology. Furthermore, Douglar (2023) explained that the lack of machines not only hinder learners' exposure to modern technology but also fails to prepare them for the dynamic requirements of current industries, compromising competitiveness in the learners' future careers. Thus the mismatch between available machines and contemporary technological advancements compounds the challenge of implementing the subject in schools.

It is evident that the availability and adequacy of learning resources play a crucial role in shaping the outcomes of both learners and teachers. The impact extends beyond mere academic performance to encompass teacher motivation and overall educational achievement. Schools lacking sufficient resources tend to exhibit lower performance levels among learners, as Johan (2014) emphasised. He posits that a positive correlation exists between examination performance and the adequacy and utilisation of learning resources, suggesting that institutions with insufficient resources are likely to witness poor performance across in the teaching and learning of Design and Technology subject in schools. Thus, providing relevant learning materials is a key strategy for enhancing results in schools, particularly in the Design and Technology subject context. The study by Diana etal (2021) also affirmed the strong relationship between the adequacy of learning resources and learner performance as Levacic and Vignoles (2015) also highlighted a direct association between school resources and learners' performance, stressing the need for proper utilisation to improve performance in examinations.

The study's findings in Table 4.4 shows that textbooks were distributed in groups rather than individually which limited each learners' access to critical learning resources leading to low perception (mean=3). When schools are faced with inadequate textbooks when implementing the Design and Technology subject, teachers and learners encounter significant impediments in accessing comprehensive and up-to-date information. Chedi and Hamza (2019) explained that the textbooks for the teaching and learning are critical. Thus, the limitation of these resources in schools restricts the depth of understanding of fundamental principles of the subject, innovative design methodologies, and contemporary industry practices. Thus, the inadequacy of the Design and Technology subject textbooks significantly impacts the pedagogical framework, learning outcomes, and overall educational experience in the subject. This is because the textbooks serve as foundational resources, providing theoretical frameworks, practical examples, and conceptual knowledge essential for learners' learning journey.

Furthermore, Mkeredzi (2019) discussed that design and technology education textbooks serve as foundational resources, offering a structured repository of theoretical knowledge, practical applications, and conceptual frameworks essential for learners' learning processes. For this reason, the inadequacy of textbooks creates a void in educational resources, undermining the quality and depth of learning experiences. Thus insufficient coverage of diverse design processes, materials, and technological advancements restricts learners' exposure to a wide spectrum of concepts and methodologies. Consequently, this limitation hampers the learners' ability to develop critical thinking skills, hindering their capacity for innovative problem-solving and design ideation. Furthermore, the rapid evolution of technology and design practices amplifies the consequences of inadequate textbooks. Thus, outdated materials fail to capture contemporary advancements in the teaching and learning processes, leaving learners ill-prepared to navigate the dynamic demands of the modern industries. This discrepancy between educational resources and industry standards hinder learners' preparedness for real-world development and application of skills; hence diminishing their competitiveness in the subject for their future responsibility. This is why Tamil (2021) pointed out that no meaningful teaching and learning occurs without adequate resource materials and appropriate infrastructure.

The implication of inadequate teaching and learning resources (inputs) in Design and Technology subject negatively impact teachers and learners. Without proper tools, equipment, and well-equipped workshops, learners miss out on hands-on learning, making it difficult for them to develop practical skills and apply theoretical concepts. This leads to a poor understanding of the subject and reduced interest in learning. Teachers may also struggle to deliver effective lessons due to limited resources, affecting the quality of implementing the subject in schools. Additionally, insufficient resources can make it hard for teachers to provide personalised attention and feedback. The gap between classroom learning and real-world application widens, leaving learners unprepared for future careers that require technical skills. Ultimately, poor resource availability lower learners' academic performance and hinder the overall success of the subject in schools.

5.3 Teaching, Learning and Assessment Processes of Design and Technology Subject

The third research objective was meant to establish the adequacy of the Design and Technology subject's teaching, learning and assessment processes. The teaching methods and assessment practices in Design and Technology focus on theoretical instruction, with learners acknowledging consistent theoretical lessons (mean = 5) as reported in Table 4.5 on page 135. Practical lessons and demonstrations were provided but were insufficient to meet the expectations of hands-on learning. While hands-on learning was rated positively (mean = 5), learners noted limited opportunities for manipulating tools and machinery, with a low perception score of 3. This imbalance between theoretical and practical elements raises concerns about the effectiveness of skill acquisition in the subject. Assessments followed a similar pattern, with theoretical evaluations being more common than practical ones as shown in Table 4.5 shows high perception (mean=4) that learners do not have hands on type of assessment . This emphasis on theory could lead to a disconnect between learners' knowledge and their ability to apply it in real-world scenarios.

5.3.1 Insufficient Periods for the Design and Technology Subject in Schools

In the 2013 curriculum, Design and Technology subject was given 12 periods per week. However, schools reduced this to either 6 or periods per week to make room for other subjects. The teachers also argued against the adequacy of teaching and learning the Design and Technology due to the reduction in the number of periods allocated to the subject and inadequate teaching and learning resources. Thus the subject was not adequately implemented to effectively carry out practical teaching. Time is a very important resource that should be managed properly. In the same way, the time allocated to each subject must be utilized correctly. However, the sentiments shared by most of the teachers during the interviews regarding the adequacy of the teaching and learning of the subject showed the inadequacy of the implementation of the subject as they indicated the reduction of the allocated number of periods for the Design and Technology subject against the 2013 curriculum framework underscore notable concerns saying that:

> *According to the 2013 curriculum, the periods allocated to the Design and Technology subject are enough. But the challenge which is there is that we have so many subjects in school that have got their own allocation. Now you will discover that we do not get the 12 periods that are required instead the periods have reduced the least is 9 periods per week. Now! Imagine reducing from 12-9 periods. That is a serious down grade in terms of the session. So as for Design and Technology subject, learners to be trained in that kind of the subject area because in a session that you are supposed to in a week, you would not have enough time for, say practicals. Learners cannot do practicals perfectly if time is not enough; if you are going to conduct practicals, you are going to do it within a short period of time. It is not possible to finish practicals within a short period of time. Because of that, the periods given to Design and Technology subject are not sufficient (TR2 C).*

The study further found that schools reduced the number of periods for the Design and Technology subject from 12 to 6 per week contrary to the 2013 curriculum framework. One participant revealed that:

> *The subject is bulky as it has many components including metal and fabrication, carpentry and joinery, electrical and graphical communication, and a lot of topics. Now with the reduction of the periods from 12 to 6, practically the 2 periods per week for each component of the subject is not enough. Again you will find that each component has a lot of topics and very detailed one (TR1 B).*

The reduction in the number of periods or sessions allocated to the teaching and learning of the Design and Technology subject poses significant challenges that profoundly impact the quality, depth, and efficacy of Design and Technology education. Fazidah et al. (2019) lamented that the reduction in teaching and learning time has complex consequences, affecting both learners' learning experiences and teachers' instructional strategies. In other words, reducing the number of periods or sessions allocated to the teaching and learning of the Design and Technology subject represents a lot of challenge that profoundly impacts the subject's depth, breadth, and efficacy.

Lubasi (2019) underscored the significance of adequate time as a pivotal factor contributing to the enhancement of educational efficacy and efficiency. Echoing this sentiment, Lubasi (2019) further emphasised that achieving educational objectives, irrespective of the abundance of resources, remains intangible without adequate time. Thus this reduction has implications for both learners' learning experiences and teachers' instructional approaches. The time constraints within class schedules limit the inclusion of practical activities and the syllabus coverage. Therefore, the insufficient time dedicated to hands-on experiences restricts the depth and breadth of opportunities necessary for comprehensive skills development among learners in schools. In other words, limited time restricts the inclusion of practical activities, which compromises the depth and breadth of hands on experiences critical for comprehensive skills development. This is because the Design and Technology education is characterised by its hands-on, experiential nature, thus demanding substantial time for practical application, experimentation and iterative design processes.

Reducing the time for Design and Technology from 12 to 6 periods per week can have a negative impact on learning. With less time, learners have fewer opportunities to practice hands-on skills, which are essential for understanding the subject. Practical lessons are rushed, preventing learners from mastering the use of tools and equipment. Teachers struggle to cover all the important topics, leading to gaps in knowledge. The reduced time lower learners' engagement and interest due to inadequate enough exposure to real-world applications. Additionally, less time for practical work make it harder for learners to develop critical problem-solving and technical skills needed for future careers. Overall, cutting down learning time eventually weaken the quality of implementing Design and Technology, making it difficult for learners to perform well in the subject.

The Design and Technology subject is practical, requiring learners' to engage hands-on, iteratively design processes, and apply theoretical concepts in real situations. Thus a decrease in the number of periods directly constrains the time available for learners to immerse themselves in practical work that they are expected to engage in. Therefore, this limitation restricts opportunities for experimentation, material exploration, and iterative design, hindering the development of critical problem-solving skills and practical experience central to the Design and Technology education. The reduction in periods adversely affects the breadth of the curriculum that teachers should cover. The Design and Technology subject is multidisciplinary, encompassing various design principles, technological applications, material studies, and problem solving methodologies. Thus a decrease in the number of sessions limits the scope of the content that can be taught, potentially leading to a shallow understanding of fundamental concepts and omitting essential topics by teachers. Lubasi (2019) elucidated the imperative of channeling efforts towards enhancing educational systems to ensure the delivery of pertinent and high-quality education.

Given the time-dependent nature of all educational activities, a concerted focus on time is central to this endeavour. This reduction in the teaching and learning of Design and Technology curriculum may compromise learners' exposure to diverse techniques, processes, and emerging technologies within the subject during the process of implementing the subject. As already alluded to, the reduction in the periods schools allocate to the Design and Technology subject diminishes the scope of the curriculum that teachers should cover; this is because Design and Technology subject is a multidisciplinary subject encompassing design theory, technological applications, material studies, and problem-solving methodologies.

Thus the decrease in the teaching and learning of Design and Technology curriculum time limits the breadth of content that has to be taught, potentially leading to a surface-level understanding of essential concepts and omitting critical topics. This deprives learners of exposure to diverse techniques, processes, and emerging technologies within the discipline. Additionally, delving into the practical application of time within the educational framework, the investigation by Rodgers and Mirra (2014) on Learning Time and Educational Opportunity in California High Schools reaffirms the pivotal role of learning time as an indispensable resource for realizing educational objectives. For this reason, the reduced time allocation strains teachers' instructional methodologies and planning. Thus teachers must condense lessons, limit hands-on activities, or streamline content delivery to fit within the reduced timeframe. This compression may lead to rushed teaching, restricted practical engagement, or the omission of experiential learning opportunities integral to design and technology education in schools. As a result the quality of instruction and depth of learners' engagement may diminish, impacting the subject's learning outcome.

Harnandez et al (2014) underscored the importance of aligning curricular objectives with specific time frames, advocating for maximal learner engagement in learning activities to optimise educational outcomes. Similarly, Mulenga (2015) elucidated the complex process of curriculum implementation, underscoring the pivotal role of teachers in facilitating students' acquisition of knowledge, skills, values, and attitudes within the school environment. Moreover, teachers face challenges in adapting their instructional strategies to accommodate the reduced time allocation. Therefore when teachers condense lessons, by prioritising specific topics, or limit hands-on activities compromises the depth and breadth of learner engagement in the subject, and eventually impact the quality of teaching.

The study's finding in Table 4.6 on page 138 shows high perception (mean=5) of inadequate practical teaching and learning in the Design and Technology subject. This significantly impedes the acquisition of knowledge and the development of practical skills among learners in secondary schools, resulting in complex challenges that hinder their holistic understanding the teaching of the subject. Roberts (2015) discussed that for the Design and Technology lessons to be practical, both teachers and learners must demonstrate the practical aspect of teaching and learning the subject. The time should be enough with inputs readily available and adequate to allow all learners and teachers equal access to them and appropriate in terms of learners' education level. With the experiential learning processes, the workshop should have a shared space with workbenches, hand tools, equipment, storage, and supply areas. Thus the inadequacy of practical teaching and learning within the Design and Technology subject poses a significant impediment to acquiring knowledge and developing practical skills among learners, leading to complex challenges that hinder their comprehensive educational growth in the subject.

The Design and Technology education relies heavily on hands on, practical experiences to foster creativity, problem-solving skills, and technical proficiency. However, when faced with inadequate resources or limited practical learning opportunities, learners' ability to engage meaningfully with the subject is severely restricted. This limitation directly affects the learners' acquisition of knowledge, as theoretical concepts often need practical application for a deeper understanding.

5.3.2 Insufficient Training of Teachers in the Design and Technology Subject

The study found that some teachers were not adequately trained in the subject of Design and Technology because they were trained in one of the components of the subject. This is why one of the participants elaborated that:

> *Sometime back, it was very interesting as a teacher when you are teaching because you really know what you are talking about. So apa, it means for us who majored in one of the components of Design and Technology, that is wood work or metal work or Technical Drawing, we are disadvantaged. Apa, we are planning to go back to school so that we can advance more about Design and Technology subject, more especially in the components we are not trained in. This will help us to know what we are talking about. It is very cumbersome, you are in class talking about metal work which you did not do way back, like ku college. That is when they introduced this Design and Technology subject whereby they just merged everything. For the materials, the materials for the components; metal work, wood work, and graphical communication, so when you are talking about, you are not even sure what you are teaching the learners is the truth kayili you are just book lifting, whereby if you have the experience and the knowledge about it way back, it is very easy for you to flow even when you teaching.*

> *Personally, I did wood work which is carpentry and joinery. Therefore, I find it a challenge to teach other components, but have adapted with other components. I'm planning to go to either Kabwe Institute of Technology or TVTC to fully specialise in the Design and Technology subject (TR1 C).*

The other participant interviewed indicated that:

> *We may also need teachers to be refreshed in terms of courses because most of the teachers just did wood work, or metal work or technical drawing, and Design and Technology subject is a new concept to them. There are many things which we do not have as capacity. Therefore, there is need to build capacity through trainings. It is very difficult to teach Design and Technology subject when a teacher just specialised in a single component of the subject. Most teachers shun from teaching the science aspect of Design and Technology subject. So mostly, they call upon other teachers to do that for them (TR3 C).*

Some Design and Technology subject teachers request other teachers to teach certain topics they are uncomfortable with. This is against the MoE (2013) which states that learning institutions should ensure that they put in place the right numbers with correct academic and professional qualifications for teaching staff to help effectively implement the curriculum. This affects the effective implementation of the subject. Fazidah et al. (2019) explained that well-equipped and knowledgeable teachers motivate learners by diversifying approaches, methods, and assessments throughout the teaching and learning sessions to prepare them for future professions. Therefore, if schools have adequate and well-trained teachers in the subject of design and technology, they may easily apply methods that promote the manipulation of the tools and equipment for practical teaching and learning. Teachers' lack of adequate training is likely to hinder learners' ability to facilitate engaging hands-on learning experiences, further impeding their practical skill development. This limits learners' ability to create engaging hands-on learning environments, hindering them from practical skills development.

The inadequacy of trained teachers in the Design and Technology subject profoundly affects the implementation and quality of education within this field, presenting challenges that impact both learners' learning experiences and the overall effectiveness of implementing the Design and Technology subject in schools. Consequently, learners fail to understand the ultimate principles of the subject. This is why Makunja (2015) guided that teachers need to be retrained if the application of prescribed pedagogies in Design and Technology syllabus is to achieve the set goals. Thus the retraining of teachers is required for the effective execution of the syllabus.

The inadequacy of trained teachers in the Design and Technology subject profoundly undermines the implementation and efficacy of Design and Technology education, resulting in complex challenges that impede the quality of teaching, learners' learning experiences and the overall advancement of the subject. The implementation of the Design and Technology subject demands well-trained teachers. Gloria, Terry, and Kanyan (2022) explained that Design and Technology education requires specialised knowledge encompassing design principles and technological applications. Thus the shortage of trained teachers creates significant difficulties in delivering comprehensive and high quality teaching and learning.

The discourse surrounding educational challenges, as elucidated by Mhango (2021) highlighted systemic deficiency of qualified teachers. These challenges inhibit effective implementation of the subject, underscoring the complex nature of the education. The shortage of adequately trained teachers in the Design and Technology subject area therefore significantly impacts the delivery of comprehensive and high-quality practical instruction. For this reason, teachers lacking specialised training may struggle to effectively convey complex theoretical concepts or guide learners through practical applications and iterative design processes, thereby limiting their depth of understanding and development of practical skills. Therefore, practical education can only be effective if teachers have successful experience of applying skills and knowledge regarding operations and work processes.

Furthermore, it is important to point out that the Design and Technology subject requires teachers who have complete training in all components for effective teaching and learning. When schools do not have adequately trained teachers in the subject, the learners cannot acquire the envisaged skills, and their education could then be considered a waste. Broom (2015) discussed that teachers' incompetence is a challenge to handling of Technical and Vocational Education (TVE) subjects. Thus when teachers have the right competencies in the subject, it is easy to help learners acquire the knowledge and develop the practical skills. The deficiency in trained teachers directly correlates with limitations in curriculum coverage and instructional methodologies. For this reason, teachers without sufficient training in the Design and Technology subject are likely to possess a narrow understanding of the subject, leading to a restricted scope of instruction and potential omissions of critical areas within the Design and Technology curriculum in school. This limitation therefore curtails learners' exposure to diverse design methodologies, emerging technologies and real-world applications crucial for their holistic development in the subject.

Furthermore, regarding the inadequate training of teachers, one of the study participants revealed that:

> *Some teachers' lack adequate training in the Design and Technology subject, being proficient only in specific components of it, raises important concerns about the breadth and depth of teachers' preparedness to deliver comprehensive teaching to learners. This fragmented knowledge base can present challenges when teachers are required to teach topics outside of their area of expertise. Instances where teachers invite colleagues to assist in teaching topics they are not familiar with highlight the need for a more holistic approach to teacher training and subject delivery (TR1B).*

From the revelation above, teachers lack adequate training in Design and Technology, with their expertise limited to specific areas of the subject. This raises concerns about their ability to provide comprehensive instruction to learners. When required to teach topics beyond their expertise, teachers face challenges in delivering effective lessons. In some cases, they rely on colleagues to assist with unfamiliar topics, highlighting gaps in their training. These findings emphasise the need for a more holistic approach to teacher training to ensure that teachers are well-equipped to teach all aspects of the subject effectively. Mhango (2021) explained that teachers with limited training may lack the detailed understanding required to navigate diverse topics within the Design and Technology subject, leading to a narrowed scope of instruction and potentially omitting critical areas of the subject curriculum. This limitation hampers learners' exposure to various design methodologies, emerging technologies, and real application of skills within the subject. This is because the Design and Technology education demands specialised knowledge encompassing various disciplines, including design theory, technological applications, materials science, and teaching methodologies. Cedfop (2015) explained that the inadequacy and non-availability of educational and human resources for a successful teaching of the practical subject have an effect on the effective implementation of subjects.

The inadequate training of teachers in the subject impact the comprehensive and high-quality teaching and learning (Broom, 2015). Therefore, teachers lacking specialised training in the design and technology subject struggle to effectively convey complex theoretical concepts and guide learners through practical applications and iterative design processes, thereby limiting the depth of understanding and practical skills development among learners. The deficiency in trained teachers directly correlates with limitations in curriculum coverage and instructional methodologies. Thus teachers without sufficient training in the subject of design and technology may have a narrow understanding of the subject, leading to a restricted scope of instruction and potential omissions of critical areas within the subject area. This limitation curtails learners' exposure to diverse design methodologies, emerging technologies, and practical skills applications critical for their holistic development in the subject.

Mwanza (2017) explained that teachers are central to achieving universal access to high quality and equitable education for learners because they have first-hand knowledge of the good learning environment and the learners and how the two relate. The Competency-Based Curriculum may look uncomplicated in design, but it is not as easy as it seems. In theory, it involves teachers being knowledgeable of the curriculum's key principles and appropriately equipped with skills and desirable attitudes to teaching using competency-based approaches. The Design and Technology education can only be effectively implemented if teachers have successful experience in applying the skills and knowledge regarding the operations and work processes carried out to enable practical knowledge and skill transmitted to learners. Thus the absence of adequately trained teachers in the Design and Technology subject might hinder the incorporation of innovative pedagogical approaches and hands on learning experiences; this is because the Design and Technology education often relies on project-based learning, practical demonstrations and interactive workshops. Therefore, the teachers lacking adequate training are likely to struggle to implement these instructional methodologies effectively, thereby limiting learners' opportunities for practical engagement and skill development.

The study by Kabeta (2022) also revealed that the implementation of the 2013 curriculum was poorly conducted as most educators' perception and knowledge on vocation education was below expectation. This is because teachers were set to take on the task but were disadvantaged by lack of orientation or retraining. Therefore, the findings of this study agree with Kabeta (2022) that the absence of adequately trained Design and Technology teachers hampers the integration of innovative pedagogical approaches and hands on learning experiences because the Design and Technology education relies on interactive workshops and practical learning through practical demonstrations. For this reason, teachers lacking appropriate training might struggle to effectively implement these instructional methodologies, limiting learners' opportunities for engaging in practical application and development of the essential skills.

Furthermore, Kakupa (2017) indicated that Zambia was still struggling to provide access to and improved quality of education due to inadequate qualified teachers to deliver practical subjects effectively. Most vocational subjects lack expert teachers to deliver the content competently; this situation seemed to be a challenge. Therefore, schools with a scarcity of qualified Design and Technology subject teachers might fail to provide quality learning opportunities to learners. The study established that some Design and Technology subject teachers were still trained in one of the components of the subject. It is for this reason that when teachers are inadequately trained, they deprive the learners to access quality Design and Technology education essential for their future careers and technological literacy. Thus trained teachers play pivotal roles in guiding learners in facilitating the connection between theoretical concepts and practical application.

The teachers serve as mentors who not only impart theoretical knowledge but also scaffold learners' transition from theory to practice, guiding their exploration, fostering critical thinking, and providing a framework for applying theoretical knowledge to real-world problems. The study found that some teachers were only trained in one of the components of the Design and Technology subject. This is why the study by Magasu (2022) suggested that teachers were improperly trained on STEM curriculum. This is likely to affect the implementation of Design and Technology subject which is one of the components of the STEM curriculum. Thus to achieve this, the subject requires adequate and well trained teachers in schools for an effective teaching and learning.

The implication of inadequate training of teachers in Design and Technology affects the quality of teaching and learning. Teachers who are not well-trained may struggle to explain concepts clearly and lack the skills needed to demonstrate practical lessons effectively. This can lead to learners having a weak understanding of the subject, making it difficult for them to apply their knowledge in real-world situations. Additionally, teachers may avoid teaching topics they are not familiar with or rely on colleagues for help, creating inconsistency in lesson delivery. Without proper training, teachers may also find it hard to keep up with new technologies and teaching methods, reducing the subject’s relevance. Ultimately, teachers lower learners’ performance in Design and Technology, limiting their ability to develop important technical and problem-solving skills.

5.3.3 Inadequate Assessment of Learners in the Design and Technology Subject

The experiences shared by teachers regarding the shortages of resources required in teaching of the Design and Technology subject shed light on a significant challenge in the teaching, learning and assessment processes of the subject. Thus one participant said that:

> *We sometimes use theoretical questions, question and answer method, and demonstration method to teach the learners. We usually manage to teach learners using demonstration method because we want the skills to be enhanced in learners, so we do not just sit because we do not have enough tools, equipment or machines, then we stop, no! We make it with the little tools that we have so that we can enhance skills in them. We do just struggle to just make things do by way of grouping the children, putting them in groups so that atleast in groups each one can try here there, here there and so on, but it is not adequate to practice in groups, it is not very, very adequate (*TR1 B).

Another participant highlighted that:

> *It is not always that we have to conduct practicals in Design and Technology subject, but I feel with limited teaching and learning materials, group work method is employed. Therefore, when the other learners are using the tools or operating a welding machine, the other learners observe the friends and by doing so they acquire the knowledge apart from the practical part of the subject which requires learners develop the skills (TR1 C).*

Regarding the use of group work, the other teacher revealed that:

> *In times when we do not have enough tools, equipment and machines and other materials, the group work is employed. I feel this is also an effective way of teaching Design and Technology subject when the teaching and learning resources are not enough. Therefore, we group them due to limited resources as you know the goal is to make every learner acquire the knowledge and develop expected skills (TR1D).*

The insights provided by the other participant regarding the teaching and learning of the Design and Technology subject offered valuable perspectives on the challenges experienced in implementing the subject that:

> *Because sometimes resources are not always enough, learners are taught the subject as theory, and when the time for the final examinations is near, the tools, and other materials are bought. How can you ensure learners acquire the necessary knowledge and skill, and how do you conduct practicals when examinations are near. We cannot just sit simply because what to use is not there or not enough. Grouping of learners is done when the section do not have the necessary teaching and learning materials for practicals (TR2 B).*

The other prevalent observation among the participants is the recognition of the nature of assessment in Design and Technology subject was that:

> *Design and Technology subject, just as the nature of the subject is a hand-on subject most of the time. So we do practicals, there is also a part for theory, the designing itself. I think those are the methods. In terms of practicals, instead of testing them individually we test them as a group so that the tools are sufficient for them because if we say each child should carry a practical on her own, it means will not do that practical in a day, it will require us to do more than one day (TR2 A).*

The other participant pointed out that:

> *When it comes to testing of learners in the subject, we use both theory and practicals. But it is very easy to test learners in theory part as opposed to practicals. In practical assessment we need to have in place the necessary tools, equipment and machines and other resources. Now with the inadequacy of these resources, according to me, learners are not adequately assessed to determine their levels of knowledge acquisition and skills development. Therefore, I can say that we need more resources in the teaching and learning of the Design and Technology subject in school. In Design and Technology subject, we assess the learners 2 times per term, but there is also an ongoing assessment for the portfolio in term 1 and 2. The inadequacy of the materials for the subject has got a bearing on the way the assessment of the learners in the subject is done. It is because of this that we assess our learners in groups of 5. I don't think if learners are adequately assessed in the subject amid limited resources and infrastructure for the practical subject (*TR3 D).

The assessment of learners in the Design and Technology subject is a critical aspect of evaluating learners' understanding, skills, and competency development in the subject. These skills influence on practices of teachers for classroom assessment. Nazirullah (2023) indicated that an assessment is an essential part of the teaching and learning in the classroom for effective evaluation. However, the study found that learners were often assessed in groups because of insufficient teaching and learning resources available. The insights from the interviews with Design and Technology subject teachers shed light on approaches and challenges associated with assessing learners' progress and achievements in the Design and Technology subject.

The assessment of learners in groups means that instead of assessing each learner individually, they are tested as part of a group. This was due to limited teaching and learning resources support individual assessment. So, teachers resorted to group assessments as a way to manage the situation. While group assessments can have benefits like encouraging teamwork, they also have downsides. For example, seeing each learner's strengths and weaknesses might be harder when assessed in a group. Additionally, some learners might end up doing more work than others in the group, leading to unfairness in grading, and may not give the true reflection of the learners. Therefore, the learners are inadequately assessed in the subject of design and technology.

Keba (2015) indicated that students' performance assessment in practicals measures the extent to which students performed their tasks to prepare them technically. However, the inadequacy of practical assessment in the Design and Technology subject significantly impacts the implementation and effectiveness of the subject, presenting multifaceted challenges that hinder both learners' learning experiences and the overall advancement of the field. The inadequacy of practical assessment methodologies in the subject of design and technology significantly impedes its effective implementation. Assessment practices play a role in the implementation process of the Design and Technology subject in schools. This is because the evaluation methods that primarily measure theoretical knowledge through written exams might undervalue practical skills. Learners might prioritise memorisation of theoretical content over hands on application, perpetuating the disregard for practical competencies in assessments as Gudyanga and Loyiso (2019) noted. Therefore, the inadequacy of practical assessment in the Design and Technology subject often priotises theoretical understanding over practical application. When assessments primarily measure theoretical knowledge through written exams or standardised tests, learners may focus on memorisation rather than hands on application, thus resulting in the undervaluation of practical skills.

Furthermore, the practical assessment in the Design and Technology education plays a crucial role in evaluating learners' application of the theoretical knowledge, problem-solving abilities, design skills, and innovative thinking within real practical contexts. However, when faced with inadequacies in practical assessment methodologies, several challenges arise, impacting the implementation of the subject. Carbonilla (2016) explained that practical assessment serves as a critical tool to evaluate learners' application of theoretical knowledge, problem-solving skills, and creative design abilities. Thus Shihab (2021) when confronted with inadequacies in the practical assessment of the subject, several challenges emerge, significantly impacting the implementation of the subject. Firstly, the practical assessments serve as a crucial tool for evaluating learners' hands on skills, critical thinking, and creativity.

Moreover, the inadequacy of practical assessment may disincentive learners' engagement in the hands on learning experiences, potentially undervaluing the learners' practical expertise and innovative capacities. Therefore, if the assessments do not adequately reflect the skills and competencies valued in the Design and Technology subject, learners may prioritise theoretical learning over practical application to meet assessment criteria only. This shift in focus is likely to compromise the holistic development of learners' practical skills and problem-solving abilities. For this reason, the inadequacies of practical assessment in the Design and Technology subject can inadvertently disincentive learners' engagement in the hands on learning experiences. Gibbs (2017) pointed out that when assessments do not adequately reflect the valued skills and competencies in the Design and Technology education, learners may prioritise theoretical learning over practical application to meet assessment criteria and nothing else. This shift in focus can therefore compromise the holistic development of the learners' practical skills.

Design and Technology education requires assessments that mirror real-world design challenges, allowing the learners to authentically demonstrate their creativity, technical proficiency, and problem-solving skills. Therefore, inadequate practical assessment methods limit learners' opportunities to showcase their capabilities in diverse design situations, undermining the authenticity of their evaluation in the subject. Sumaiya and Shah (2023) explained that the absence of robust practical assessment methods impacts evaluations' authenticity and quality because the Design and Technology education demands assessments that mirror real-world design challenges, allowing learners to authentically demonstrate their creativity, technical proficiency, and problem-solving skills. For this reason, the inadequacy of assessment methods restricts learners' opportunities to showcase their capabilities in diverse design scenarios, undermining the authenticity and validity of their evaluations in the subject.

Inadequate assessment of learners in Design and Technology subject negatively impact their learning and skill development. Hence without proper assessment, teachers may not accurately measure learners' understanding and progress, making it difficult to identify areas where they need improvement. This result in learners moving forward with gaps in their knowledge and skills, which affect their ability to apply what they have learned in practical situations. Thus, poor assessment methods make learners not receive useful feedback to help them improve. Additionally, if practical skills are not properly assessed, learners graduate without the hands-on experience needed for real-world problem-solving and technical careers. Overall, ineffective assessment weakens the quality of implementing design and technology, making it harder for learners to succeed in the subject.

5.4 Learners' Acquisition of Knowledge, Development and Application of Practical Skills

The fourth research objective was meant to analyse the extent to which learners develop and apply the knowledge and skills of the Design and Technology subject. Table 4.7 on page 145 shows a mixed picture of learners' ability to develop and apply the knowledge and skills taught in the Design and Technology curriculum. While learners reported a high understanding of electrical and electronics concepts (mean = 4), they struggled with applying their knowledge in practical tasks such as domestic electrical installation (mean = 3) and carpentry skills (mean = 3). Notably, bricklaying, plastering, and metal fabrication skills were perceived as underdeveloped despite exposure to these topics in the curriculum. This gap between theoretical understanding and practical skill highlights the need for more immersive, hands-on learning opportunities. Table 4.7 shows that while learners have acquired theoretical knowledge of the subject, there is a notable discrepancy in the development of practical skills. The data paints a mixed picture of learners' ability to develop and apply the knowledge and skills taught in the Design and Technology curriculum. While learners reported a high understanding of electrical and electronics concepts (mean = 4), they struggled with applying their knowledge in practical tasks such as domestic electrical installation (mean = 3) and carpentry skills (mean = 3). Notably, bricklaying, plastering, and metal fabrication skills were perceived as underdeveloped despite exposure to these topics in the curriculum. This gap between theoretical understanding and practical skill highlights the need for more immersive, hands-on learning opportunities.

5.4.1 Learners' Acquire more Knowledge than the Development of Skills in Design and Technology Subject

The affirmation echoed by some teachers emphasises the critical role of the teaching and learning resources in fostering the development of practical skills among learners in the Design and Technology subject. Thus, one of the teachers argued that learners acquired more knowledge as opposed to skills development by saying that:

> *The way I see, our learners have acquired more knowledge as compared to skills development. Personally, I don't see them applying what they have learnt from the Design and Technology subject. I feel because of the challenges have earlier alluded to. This is the more reason why our learners take the subject for sake of passing it and not for skills development. A lot need to be put in place to ensure learners acquire the practical knowledge and skills for them to stand on their own in future. I would recommend a good workshop to be built specifically for the Design and Technology subject. The tools, equipment and machines should be available to ensure smooth teaching and learning of the subject. When these resources are readily available will be very easy for the learners to develop the practical skills expected of them (*TR1 D).

Firstly, practical skills development in the Design and Technology education requires learners to engage in practicals, experiment with materials, apply theoretical concepts in real-world scenarios, and develop critical problem-solving skills. The learners need opportunities to bridge the gap between theoretical understanding and hands-on experiences ((Nkanza, 2014). However, directly translating theoretical understanding into practical skills involves a complex process. While theoretical teaching lays the groundwork, its effectiveness in developing practical skills depends on how well learners can apply this knowledge. Simply acquiring theoretical knowledge does not automatically ensure the development of practical competencies. The challenge arises when there is an imbalance or disconnect between theoretical teaching and practical application. Therefore, if the emphasis is predominantly on theoretical learning without adequate opportunities for hands on experimentation and application, learners are likely to struggle to transfer their theoretical understanding into practical contexts. This discrepancy hinders the development of critical practical skills among learners for the Design and Technology education in schools.

5.4.2 Inability of Learners to Develop Practical Skills

The study results show that learners did not fully develop and apply practical skills as shown in Table 4.7. Therefore, the implementation of the subject might be theoretical. The concerns raised by most of the Design and Technology subject teachers shows inability of learners to develop practical skills due to inadequate teaching and learning resources reflect a critical issue in the implementation of the subject by indicating that:

> *What I can say is that some learners partially develop domestic electrical installation skill. I'm saying so because this component is so demandful for resources when it comes to its implementation as the teaching and learning resources have to be readily available. Now with the inadequacies of the materials as I indicated earlier, learners partially develop the domestic electrical skill. By partially I simply mean that learners may only develop the practical skills only in those components of the Design and Technology subject that are adequately stocked with the machines, tools and equipment (TR3 A).*

In the Design and Technology subject, the emphasis on knowledge acquisition over the development of critical practical skills represents many educational challenges that significantly impact the learners' preparedness for applying theoretical knowledge. The study showed similar results to those of Cathrine and Sabariah (2019), who stated that teachers' competency pedagogy knowledge had not reached a satisfactory level. The teachers tend to use the traditional lectures approach due to resource constraints negatively affect the practical teaching and learning of the Design and Technology subject. Theoretical teaching in the Design and Technology subject encompasses imparting knowledge about the subject concepts. This provides learners with a conceptual framework and understanding of the underlying principles governing various design methodologies and technological applications. However, the mere acquisition of theoretical knowledge does not guarantee the development of practical skills.

The theoretical teaching in the Design and Technology encompasses imparting fundamental knowledge, principles, and concepts related to design methodologies, technological applications, material science, and problem-solving frameworks. It serves as the groundwork that provides learners with a theoretical understanding of the subject’s core principles and informs their approach to practical applications. This theoretical knowledge forms the scaffolding upon which practical skills are built. The challenge arises in translating theoretical knowledge into practical application amid inadequacy of tools, equipment, machines and trained Design and Technology subject teachers in schools.

The inadequacy of practical application opportunities stemming from a heavily theoretical focus in the Design and Technology education hinders learners’ development of practical skills. If the teaching emphasises theoretical learning without sufficient opportunities for hands on experimentation and project-based learning, learners are likely to struggle to apply theoretical concepts in a practical way. This disconnect can impede the development of critical skills, including problem-solving, creative thinking, and technical proficiency, which are fundamental to Design and Technology education success. Shirley and Hasse (2018) explained that implementing the subject of Design and Technology should seek to integrate theory and practice. This is likely to expose learners to both theory and practice for experiential learning which requires learners to practice what they learn from theory to experience its influence. Thus, implementing the Design and Technology subject should lead to significant practical skills acquisition by exposing the learners to practicals rather than theory for easy acquisition of knowledge and practical skills development. This may discourage the theoretical aspect of the Design and Technology education that deals with the masterly of the content and promotes the practical education that aims at equipping learners with the practical skills to shape them to become productive and useful and ultimately help improve on their performance.

Furthermore, the effective development of practical skills in the Design and Technology education relies on a complementary and integrated approach that intertwines the theoretical understanding with practical application. This is because the Design and Technology subject curricula is designed to seamlessly blend theoretical concepts with hands on experiences to enable the learners apply the acquired theoretical knowledge from the subject. Marx (1866) explained that man learns by acting on the natural phenomena, transforming them while experiencing their influence; this experience is regarded as a criterion of truth. Thus the implementation of the Design and Technology subject in schools should integrate theory with practice to help produce an intellectual learner who can apply the acquired knowledge and skills. This is because the idea of practice is central to Design and Technology education. The emphasis of this education should therefore be always on the value of activity and experience other than theory. Thus the implementation of the Design and Technology subject in schools should stress much on the educative productive work other than theory in the institutions of learning (Mkonongwa 2017).

The implementation of the Design and Technology subject in schools prioritises the transmission of theoretical knowledge within the subject and puts much emphasis on conceptual understanding, design principles, and technological concepts. While this theoretical knowledge forms the foundation of learning, an overemphasis on knowledge acquisition inadvertently sidelines the cultivation of the critical practical skills among learners. Thus when there is an overemphasis on knowledge acquisition, the implementation tend to overshadow the development of the critical practical skills necessary for real-world application and innovation among learners. This is contrary to what Kekaya (2014) explained that learners are expected to acquire the knowledge and develop the practical skills after the learning process of the Design and Technology education in schools. Thus, it has to be made clear that the aim of learning the subject in schools should be to make learners stand on their own and become self-reliant through practical skills development.

Luhala (2021) discussed that during and after the learning process, learners are expected to acquire the knowledge and practical skills and change their values and attitudes towards practical subjects such as Design and Technology. However, when the educational focus primarily centers on knowledge acquisition, there is a tendency to prioritise rote learning and theoretical understanding without providing learners with ample opportunities for hands on application and skill development. This limits learners' exposure to practical experiences essential component for developing critical practical skills to become self-reliant. Thus when the teaching predominantly focuses on knowledge acquisition, the learning process often revolves around rote memorization and comprehension of theoretical concepts. This limits opportunities for learners to engage in hands-on experiences, iterative design processes and experimentation with materials, which are essential elements for fostering critical practical skills.

Mubangwe (2016) explained that there is a strong and significant relationship between the infrastructure for teaching and learning of Design and Technology subject with the trainee teachers' academic and professional performance. Thus the Design and Technology is a practical subject, thus it demands that learners and teachers should have hands on lessons. For this reason, schools should be prepared with appropriate workshops, classrooms, trained teachers and adequate resources to ensure an effective and successful teaching and learning of Design and Technology subject. Within the Design and Technology education domain, the predominant acquisition of knowledge at the expense of critical practical skills presents a complex educational scenario that significantly impacts learners' learning experiences and their preparedness for real-world application of skills.

The absence of substantial practical engagement and skills development impedes learners' ability to innovate, solve problems and navigate the complexities of real-world challenges. The World Bank (2016) lamented that the shortage of workshops account for the consistently low practical outcomes in the education system. This is attributed to shortages of resources and infrastructure for the subject, which is a great challenge that affects practical education implementation of the Design and Technology subject. The partial development of practical skills among learners in the Design and Technology subject is a complex issue that is influenced by various factors within the Design and Technology educational system, instructional methods, and the nature of the subject itself. This challenge hampers learners' ability to apply the theoretical knowledge to real-world contexts effectively and limits their capacity for innovation and problem-solving within the subject.

The learners may possess a strong theoretical understanding of design concepts and technological principles but lack the practical expertise necessary to apply the knowledge effectively. This gap between theoretical knowledge and practical application hinder learners' innovation. Thus learners may demonstrate a strong theoretical understanding of design and technological concepts but might lack the practical expertise required to apply this knowledge. Consequently, learners are likely to demonstrate proficiency in understanding theoretical concepts and principles but cannot effectively apply the knowledge in practical contexts. Roy (2022) indicated that the teaching and learning of the design and technology subject should be conducted practically. Doing so enables learners to acquire knowledge and develop practical skills.

The ideal process of the Design and Technology education should be noted with practical demonstration of the lesson. In that way allow the practical way of teaching and learning the subject. This is because acquiring knowledge and developing practical skills can only easily be achieved when practical teaching and learning is enhanced in the Design and Technology subject classrooms and workshops. Moreover, manipulating the tools and equipment is critical for a practical lesson if the knowledge and practical skills are to be developed among learners of the Design and Technology subject. The partial development of practical skills among learners in the Design and Technology subject is a nuanced challenge with multifaceted attributions rooted in educational paradigms, pedagogical approaches, resource allocations, assessment methodologies, teacher training, time constraints, and learners' engagement. Understanding the interconnected nature of these factors is crucial in comprehending why learners may not acquire the requisite practical competencies within the Design and Technology education.

Hatiya (2016) explained that good infrastructural facilities always support the education enterprise and that the shortage of classrooms poses challenges for schools to conduct practical lessons eventually denying learners of knowledge and practical skills. Thus a good learning environment is important for learners' academic achievement. As Gaothobongwe (2014) discussed, practical education should produce substantial returns, offering learners the chance to acquire attitudes and skills that are unlikely to be developed if standard infrastructure that support practical learning exist. This enables learners to develop job oriented skills and become self-reliant. However, one of the key contributors to the partial development of practical skills in the subject of design and technology is the imbalance in the teaching and learning process. While the Design and Technology education intends to strike a balance between theoretical understanding and practical application, an overemphasis on theoretical knowledge often relegates practical skills to a secondary position. As a result, limited time and resources are allocated to hands on activities, hindering learners' comprehensive development of practical competencies.

Design and Technology education intends to intertwine theoretical knowledge with hands on application; however, an overemphasis on theoretical understanding often sidelines the practical skill development among learners in schools. This results in a disproportionate allocation of time and resources, skewing towards theoretical aspects and inadequately nurturing hands on competencies among learners. As Adran, Addysg, Gydol and Sgiliau (2019) explained, the implementation of the Design and

Technology subject should ensure that learners have opportunities to develop, practice and apply the skills identified in the programmes of study. Therefore, safe and appropriate use of tools and other equipment should be embedded throughout all learning activities as Lolwana (2014) discussed that the lack of resources is a critical factor in the implementation of the Design and Technology subject as it may negatively affect classroom practical learning and teaching processes. Thus the lack of facilities and under resourced schools are directly associated with the academic failure of practical subjects among learners in the Design and Technology subject.

The pedagogical approaches play a pivotal role in the design and technology subject's practical teaching and learning process. Traditional teaching methods in the Design and Technology subject often prioritise theoretical instruction through lectures and textbook-based learning, potentially neglecting the experiential learning needed for practical skills development. The lack of emphasis on hands on experiences limits learners' opportunities to engage in practical applications. As a consequence, learners lack experiential learning opportunities, essential for honing practical skills. Nkanza (2014) and Cedefop (2015) explained well that teaching should assist learners in acquiring new knowledge and practical skills. It should consist of the principles of showing and guiding the learners in relation to task performance and then measuring their results. Thus the learning should be a process of acquiring knowledge and development of practical skills by the learners. Thus Design and Technology subject is a practical subject and should be taught under discovery learning as it is a subject of learning by doing and believes that practicing is a foundation of learning, and without learning practice, learners get lost. Therefore, design and technology are practical subjects, so teachers and learners should have hands-on teaching and learning experiences. This can be realised if an environment where the teaching and learning takes place is conducive and well supplied with teaching and learning inputs.

Moustafa (2015) pointed out that the biggest challenge facing practical education in developing countries was the provision of quality teaching and learning programmes that ensure the development of a productive and efficient workforce capable of meeting international competitiveness. Thus Moustafa (2015 discussed that Design and Technology is a practical subject which should be taught using a practical approach that requires availability and adequacy of workshops, tools, equipment, and other resources for demonstrations and practical works during the teaching and learning process in order to enable learners meet the anticipated international competitive standards of Design and Technology education.

Design and Technology education aims to improve learners’ independence in entrepreneurship according to their developed competencies (Kennedy, 2021). The preparation of the expected competencies should help prepare learners primarily to work in a particular field and prepares learners who are able and willing to work in their field of expertise (Yahya, 2015, and Usman, 2016). This can only be possible if the learning environment match with the working environment (workshops and laboratories) equipped with the same tools and equipment as Mkonongwa (2017) discussed that the inadequate provision of physical facilities leads to poor implementation of the subject. Therefore, the lack of school facilities such as workshops compromises the implementation of the Design and Technology subject in schools because topics meant to be taught practically are taught theoretically due to a lack of supporting physical facilities and equipment. Therefore, it is clear that the availability of facilities in schools positively affects learners' practical performance and enables acquisition of practical education for self-reliance.

The inability of the Design and Technology subject learners to effectively apply acquired skills stems from an intricate interplay of various systemic, instructional, and contextual factors, influencing their practical skill transfer within the subject. The Design and Technology education reflects on innovative aspects and thus, is a way to introduce learners to impending contexts and novel approaches to teaching (Reinsfield et al, 2023). From this perspective, there is provision for teaching practices to be receptive to learner well-being through the development of creative and critical thinking. Similarly, Design and Technology education provides opportunities for learners to engage in practical tasks to solve technological problems. Understanding these complex interrelations is pivotal in comprehending why learners might struggle to translate their theoretical knowledge into practical application within the secondary school context. Hence the teaching process of the Design and Technology subject must be supported with adequate infrastructure to enable performance among learners, practical activities in a supportive school workshops and classrooms. When schools do not have such facilities, Sale and Saffadi (2018) indicated that implementing the Design and Technology subject consequently result into producing learners with little or no practical skills or the expected knowledge for hands on activity that can make them stand on their own in society.

The teaching and learning the Design and Technology subject should enable learners to become self-reliant and stand on their own. For this reason, learners should have the knowledge and the practical skills of working with materials using hand tools, demonstrate ability to apply what they acquired and developed in school. Thus teaching and learning the subject of design and technology should help provide education that equips learners with vital knowledge and skills. The implementation of the subject should link education to real life experiences that give learners practical skills to apply knowledge and help gain life skills. For this reason, the learners taking Design and Technology are expected to acquire knowledge and develop practical skills, which they can later apply to solve society's current challenges. However, as Mkonongwa (2017) pointed out the major factors hindering the growth of practical education in schools are lack of qualified personnel, inadequate facilities, and more theoretical training given to learners, which greatly affect the effective implementation of the subject.

Furthermore, pedagogical approaches play a pivotal role in practical skills transfer. Thus traditional teaching methods in the Design and Technology subject often prioritize theoretical instruction through lectures and textbooks, potentially neglecting the hands on application of learned skills. This lack of emphasis on experiential learning impedes learners' ability to translate theoretical knowledge into hands on projects or design tasks. When teaching in the classroom or workshops, teachers should strive to assign enabling tasks first to learners. However, teachers who lack adequate training directly impact learners' ability to acquire new skills (Kilinc et al., 2018; Tarman et al., 2019; Winter et al., 2021). For example, Mbongwe (2016) established that teachers' inadequate ability to manage the practical aspect implies the incompetence to support learners in utilising the practical work. Therefore, the lack of sufficient training by the Design and Technology subject teachers in guiding learners to apply their learned skills practically affect the recipient learners. For this reason, insufficient support and expertise in facilitating hands on projects deters learners from confidently applying the practical knowledge and skills.

The study found that the Design and Technology subject learners are inadequately assessed. Therefore, the inadequacy assessment practices by teachers are also likely to influence the learners' application of skills. When assessments primarily measure theoretical understanding through written exams, learners may focus more on memorisation than on applying their skills practically. This undervaluation of practical competencies reduces the incentive for learners to apply their skills real and practically. Thus assessments that primarily measure theoretical knowledge undervalue practical skills. This is why (Kennedy, 2020; Kibirige et al., 2021) explained that when assessments do not adequately evaluate or reward practical competencies, learners might not prioritise practical application of their skills.

Furthermore, resource constraints within secondary schools pose considerable obstacles to developing and applying practical knowledge and skills among learners of the Design and Technology subject. Thus inadequate access to tools, materials, or technology limits learners' opportunities for practical skill application. It is therefore clear that the scarcity of resources inhibits learners from engaging in design projects or technological experiments, hindering their capacity to apply learned skills effectively. It is important to note that resource constraints pose substantial hurdles in the implementation of the subject of design and technology. The rationale for the Design and Technology subject is to provide learners with practical skills and appropriately prepare them for upward mobility in vocational activities. Thus Design and Technology would develop values and cater to the learners' needs and aspirations for self-reliance and entrepreneurship to develop a responsible, productive, and self-sustaining citizen (Tang and Shi, 2017; Mkonongwa, 2017).

The Design and Technology subject can only be efficient in proportion as the environment in which the learners are learning is a replica of the place in which they must subsequently work. As Luhala (2021) discussed that practical education requires adequate facilities for effective teaching and learning. Therefore, without adequate facilities, the learners cannot acquire the required skills, and later apply them in their daily lives. Consequently, their education could then be considered a waste if they cannot apply what they have learned in the classroom.

5.5 Suggestions to Improve the Teaching and Learning of the Design and Technology Subject in Schools

The respondents and participants suggested for modern workshops for design and technology, the provision of tools for practical work, and the provision of more machines and teachers with expertise in design and technology.

5.5.1 Design and Technology Workshops

In the context of implementing the Design and Technology curriculum in secondary schools, the significance of modern workshops cannot be overstated. These workshops serve as the cornerstone for practical application of theoretical knowledge, offering learners invaluable hands-on experiences in crafting, designing, and problem-solving. Equipped with up-to-date tools and facilities, modern workshops provide learners with a conducive environment to explore various aspects of Design and Technology.

One participant submitted that:

> *When it comes to areas of improvement, I think the first one is just the machinery part. Therefore, if enough machines can be brought in school for DT, is likely to enable the subject to be taught well. When we have adequate machines can help to enhance skills development in*

learners because you would find that due to lack of machines, some skills may not be attained by learners to their full potential (TR1 A).

One of the primary advantages of modern workshops is their pivotal role in skill development. Giasemi and Sharples (2017) discussed that engaging in practical tasks within well-equipped spaces allows learners to hone their technical abilities, enhance their creativity, and refine their problem-solving skills. Therefore, by working with state-of-the-art tools and equipment, learners become familiar with modern technologies, thereby preparing them for the demands of contemporary industries.

Moreover, modern workshops play a crucial role in preparing learners for future careers in Design and Technology-related fields. The hands-on experiences gained in these environments provide learners with a realistic understanding of industry practices and standards. Learners develop a deep appreciation for the complexities and intricacies of Design and Technology disciplines by immersing themselves in practical projects within modern workshops (Pamies et al, 2015 and Mukeredzi, 2019). This practical exposure equips them with the necessary technical competencies and fosters an entrepreneurial mindset, encouraging innovation and creativity.

Furthermore, Harnandezi (2014) discussed that modern workshops serve as hubs for collaboration and knowledge sharing among learners and teachers. These should have learning spaces to facilitate peer-to-peer learning, where learners can exchange ideas, collaborate on projects, and learn from each other’s experiences. In essence, modern workshops represent more than just physical spaces; they embody the transformative potential of experiential learning in the realm of design and Technology Education. By providing learners with hands-on experiences, fostering skill development, and preparing them for future careers, these workshops serve as catalysts for innovation and excellence in the field of Design and Technology (Ignasia, 2018). Thus, investing in modern workshops equipped with up-to-date tools and facilities is essential for unlocking learners' full potential and empowering them to thrive in an ever-evolving technological landscape.

5.5.2 Provision of Teaching and Learning Resources

In the area of Design and Technology education in secondary schools, the provision of adequate tools is indispensable for facilitating effective engagement in practical work. A diverse array of tools empowers learners to delve into practical tasks with confidence and creativity. This diversity enables learners to experiment with various techniques, materials, and processes, thereby expanding their skillset and nurturing their problem-solving abilities. Charles and Comb (2021) explained that by offering access to a wide range of tools, teachers foster an environment where learners can explore their interests and express their creativity through hands-on experimentation. Furthermore, the availability of tools plays a pivotal role in ensuring the safety of learners during practical work. Thus equipping learners with the necessary tools enables them to execute their projects effectively and minimises the risk of accidents or injuries. By adhering to proper safety protocols and providing appropriate tools, teachers create a positive and conducive learning environment where learners feel supported and empowered to explore their interests and unleash their creative potential.

Moreover, Andeleke (2017) indicated that the provision of tools in Design and Technology education serves as a means of promoting inclusivity and equity among learners. For this reason, access to various tools ensures that all learners, regardless of their background or prior experience, can engage meaningfully in practical work. This fosters a sense of belonging and empowerment among learners, as they are equipped with the resources necessary to pursue their interests and contribute to collaborative projects. In essence, the provision of tools in Design and Technology education is not merely about supplying materials; it is about empowering learners to unleash their creativity, develop critical skills, and pursue their passions. By ensuring access diverse range of tools, educators lay the foundation for a rich and fulfilling learning experience, where students can explore, innovate, and thrive in their journey towards becoming proficient designers and technologists. Therefore, prioritizing the provision of tools is essential for creating an inclusive, safe, and enriching learning environment in secondary school Design and Technology classrooms.

5.5.3 Provision of Machines for the Design and Technology Subject in School

In the Design and Technology education, enhancing the availability of machines within classrooms holds immense potential for enriching learners' educational experiences. These machines serve as catalysts for innovation and skill development, offering learners the tools needed to bring their design concepts to life and produce high-quality prototypes (Charles and Comb, 2021). Thus by increasing access to machines, teachers allow learners to explore advanced technologies and gain hands-on experience with state of the art equipment. Therefore, one of the primary benefits of expanding machine availability in Design and Technology classrooms is the ability to realize complex design concepts. With access to a diverse range of machines, learners can experiment with various processes and techniques, pushing the boundaries of their creativity and problem-solving abilities. These machines empower learners to transform their ideas into tangible prototypes, fostering a deeper understanding of design principles.

Furthermore, exposure to machines equips learners with valuable technical skills that are highly sought after in today's technology. By working with advanced machinery, learners are likely to develop proficiency in operating, and maintaining various equipment, enhancing their employability and readiness for future careers in Design and Technology related fields. Atsumbe et al (2022) also discussed that the hands-on experience gained through interacting with machines fosters a sense of confidence and competence among learners, empowering them to tackle real-world challenges with ease and efficiency. Therefore by increasing access to machines in Design and Technology classrooms promotes a culture of innovation and entrepreneurship among learners. Moreover, exposure to advanced technologies fosters a mindset of adaptability and resilience, preparing learners to thrive in a rapidly evolving technological period. Expanding machine availability in Design and Technology classrooms represents a transformative investment in learners' education, empowering them to unlock their full potential as designers, technologists, and innovators.

5.5.4 Training and Recruitment of Teachers with Expertise in the Design and Technology Subject

In the Design and Technology education, the role of teachers with expertise in the subject cannot be overstated. These teachers play a pivotal role in shaping learners' learning experiences and are instrumental in delivering high-quality teaching. Sale and Affadi (2018) pointed out that through their depth of knowledge and experience, expert teachers are uniquely positioned to impart essential concepts, demonstrate advanced techniques, and provide valuable feedback to learners. One of the primary advantages of employing teachers with expertise in the Design and Technology is their ability to convey complex concepts and skills to learners effectively. Drawing upon their depth of knowledge and understanding of the subject matter, experienced teachers can break down difficult concepts into digestible segments, making them more accessible to learners. Mhango (2021) indicated that with clear explanations and engaging demonstrations, expert teachers foster a deeper understanding of design principles and technical processes among learners, laying the groundwork for their future success in the field.

5.7 Summary

Design and Technology education is crucial for fostering creativity, critical thinking, and problem-solving skills, yet its effective implementation faces several challenges. A major obstacle is the lack of resources and infrastructure, which limits hands-on learning and access to specialised tools, thereby restricting learners' practical experience. Additionally, a shortage of adequately trained teachers hampers effective teaching and learning, leading to large class sizes and reduced personalised guidance. The disconnect between theoretical knowledge and real-world application further complicates learning, making it difficult for learners to integrate abstract concepts with practical skills. Educational frameworks that prioritise final outcomes over iterative learning processes contribute to this challenge, as learners struggle to adapt knowledge to dynamic problem-solving. Thus, the inadequate practical learning results in learners possessing theoretical knowledge without practical utility, limiting their ability to transfer skills beyond the classroom. The next chapter presented the summary, conclusion and recommendations of the study.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.0 Overview

The previous chapter discussed the research findings. This chapter tried to show that the research questions that were presented in chapter one are answered. The researcher in this chapter also report that the research gap that was identified under chapter two has been reduced. The purpose of the study and the major research findings in relation to the research questions has been reported. The recommendations have also been made based on the research findings. The theoretical and practical implications of the study's research results, the contribution to new knowledge, and the suggestions for further research have been presented too.

6.1 Main Research Findings

This study looked at the evaluation of the implementation of the Design and Technology curriculum. The problem that was identified for the evaluation was the observed consistent and steady decline in financing the education sector from 2015 to 2022 and the consistent learners' poor academic performance in Design and Technology subject. The extent of the implication of the declining funding on the quality of education regarding the infrastructural facilities, teaching and learning resources critical for the Design and Technology subject was unknown as schools are unique. The summary of the major research findings are presented as guided by the research questions.

6.1.1 Infrastructure of the Design and Technology Subject

The first research objective was meant to evaluate the adequacy of the infrastructure for design and technology subjects and determine how well-equipped the schools were for teaching and learning design and technology. The researcher wanted to find out if these workshops were available and adequate enough and if they had enough space. The learners, Design and Technology teachers, head teachers, deputy head teachers, and heads of practical subjects department, SESO, and DESO were engaged to properly evaluate the infrastructure for the subject. The study revealed that the workshops were not adequate. Even if there were some workshops in some schools, they were too small and did not have enough space. Thus, some schools had to use regular classrooms to teach and learn Design and Technology, even though they were not designed for that purpose. In the workshops that existed, there was not enough room to store all the tools and materials needed for the subject. So, it was hard to teach and learn the subject effectively.

6.1.2 Teaching and Learning Resources of the Design and Technology Subject

The second research objective of the study was meant to assess the teaching and learning resources of the Design and Technology subject in schools. The study's findings showed that many schools did not have enough tools, machines, and equipment for effectively teaching the subject. Design and Technology is all about hands-on experience, where learners get to use tools, equipment and machines themselves. But because there were not enough resources, learners had to work in groups to share what was available. This means that not all learners got to have the full experience of using the tools, machines and equipment themselves. Sharing resources like this might mean that some learners miss out on the practical side of learning Design and Technology subject in schools.

6.1.3 Teaching, Learning and Assessment Processes in the Design and Technology Subject

The third research objective sought to establish the adequacy of teaching, learning, and assessment processes in Design and Technology education within schools. The findings indicated significant inadequacies in these areas, primarily attributable to resource constraints affecting practical teaching and learning methods. Consequently, learners were often taught in group settings due to limited resources, which might not offer the ideal environment for effective teaching, learning, and assessment in the subject. The study revealed shortage of qualified teachers for Design and Technology, exacerbating the challenges faced in delivering comprehensive teaching, learning and assessment processes. Furthermore, it was found that some teachers available lacked sufficient training in the subject, with backgrounds predominantly in areas such as woodwork, metalwork, or geometrical drawing. As a result, they might not have been fully equipped to cover all components and topics within the Design and Technology curriculum, necessitating collaboration with other teachers for certain areas.

Additionally, the study found a reduction in the allocated teaching periods for Design and Technology, contrary to the guidelines outlined in the 2013 curriculum framework, which recommended 12 periods per week for the subject. However, many schools opted to reduce these periods to just 6-8 to accommodate other subjects on the timetable. This reduction adversely impacts the effective implementation of the Design and Technology curriculum, given its comprehensive nature encompassing numerous components and topics. In other words, the study identified systemic inadequacies in teaching, learning, and assessment practices within Design and Technology education, stemming from resource limitations, teacher shortages, and reductions in allocated teaching periods. These findings underscore the need for comprehensive strategies to address these challenges and ensure the provision of quality Design and Technology education in schools.

6.1.4 Development and Application of the Design and Technology Knowledge and Skills

The fourth research objective was meant to analyse the extent to which learners develop and apply the knowledge and skills of the Design and Technology subject. The findings revealed significant challenges stemming from inadequacies in several areas, including teacher training, workshop facilities, teaching and learning resources, and a reduction in allocated teaching periods for the subject. Due to these inadequacies, learners were not adequately prepared to acquire the necessary knowledge and develop practical skills in Design and Technology. As a result, they struggled to apply what they learned effectively throughout the learning program.

The study revealed that learners in the Design and Technology subject did not fully acquire and develop the expected practical competencies, consequently impacting their ability to practically apply the subject content. The findings underscored a gap between the theoretical knowledge and practical skills expected of learners in the Design and Technology subject. The inadequacies identified in teacher training, workshop facilities, and teaching resources hindered learners' ability to fully engage with the subject material and develop the necessary practical competencies. As a result, learners faced challenges in applying their learning effectively, highlighting the need for comprehensive interventions to address these shortcomings and enhance the quality of Design and Technology education.

6.2 Theoretical and Practical Implications of the Research Results

Design and Technology subjects play a crucial role in fostering creativity, problem-solving skills, and technical knowledge among learners. Central to the effective implementation of Design and Technology subject are workshops, which serve as hands-on laboratories where learners explore, experiment and create. However, the inadequacy of these workshops, both in terms of resources and space, poses significant theoretical implications that warrant careful consideration. Thus the inadequacy of workshops restricts learners' ability to engage in open-ended design processes. Workshops serve as experiential learning environments where learners should develop practical skills through hands-on practice. However, inadequate workshops hinder this process by limiting exposure to different techniques and processes. As a result, learners leave school with a narrow skill set, ill-prepared for the complexities of real-world design environments.

Design and Technology education emphasises on project based learning. However, inadequate workshop space restricts opportunities for this kind of learning, thus crowded or cramped workshops impede the effective way of teaching and learning the subject. Thus, overcrowded workshops make it challenging for teachers to monitor learners' progress effectively, limiting their capacity to provide timely feedback and support. It is therefore important to point out that inadequate workshop space constrains teachers' ability to also provide individualised attention and assistance to learners during the teaching and learning process.

Furthermore, without access to a diverse range of tools, materials, and equipment, learners are confined to simplistic or repetitive work, limiting their capacity for creativity and innovation. This constraint undermines the fundamental purpose of

Design and Technology education in nurturing design thinking and problem-solving skills. Design and Technology education relies heavily on hands-on and experiential learning. Inadequate resources, such as tools, materials, and equipment, hinder learners' ability to engage in practical projects and experiments. This limitation reduces the effectiveness of Design and Technology implementation as it deprive learners of opportunities to apply theoretical concepts in real-world contexts, hindering their ability to develop practical skills and problem-solving abilities.

Effective Design and Technology education requires skilled facilitation by teachers who can guide and support learners through the design and fabrication processes. The implementation of this subject requires the ability to accommodate diverse learning styles and abilities. However, inadequate resources impede teachers' ability to provide differentiated teaching tailored to individual learner needs. For this reason, without access to a variety of tools, materials, and technologies, teachers struggle to adapt their teaching methods to cater to diverse learners, potentially leaving some learners behind and perpetuating educational inequalities. Design and Technology education aims to foster creativity and innovation through design projects and problem-solving tasks. However, limited resources constrain learners' creative expression and innovative potential. Thus without access to a wide range of materials and technologies, learners are confined to predetermined design solutions or unable to explore alternative approaches, stifling their creativity and limiting the scope of their learning experiences.

Effective Design and Technology implementation requires teachers to understand subject content and pedagogical strategies deeply. However, inadequate training hinders teachers' ability to effectively deliver Design and Technology curriculum and engage learners in meaningful learning experiences. Therefore, teachers struggle to integrate theoretical concepts with practical applications without adequate training, resulting in basic learning experiences that fail to develop learners' critical thinking and problem-solving skills. The inadequate training leaves teachers ill-equipped to effectively integrate teaching and learning resources into their practical implementation of the subject. This is because without the necessary skills and knowledge, teachers shy away from incorporating technology rich activities into their lessons, depriving learners of opportunities to develop expected competencies essential for their success.

Limited time for implementing Design and Technology education results in a compressed curriculum, where essential concepts and skills are rushed through or omitted altogether. This compression undermines the depth and breadth of learners' learning experiences, preventing them from fully engaging with subject content and developing mastery over key concepts and skills. Thus inadequate periods for the teaching and learning restrict the implementation of project based activities, relegating Design and Technology implementation to theoretical teaching and rote learning exercises. This neglect diminishes the authenticity and relevance of learners' learning experiences, hindering their ability to develop practical skills and apply theoretical knowledge in meaningful contexts. Adequate teaching and learning time is essential for conducting authentic, comprehensive assessments that accurately measure learners' understanding and proficiency in Design and Technology subject. However, inadequate periods for teaching and learning constrain assessment practices, leading to superficial evaluations that fail to capture the complexity of learners' learning outcomes. Without sufficient time to engage in practical tasks, teachers resort to standardised tests or summative assessments that provide limited insights into learners' capabilities and growth.

6.3 Conclusion

The Design and Technology subject was not well implemented due to insufficient infrastructure and inadequate resources. Some schools lack adequate, conducive workshop spaces, forcing classes into general classrooms that lack the necessary setup for hands-on learning. Additionally, schools faced critical shortages of essential tools and equipment, which are central to the Design and Technology curriculum, leading to shared resources that limit learner engagement and practical experience for learners. There was a shortage of specialised teachers trained specifically in Design and Technology, with many teachers possessing only related knowledge in fields like woodwork or metalwork. This shortage, combined with a reduction in allocated teaching periods (down to 6-8 from the recommended 12), restricted the depth of teaching, learning, and assessment, impacting learners' ability to comprehensively understand the subject. These deficiencies prevented learners from acquiring the practical competencies expected in Design and Technology. The lack of resources, trained teachers, and teaching and learning time created a significant gap between the theoretical knowledge taught and the practical skills needed, leaving learners underprepared for real-world applications. Thus, the Design and Technology subject was not well implemented in the secondary schools that offered it.

It is important to indicate that when schools that offer Design and Technology have inadequate context (workshops), inputs (resources), affects the Process (teaching and learning or implementation) of the subject, and eventually affects the products (acquisition of knowledge, development and application of skills by learners).

6.4 Recommendations

Based on the research findings in chapter four, the following recommendations are made:

i. The Government through the Ministry of Education should fund schools that offer Design and Technology subject to upgrade existing workshops and build new ones with sufficient space and resources. The new workshops should be big enough to accommodate all learners and the artifacts learners come up with. Therefore, the Government can reduce the budget allocation for the Ministry of Community Development and allocate it to the Ministry of Education specifically upgrade old workshops and schools where they are using classrooms build new ones gradually.

ii. The Ministry of Education should procure modern equipment and tools for workshops. To improve the Design and Technology subject, schools should work with companies that make things similar to products learners develop companies that make things similar to products learners come up with in Design and Technology education. These companies can help get new and modern tools and equipment for the workshops. By working with these companies, schools can make sure that learners have the best tools and equipment to learn and create with.

iii. The Government through the Ministry of Education should increase training recruitment efforts to attract qualified teachers with expertise in Design and Technology subject. In order to effectively implement the subject, Design and Technology subject teachers should be considered. By doing so, the Ministry of Education can make sure that schools have qualified teachers who can teach the subject more effectively. This may help learners learn more and be better prepared for the future with relevant knowledge and skills.

iv. The Ministry of Education should provide incentives and professional development opportunities to encourage existing teachers to specialise in Design and Technology education. Thus the Ministry of Education should also implement targeted training programs to prepare existing teachers in Design and Technology content and pedagogy.

v. The Ministry of Education should conduct a comprehensive inventory of existing resources and prioritise procurement of essential machines, tools and equipment. Thus the Ministry of Education needs to do a thorough check of all the resources schools have for the teaching of Design and Technology subject. They should make a list of everything and see what is missing, and buy the most important resources that teachers and learners really need to effectively implement the subject in schools. In this way, learners can have all the resources they need to learn Design and Technology properly.

vi. The Ministry of Education should advocate for the reinstatement of allocated teaching periods for Design and Technology subject on the school timetables. Thus the Ministry of Education should guide schools to make sure there is enough time for teaching Design and Technology in schools. They should make sure that every school has enough periods for Design and Technology classes on the timetable. This is important so that learners have enough time to learn and practice what they are taught. By doing this, schools can ensure that design and technology get the attention they deserve and that learners can learn all they need.

6.5 Tri–Structural Actions for the Implementation of Design and Technology Curriculum

The study's findings informed the proposed conceptual framework as shown in Figure 6.1. The framework was meant to address the challenges schools face in the teaching and learning of design and technology. Thus the framework proposed actions that must be taken by government, private companies and schools on how to effectively implement the design and technology curriculum and attain to the expected results.

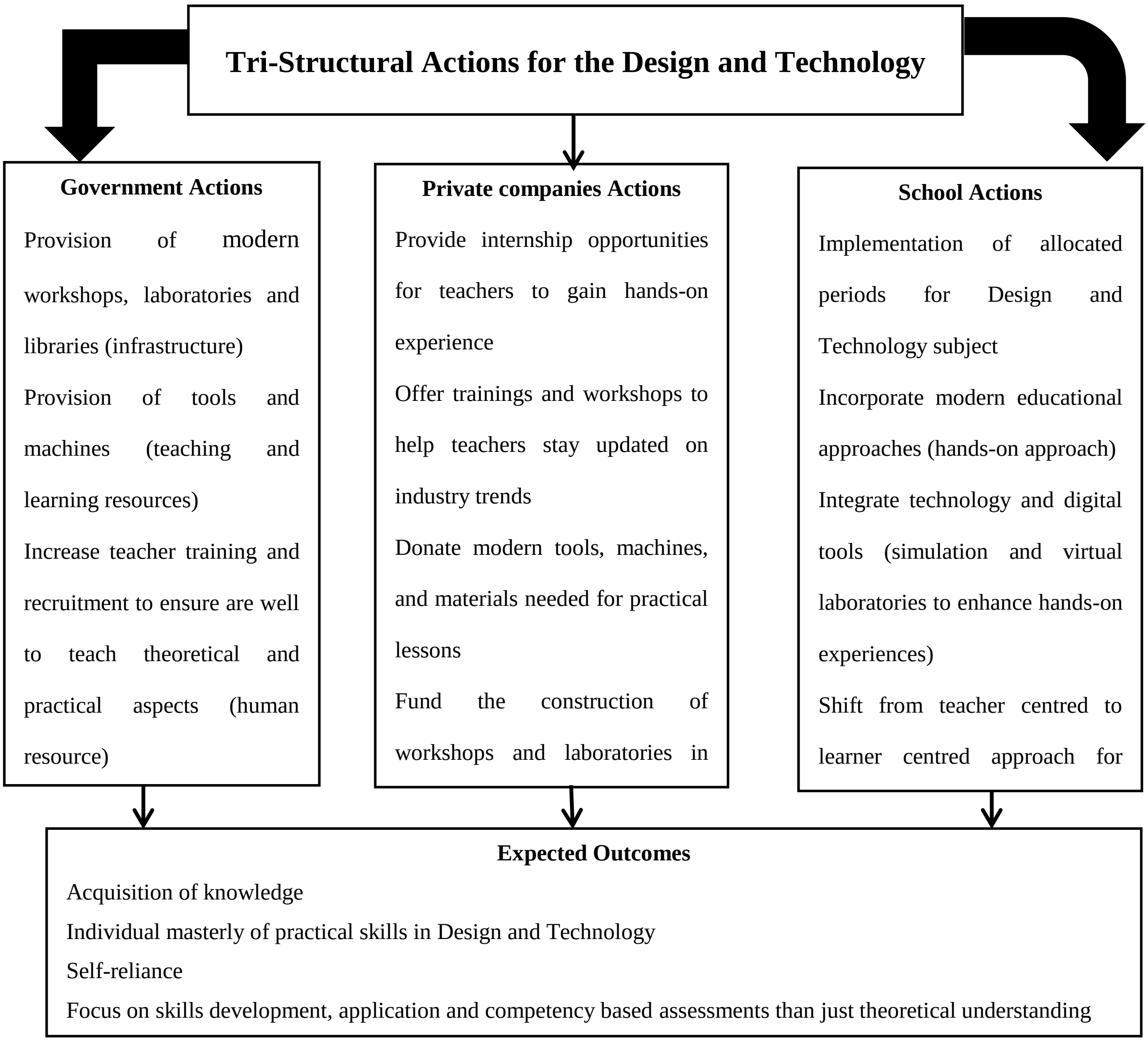

Figure 6.1: Tri–Structural Actions Conceptual Framework for the Implementation of Design and Technology Curriculum

6.5.1 Operationalisation of the Conceptual Framework

This section provides operational actions to be taken by the government, private companies and schools to effectively implement the design and technology curriculum to achieve its intent in schools that offer the subject.

6.5.1.1 Government Actions

Infrastructure and resources for design and technology are critical in the implementation of the subject. Thus, when the government takes these measures to implement the Design and Technology subject in schools, it would greatly improve both the quality of education and learners' skill development. The provision of modern workshops, laboratories, and libraries would create a conducive learning environment where learners could gain hands-on experience, enhancing their practical skills. The availability of tools and machines would ensure that learners apply theoretical knowledge in real-world scenarios, making learning more engaging and effective. Additionally, increasing teacher training and recruitment would ensure that teachers are well-equipped to teach both the theoretical and practical aspects of the subject, leading to better teaching and learner understanding. As a result, learners would develop strong technical skills, improving their career opportunities and contributing to national development by producing a skilled workforce for industries.

6.5.1.2 Actions by the Private Companies

The private have roles to play in the implementation of the design and technology curriculum. These includes the provision of internship opportunities for teachers to gain hands-on experience, offering of trainings and workshops to help teachers stay updated on industry trends, donate, modern tools, machines, and materials needed for practical lessons and fund the construction of workshops and laboratories in schools.

Thus, the involvement of private companies in the implementation of the design and technology curriculum could significantly enhance the quality and effectiveness of education. By providing internship opportunities, private companies might offer teachers valuable hands-on experience, ensuring they are better equipped to teach practical skills. Additionally, through training sessions and workshops, teachers can stay informed on the latest industry trends, improving their teaching methods. Donations of modern tools, machines, and materials could help Schools Bridge the gap between theory and practice, making lessons more relevant and engaging. Furthermore, funding the construction of workshops and laboratories could create conducive learning environments, allowing learners to gain practical experience that aligns with industry standards. Overall, private companies' involvement could foster a stronger partnership between education and industry, benefiting both teachers and learners.

6.5.1.3 Actions by Schools

The school plays the central role in implementing design and technology curriculum. Thus, the school should implement the subject according to the allocated periods, incorporate modern educational approaches (hands-on approach), integrate technology and digital tools (simulation and virtual laboratories to enhance hands-on experiences) and shift from teacher centred to learner centred approach for hands-on project based learning. The school's involvement in implementing the design and technology subject is crucial in ensuring its effective delivery and relevance to learners. By adhering to the allocated periods, schools could ensure that the subject receives adequate attention within the curriculum. Incorporating modern educational approaches, such as hands-on learning, allows learners to develop practical skills essential for real-world applications. The integration of technology and digital tools, including simulations and virtual laboratories, enhances hands-on experiences, making learning more interactive and engaging. Additionally, shifting from a teacher-centered to a learner-centered approach fosters project-based learning, encouraging creativity, problem-solving, and innovation among learners. Overall, the school's commitment to these strategies ensures that design and technology education equips learners with knowledge and the necessary practical skills.

6.6 Originality of the Thesis and Contributions

Addressing the issue of originality in this study is crucial because it is a criterion for assessing the quality of doctoral research and ensures the study makes a significant contribution to the implementation of Design and Technology curriculum, especially from the Zambian perspective. The study's originality lies in its revelation of the constraints in implementing the Design and Technology subject in schools. The study substantially contributed locally to the literature and the Design and Technology curriculum.

Some of the information gathered has not been documented elsewhere. The study uncovered that schools have inadequate workshops with limited space, a shortage of qualified teachers for the subject, and those available are often trained in only one aspect of the subject. Additionally, the study revealed that schools deviate from the 2013 curriculum framework by implementing the subject with fewer periods per week than recommended. Furthermore, the study revealed that Design and Technology learners are not adequately prepared, hindering their ability to apply expected knowledge and skills due to inadequate resources like tools, equipment, machineries, trained teachers and time. This new knowledge contributes to the existing body of knowledge in the field of Design and Technology in Zambia. The advancement of the conceptual framework represents a pivotal contribution of this thesis to the realm of knowledge. This conceptual framework serves as a foundational structure for understanding and navigating the intricacies of the research domain. Intricate relationships and interdependencies between key variables are delineated within the conceptual framework. By elucidating these connections, the framework facilitates a deeper comprehension of the underlying mechanisms at play within the study.

Furthermore, Figure 6.1 shows the conceptual framework which serves as a practical tool for researchers and practitioners. Empowered by its insights, future researchers are equipped to conduct more targeted inquiries, while practitioners can leverage its guidance to inform decision-making processes and strategic interventions. Thus the conceptual framework unveiled in this thesis contributes to the expansion of theoretical knowledge and offers tangible utility in the pursuit of advancing scholarly inquiry. The provision of the solutions in the conceptual framework provided practical recommendations to the government, private companies and schools using the Tri-Structural Actions approach of implementing the Design and Technology subject. Therefore, the provision of primary data offers fresh empirical insights and created the foundation for future research.

6.7 Suggestions for Further Research

In the pursuit of advancing scholarly inquiry and expanding understanding of various phenomena, it is imperative to identify areas ripe for further investigation. This section serves as a guidepost, illuminating potential avenues for future research endeavors. By pinpointing gaps in existing knowledge and highlighting unexplored dimensions within the research domain, this section aims to inspire and catalyse future scholarly pursuits.

i. An evaluation of the implementation of the Design and Technology curriculum in secondary schools at national level.

ii. An Assessment of schools' preparedness for the implementation of the Design and Technology adoption in secondary schools.

iii. A Comparative Analysis of Government and Private secondary Schools on the implementation of Design and Technology curriculum.

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APPENDICES

Appendix 1: Respondents' Consent Form

Introduction

I am seeking your consent to be involved in a study related to Design and Technology subject that Iam carrying out.

Description

The study is titled *"An Evaluation of the Implementation of the Design and Technology Curriculum in Selected Secondary Schools in Kapiri Mposhi District: A Context Input Process and Product (CIPP) Evaluation Model."* It will request you to assess the infrastructure, teaching and learning materials, teaching and learning process, the knowledge and skills acquired and developed from Design and Technology subject.

Risks and Benefits

Occasionally, people do not like to be participants in research studies. This is the only risk associated with this study. There will be no direct benefit to you, but your participation is likely to help provide information that can help bring out appropriate strategies to effectively implement Design and Technology subject in secondary schools.

Ethics and Participant's rights

This study adheres to research ethics and I assure you that:

i. The study will not interfere with your work here at school
ii. You will not be identified or named.
iii. You can choose to withdraw from the study at any time.

Thank you for considering this.

Participant's Consent

Name: ……………………...

Signed: ....…………………………………………………………...

Date …………………………………………………………………..

APPENDIX 2: QUESTIONNAIRE FOR DESIGN AND TECHNOLOGY SUBJECT LEARNERS

Dear respondents,

Iam a student at The University of Zambia pursuing a Doctor of Philosophy in Curriculum Studies. I am conducting an academic study. ***Research Title: An Evaluation of the Implementation of the Design and Technology Curriculum in Selected Secondary Schools in Kapiri Mposhi District: A Context Input Process and Product (CIPP) Evaluation Model.***

The purpose of the study is to evaluate the infrastructure, teaching and learning materials, teaching and learning process, the knowledge and skills acquired and developed by learners from Design and Technology subject in the selected secondary schools in Kapiri Mposhi district. You are requested to take part in this study. The information you provide will be used only for research purpose and will remain highly confidential. Your responses to this questionnaire contribute a lot to the successful completion of this study. You are therefore kindly requested to provide accurate information.

Instructions

i. Do not write your name on this questionnaire.

ii. Do not mention any name of any person in this questionnaire.

iii. Read the questionnaire items carefully before you answer them.

SECTION A: PERSONAL DETAILS

Indicate your response by making a tick in the box.

1. Gender:

Male		**Female**	

2. Age (Years)

15-17		**18-20**		**Above 21**	

3. Grade:

Grade	**Tick**
9	
12	

SECTION B: The Infrastructure for the Design and Technology Subject in School

1. Using the five-point likert scale indicate your level of agreement with each of the following statements by circling the appropriate number in the box on the right hand side.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					
We have enough workshops for Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We do not have enough laboratories for Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We have enough classrooms for Design and Technology subject	**1**	**2**	**3**	**4**	**5**
Library is not available at our school	**1**	**2**	**3**	**4**	**5**

2. Using the five-point likert scale indicate your level of agreement with each of the following statements by circling the appropriate number in the box on the right hand side.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					
The spaces in the workshops accommodate all learners in the teaching and learning of the subject	**1**	**2**	**3**	**4**	**5**
The spaces in the laboratories for Design and Technology do not accommodate all learners in the teaching and learning of the subject	**1**	**2**	**3**	**4**	**5**
The spaces in the classroom for Design and Technology subject accommodate all learners	**1**	**2**	**3**	**4**	**5**
The spaces in the school library does not accommodate all learners	**1**	**2**	**3**	**4**	**5**

SECTION C: Teaching and Learning Materials for Design and Technology Subject

3. Using the five-point likert scale indicate your level of agreement with each of the following statements by circling the appropriate number in the box on the right hand side.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					
We are put in groups and wait for the other groups to use the tools in the teaching and learning of Design and Technology subject	**1**	**2**	**3**	**4**	**5**
The equipment needed in the teaching and learning of Design and Technology subject are not adequate at our school	**1**	**2**	**3**	**4**	**5**
We always wait for our friends to use the machineries needed in the teaching and learning of Design and Technology subject	**1**	**2**	**3**	**4**	**5**
Design and Technology text books are distributed in groups for us to make use of them during the teaching and learning process	**1**	**2**	**3**	**4**	**5**

SECTION D: Teaching, Learning and Assessment Processes in Design and Technology Subject

4. Using the five-point likert scale indicate your level of agreement with each of the following statements by circling the appropriate number in the box on the right hand side.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					
We do have practical lessons in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We do have theoretical lessons in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We do have both practical and theoretical lessons in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We have demonstration lessons with tools, equipment and machineries in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We do have hands on type of learning Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We have more theoretical learning than practical in Design and Technology subject	**1**	**2**	**3**	**4**	**5**

5. Using the five-point likert scale indicate your level of agreement with each of the following statements by circling the appropriate number in the box on the right hand side.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					
Demonstration method is used in the teaching and learning process of Design and Technology	**1**	**2**	**3**	**4**	**5**
Design and Technology subject teacher spend most of the time giving us the information in the teaching and learning process	**1**	**2**	**3**	**4**	**5**
We always touch and manipulate the tool, equipment and machineries in the teaching and learning process of Design and Technology	**1**	**2**	**3**	**4**	**5**
We are given individual tasks to work on in the teaching and learning process of Design and Technology	**1**	**2**	**3**	**4**	**5**
We are given activities to work on in groups in the teaching and learning process of Design and Technology	**1**	**2**	**3**	**4**	**5**

6. Using the five-point likert scale indicate your level of agreement with each of the following statements by circling the appropriate number in the box on the right hand side.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					
We do not have practical assessment in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We do not have theoretical assessment in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We do not have both practical and theoretical assessment in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We do not have hands on type of assessment in Design and Technology subject	**1**	**2**	**3**	**4**	**5**
We have more theoretical assessment than practical in Design and Technology subject	**1**	**2**	**3**	**4**	**5**

SECTION E: Knowledge and Skills of Design and Technology Subject are Developed and Applied

7. Using the five-point likert scale indicate your level of agreement with each of the following statements by circling the appropriate number in the box on the right hand side.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					
I learnt domestic electrical installation but cannot install a circuit	**1**	**2**	**3**	**4**	**5**
I have the knowledge on carpentry and joinery but lack the skill	**1**	**2**	**3**	**4**	**5**
I do apply knowledge of electrical and electronics in solving problems	**1**	**2**	**3**	**4**	**5**
I have the Design and Technology knowledge but fail to apply it	**1**	**2**	**3**	**4**	**5**
I have the graphical communication skill/geometric drawing skill	**1**	**2**	**3**	**4**	**5**
I have not developed the bricklaying and plastering skill	**1**	**2**	**3**	**4**	**5**
I have not developed metal fabrication skill	**1**	**2**	**3**	**4**	**5**

8. What suggestions would you give to improve the teaching and learning of Design and Technology subject in school?

……………………………………………………………………………………………

……………………………………………………………………………………………

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……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

THANK YOU FOR YOUR TIME

APPENDIX 3: INTERVIEW GUIDE FOR DESIGN AND TECHNOLOGY SUBJECT TEACHERS

1. How adequate are the workshops and classrooms for the teaching and learning of Design and Technology subject?

2. How adequate is the space in the workshops and classrooms in which the teaching and learning of Design and Technology subject takes place?

3. How adequate are the tools, equipment and machineries needed in the teaching and learning of Design and Technology subject?

4. What teaching and learning materials for Design and Technology subject you would recommend to have for the teaching and learning of the subject?

5. Do you think the periods allocated for Design and Technology subject per week are enough?

6. What methods do you use to test learners in Design and Technology subject?

7. How often do you test learners in Design and Technology subject per term?

8. What practical skills do learners of Design and Technology subject develop?

9. What areas need improvements for the effective teaching and learning of Design and Technology in schools?

THANK YOU FOR YOUR TIME

APPENDIX 4: INTERVIEW GUIDE FOR HEAD TEACHERS, DEPUTY HEAD TEACHERS AND PRACTICAL HEADS OF DEPARTMENT

1. How adequate are the workshops and classrooms for the teaching and learning of Design and Technology subject?

2. How adequate is the space in the workshops and classrooms in which the teaching and learning of Design and Technology subject takes place?

3. How adequate are the tools, equipment and machineries for Design and Technology subject in school?

4. What teaching and learning materials for Design and Technology subject you would recommend the school to have for the teaching and learning of the subject?

5. Do you have enough teachers for Design and Technology to be taught well in school?

THANK YOU FOR YOUR TIME

APPENDIX 5: INTERVIEW GUIDE FOR THE DISTRICT EDUCATION STANDARD OFFICERS (DESO) AND SENIOR EDUCATION STANDARDS OFFICER (SESO) PRACTICALS

1. How adequate are the workshops and classrooms for practical teaching and learning of Design and Technology subject?

2. How adequate is the space in the workshops and classrooms in which practical teaching and learning of Design and Technology subject takes place?

3. How adequate are the tools, equipment and machineries for Design and Technology subject in school?

4. What teaching and learning materials for Design and Technology subject you would recommend to have for the subject to be taught well?

THANK YOU FOR YOUR TIME

APPENDIX 6: OBSERVATION CHECKLIST

Key: 1 = Adequate, 2 = Inadequate, 3 = Not Available

No	T/L Materials for DT	1	2	3
	Machinery/Equipment			
1	Angle grinder			
2	Domestic regular saw			
3	Industrial welding machine			
4	Domestic welding machine (oiled)			
	Metal Work Tools			
5	Metal bench vice			
6	Measuring tapes			
7	Steel ruler			
8	Try square			
9	Hand shield			
10	Flip front welding googles			
11	Tin snips			
12	Tools box			
13	Pliers			
14	Drill bits (set)			
15	Files			
	Wood Work Tools			
16	Benches			
17	Wood bench vice			
18	Hand vice			
19	G-clamp			
20	Sash clamp			
21	Copying saw			
22	Jack plane			
23	Rip saw			
24	Ten saw			
25	Instant grip			
26	Wood chisels			
27	Try squares			
28	Claw hammers			
29	Gentleman's saws			
30	Carpenters brace			
31	Mallets			
	Electrical Tools			
32	Cable stripper			
33	Screw driver			
34	Tester			
35	Multi meter			
36	Pliers			
	Bricklaying and Plastering			
37	Builder's trowel			
38	Spirit level			

39	Builder’s square			
40	Plastering trowel			
41	Internal angle trowel			
42	External angle trowel			
43	Boaster chisel			
44	Builder’s line			

APPENDIX 7: Approval Letter of Study from the Directorate of Research and Graduate Studies

THE UNIVERSITY OF ZAMBIA
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES

Great East Road Campus | P.O. Box 32379 | Lusaka10101 | Tel: +260-211-290 258/291 777 Fax: (+260)-211-290 258/253 952 | E-mail: director.drgs@unza.zm | Website: www.unza.zm

APPROVAL OF STUDY

IORG No. 0005376
HSSREC IRB No. 00006464
REF NO. HSSREC-2023-SEPT-022

22nd September, 2023

Mr. Nephat Kasebusha
The University of Zambia
P.O. Box 32379
LUSAKA

Dear Mr. Kasebusha

RE: "AN EVALUATION OF THE IMPLEMENTATION OF THE DESIGN AND TECHNOLOGY CURRICULUM IN SELECTED SECONDARY SCHOOLS IN KAPIRI MPOSHI DISTRICT: A CIPP THERETICAL APPROACH."

Reference is made to your submission of the protocol captioned above.

The HSSREC resolved to approve this study and your participation as Principal Investigator for a period of one year.

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of HSSREC, we would like to wish you all the success as you carry out your study.

Yours faithfully,

Dr. J. I. Ziwa

DR. J. I. Ziwa
CHAIRPERSON
THE UNIVERSITY OF ZAMBIA HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE - IRB

cc: Director, Directorate of Research and Graduate Studies
Assistant Director (Research), Directorate of Research and Graduate Studies
Assistant Registrar (Research), Directorate of Research and Graduate Studies

APPENDIX 8: Authorisation Letter to Conduct Research

REPUBLIC OF ZAMBIA
MINISTRY OF EDUCATION
18 SEP 2023
PRINCIPAL EDUCATION STANDARDS OFFICER
P. O. BOX 80197, KABWE

for PEO

Permission granted

PESO for PEO

THE UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

Telephone: 291381
Telegram: UNZA, LUSAKA
Telex: UNZALU ZA 44370

PO Box 32379
Lusaka, Zambia
Fax: +260-1-292702

No objection

Date......................................

REPUBLIC OF ZAMBIA
MINISTRY OF EDUCATION
KAPIRI MPOSHI DISTRICT EDUCATION OFFICE
18 SEP 2023
DISTRICT EDUCATION BOARD SECRETARY
P. O. BOX 810062, KAPIRI MPOSHI

DEBS

TO WHOM IT MAY CONCERN

Dear Sir/Madam

RE: FIELD WORK FOR ~~MASTERS~~/ PhD STUDENTS

The bearer of this letter Mr/~~Ms~~ NEPHAT KASEBUSHA Computer number ED22000047 is a duly registered student at the University of Zambia, School of Education.

He/~~She~~ is taking a ~~Masters~~/PhD programme in CURRICULUM STUDIES

The programme has a fieldwork component which he/~~she~~ has to complete.

We shall greatly appreciate if the necessary assistance is rendered to him/~~her~~.

Yours faithfully

THE UNIVERSITY OF ZAMBIA
ASSISTANT DEAN (PG)
13 SEP 2023
SCHOOL OF EDUCATION
P. O. BOX 32379, LUSAKA

Bibian Kalinde (Dr)
ASSISTANT DEAN POSTGRADUATE STUDIES- SCHOOL OF EDUCATION

cc: Dean-Education
Director-DRGS

APPENDIX 9: Permission to Conduct Research: PEO-Central Province

Kapiri Girls National Secondary School,
P. O. Box 810045,
Kapiri Mposhi.
18th September, 2023.

REPUBLIC OF ZAMBIA
MINISTRY OF EDUCATION
18 SEP 2023
PRINCIPAL EDUCATION
STANDARDS OFFICER
P. O. BOX 80197, KABWE

PESO
for PEO

Permission granted
On behalfo of PEO
PESO

The Provincial Education Officer,
Central Province,
P.O. Box 80197,
Kabwe.

Dear Sir / Madam,

Ref: Permission to collect data from the Design and Technology subject Learners and Teachers, Practical subjects Heads of Department, Deputy Head teachers, Head teachers and Central province SESO practical subjects.

Reference is made to the above captioned subject. Iam writing to request for permission to carry out a research in the selected secondary school among the Design and Technology subject Learners and Teachers, Heads of Practical subjects Department, Deputy Head teachers, Head teachers and District Education Standards Officer (DESO) in Kapiri Mposhi district and Senior Education Standards Officer for Practical subjects, Central province.

The study involves **"An Evaluation of the Implementation of the Design and Technology Curriculum in the Selected Secondary Schools in Kapiri Mposhi District: A CIPP Theoretical Approach."** Thus it will require the Design and Technology subject Learners and Teachers, Practical subjects Heads of Department, Deputy Head teachers, Head teachers, District Education Standards Officer and Senior Education Standards Officer for Practical subjects in Central province to give some of their experiences of the implementation of Design and Technology subject. To this effect, they will be asked to participate through interviews and questionnaire. The study is in fulfillment of the requirements of the researcher's Doctor of Philosophy in Curriculum Studies at the University of Zambia.

Thank you in anticipation for your assistance.

Yours Faithfully

Nephat Kasebusha
Student in Curriculum Studies
Student Computer Number: ED2200047

APPENDIX 10: Permission to Conduct Research: DEBS-Kapiri Mposhi District

Kapiri Girls National Secondary School,
P. O. Box 810045,
Kapiri Mposhi.
18th September, 2023.

No objection

REPUBLIC OF ZAMBIA
MINISTRY OF EDUCATION
KAPIRI MPOSHI DISTRICT EDUCATION BOARD OFFICE
18 SEP 2023
DISTRICT EDUCATION BOARD SECRETARY
P.O. BOX 810063, KAPIRI MPOSHI

DEBS

The District Education Board Secretary
Kapiri Mposhi District Education Board,
P. O. Box 810063,
Kapiri Mposhi.

Dear Sir / Madam,

Ref: Permission to collect data from the Design and Technology subject Learners and Teachers, Practical subjects Heads of Department, Deputy Head teachers and Head teachers.

Reference is made to the above captioned subject. Iam writing to request for permission to carry out a research in the selected secondary school among the Design and Technology subject Learners and Teachers, Heads of Practical subjects Department, Deputy Head teachers, Head teachers and District Education Standards Officer (DESO) in Kapiri Mposhi district.

The study involves **"An Evaluation of the Implementation of the Design and Technology Curriculum in the Selected Secondary Schools in Kapiri Mposhi District: A CIPP Theoretical Approach."** Thus it will require the Design and Technology subject Learners and Teachers, Practical subjects Heads of Department, Deputy Head teachers, Head teachers and District Education Standards Officer to give some of their experiences of the implementation of Design and Technology subject. To this effect, they will be asked to participate through interviews and questionnaire. The study is in fulfilment of the requirements of the researcher's Doctor of Philosophy in Curriculum Studies at the University of Zambia.

Thank you in anticipation for your assistance.

Yours Faithfully

NKasebusha

Nephat Kasebusha
Student in Curriculum Studies
Student Computer Number: ED2200047