

**AN ANALYSIS OF TEXTILE TECHNOLOGY AND DESIGN
SUBJECT OPERATIONS FOR SECONDARY SCHOOLS
THROUGH WORK STUDY APPROACH IN ZIMBABWE.**

by

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Declaration

I, Sindisiwe Dube, do hereby declare that this dissertation is the result of my own investigation and research, except to the extent indicated in the acknowledgement, references and comments included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.



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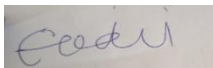
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Abstract

The study focuses on analysing Textile Technology and Design (TTD) subject operations for secondary schools in Zimbabwe with the aim of improving towards education 5.0. The study was informed by the theory of constraints (TOC) and Work study. Work study has received commendation in the clothing industry due to its effectiveness on productivity and therefore was used to assist in finding improvement strategies in the TTD subject operations in secondary school in Zimbabwe. A post-positivism approach accompanied by mixed methods was used to find information on TTD operations in secondary schools. A non-probability and probability sampling design was used, purposive –random sampling was used to select 26 schools that offer TTD subject, Authoritative –judgemental sampling to select 26 teachers and 52 students were randomly selected from the schools. Online and manual questionnaires with open ended and closed ended questions, semi-structured interview and observation were used as instruments to collect data whilst an experimental case study was used to determine the time taken for the TTD subject operations. The findings showed that some standard clothing industry operations like design development and packaging were not done in the TTD subject in secondary schools whilst methods used were dominated by traditional methods more than technological methods. Observational time study done in the school environment showed that learners used 2014 minutes to complete a garment while curriculum summative time expects them to use 900 minutes showing an increase of 123.8% in the time taken to make a skirt. Challenges encountered in schools ranged from lack of technological equipment, less competent teachers in using technological tools and methods, and lack of funding to inadequate working environments. Results for time study experiments done in an improved environment showed that the time taken by students reduced to 449 minutes using the whole garment and to 167 minutes using sectionalisation methods. By applying method study, work measurement and time study it was concluded that school operations exhibit loopholes that did not match industry requirements and the expected curriculum exit profile. The study concluded that the operations in TTD subject were 24.8% industrialisation compared with 75.2% domestic or traditional. Through time study, it was concluded that TTD subject operations can be improved from less than 1 garment to between a maximum of 7 garments per student per term when using the whole garment method and to a maximum of 17 skirts per term when using the sectionalisation method. Based on the conclusion of the study, an operational framework was developed and it was recommended, that a time study guide that follows the proposed framework be used as an engineering tool for improvement of the TTD subject operations in secondary schools in Zimbabwe.

Key Words: Work Study, Work Measurement, Method Study, Time Study, Time taken,

Operations, Standard Operation, improved environment.

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Dedication

I dedicate this dissertation to my husband Prince, for his outpouring of support, steadfast commitment, love, and dedication.

Acronyms and Abbreviations

TTD-Textile Technology and Design

TOC-Theory of Constraints

TP-Thinking process

MoMSE-Ministry of Primary and Secondary Education

CAD- Computer Aided Designing

CAM-Computer Aided Machines

ICT-Information and Communication Technology

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CHAPTER 1

BACKGROUND OF THE STUDY

1.1 Introduction

The study is an analysis of Textile Technology and Design (TTD) subject operations for secondary schools in Zimbabwe through the work study approach with the aim of improving towards education 5.0. The education output is measured by the exit profile of the learner and productivity during implementation. The country can only be satisfied when education productivity is significantly contributing to the growth and development and satisfying the world market. The fast emerging modifications in the world's clothing industries have triggered many operational encounters in the Textile Technology and Design subject today (Periyasamy & Periyasami, 2023). Over the past century and a decade, schools have experimented, discarded, iterated, evolved and embraced methods of operating the TTD subjects that have proved appropriate and effective (Maryanti, Rohana, & Kristiawan, 2020). In Zimbabwe, education aims to transform learners through quality education and promoting lifelong opportunities through industrialisation. This reflects the government's vision 2030. The TTD subject curriculum aims to industrialise operations (Curriculum Development Unit, 2015-2022). As the clothing industry aspires to succeed in its operations, the TTD subject as the base of industry should not lag behind. The current operations in Zimbabwe's secondary schools do not constantly prepare learners well; the most important elements of the TTD subject and process are seldom taught (Meyer & Norman, 2020). In some secondary schools, learners are not given essential concepts in the use of technological equipment; content is not well taught and some teachers are not proficient with new methods recommended for production in the updated syllabus (Chirapa and Mberengwa, 2021)). The learner's exit profile in the TTD subject does not fully matches university expectation and lecturers have faced challenges in adjusting the curriculum's content to accommodate the different experiences of the students as they start tertiary education (Chimbindi & Rembe, 2018). The industry players complain that the qualifications of school graduates do not match their expectations and that there is an over-balance and scarcity of school graduates in line with the rise of Industry 4.0 (Maisiri, Darwish, & Van Dyk, 2019).

Teachers keep on clinging to traditional approaches of teaching TTD, while training has advanced to new

approaches and students' aspirations are now motivated by new technologies used in the advancing clothing industry (Yamada & Otchia, 2021). Chituc (2021), in a research study on components of Education 4.0 in the 21st century skills framework systems review concluded that there is need to improve skills for this generation, using frameworks that align with the objectives of Education 4.0 after finding out that there is a gap in the guiding frameworks for the implementers in the teaching area, and therefore recommended the formulation of educational models to improve learner value in the clothing industry. There is need for a method that will give a deep analysis of the TTD subject operations for secondary schools in Zimbabwe so that it is compatible with the world of work. Work study has proved to be an effective method for improving production and operations performance in other industries and could also be used in the education sector. India, Bangladesh and China have embraced the use of work study technique to monitor the operations of the TTD subject and it has contributed to their major stake in textile products and trade (Minhus, Wang, & Hui, 2023). In India, the wide gap between the industry and educational institutions is bridged by using the work study method to find the problems in the subjects and proposing solutions (Sindhvani & Singh, 2020). Work study process has been used in the clothing industry and it aims at analysing and doing work better while exploring the methods used to measure work done (Chisosa & Chipambwa, 2018). Mauwa & Felisia (2021) also recommended the use of work study for the improvement of clothing manufacturing companies in Zimbabwe. Nabi, Mahmud, & Islam (2015), recommended work study for other systems after their study on Improving Sewing Section Efficiency through Utilization of Worker Capacity by Time Study Technique in Bangladesh. The results showed a significant improvement after implementing work study. Work study and work measurement complement to provide a time study that will facilitate planning by providing accurate data, setting realistic targets, avoiding overloading or under loading teachers and learners, providing benchmarks for evaluation and setting standards for rewarding high performers. Time study in the TTD subject operations could help establishing a framework for managing operations in the TTD subject (Ur Rehman, et al., 2019). Linking work study and the TTD subject curriculum could create more production in the learning environment. The education sector in Zimbabwe is improving the curriculum and the quality of operations so that it matches the global world of work (Ministry of Primary and Secondary Education, 2015-2022). The value of the TTD subject could be taken to a high level to prepare learners for careers in the clothing industry.

1.2 The Textile Technology and Design Subject in Zimbabwe

Textile Technology and Design (TTD) is a subject that focuses on the study of business, entrepreneurship,

textile materials, garment construction processes and design principles. In Zimbabwe, TTD is an important component of the education system, particularly within the field of vocational and technical education (Ministry of Higher and Tertiary Education, Science and Technology Development, 2013). This subject equips students with the knowledge and skills required to work in the textile and clothing industry, or pursue further studies in related fields.

The TTD curriculum in Zimbabwe covers a wide range of topics to provide students with a comprehensive understanding of textile technology and design entrepreneurship (Curriculum Development and Technical Services, 2015). Some of the key areas covered include textile science, textile processes, fashion design and development. Evaluation/assessment is done through continuous and summative assessment that covers the theory, assignment and practical components of the syllabus. Continuous assessments are done in 5 terms and each term should have a practical task (practical tasks are activities that teachers use in their day to day teaching which include subject related projects and individual practical assignments), each month and at least one project each year. Continuous assessment contributes 30% towards the final grade. The summative assessment has a practical examination with a maximum of 15 days, day 1 –7 ½ hrs Day 2 - 7 1/2 hours and contributes 40% of the final mark. The paper will be awarded 100 marks of which 40 marks will be for pattern making whilst 60 are for construction. The processes to be assessed in the examination are pattern making, laying out, cutting out and constructing the article in two consecutive days. The relaxation allowance is 30 minutes per session. According to the TTD syllabus the time recommended is 8– 10 periods per week of 35 - 40 minutes. The practical recommendation is two blocks of four periods and one double period for theory per week. Textile science involves studying the properties, characteristics, and behaviour of different textile fibres, yarns, and fabrics. Students learn about fibre identification, yarn production methods, fabric construction, and textile testing techniques (Gómez-Bombarelli, Sánchez-Lengeling, & Sheberla, 2018). This is done to impart knowledge and skills to be able to select suitable material to use for their fashion and clothing products.

In textile processes, students learn about various processes, such as weaving, knitting, dyeing, printing and finishing. Under fashion design and development, the TTD syllabus emphasizes the creative aspect of designing clothing fashion, where students explore elements of design, colour theory, pattern making, and garment construction. They learn about fashion trends, market analysis, and the development of fashion collections. TTD also includes entrepreneurial skills development, where students learn about business planning, marketing, and management principles specific to the textile industry which equips learners with the knowledge to start and manage their own textile-related ventures (Grundmeier & Höfer,

2023).

Industrial attachments provide exposure to the real-world work environments and enable students to apply their skills in professional settings (Moyo & Özgit, 2022). Developed countries have created a strong link between industry and the education system that ensures every learner gets the opportunity to be attached for at least 4-6 months during their experience at school (Sari, Nuswantara, & Iriani, 2022).

The TTD subject syllabus in Zimbabwe does not have time allocated to allow learners to engage in industrial attachment at secondary level. Industrial experience exposes learners to the work environment, thereby creating opportunities to market themselves and link with potential employers. To enhance practical skills and industry relevance, TTD programmes in schools should typically incorporate hands-on training and industrial attachments at secondary level. Students should have the opportunity to work with textile machinery, experiment with different textile processes, and create their own textile products. Studying TTD opens up a range of career opportunities in the textile and fashion industry. The high school learners can pursue post-secondary education and careers as textile technologists, fashion designers, textile engineers, textile chemists, quality control inspectors, pattern makers, or textile and apparel consultants. They can work in textile manufacturing companies, fashion design studios, retail organizations, research institutions, or start their own textile businesses (Yoel & Dori, 2021). However, the cost of the resources and material impairs the importance of the TTD subject in lower socio-economic areas, making it less important in secondary schools (Duvernet, 2017). The status of the subject is reflective of the support for its operations giving a reason for curriculum developers to work on improving and changing the TTD syllabus to match industry. The continuity of the TTD subject depends on the reputation of teachers, resources and facilities, availability of operations and whether the subject meets their needs for pursuing business and joining industry (Makuvire, Mufanechiya, & Dube, 2023).

Zimbabwe's education system has huge potential to influence the success of the National Vision of becoming an empowered and prosperous upper middle- income society by 2030. However, studies by Mberengwa and Charapa (2021) reveal that the overall performance of the TTD subject is unsatisfactory as compared with the expectations of the National Development Strategy (2021-2030) of Zimbabwe. They also found that skills and knowledge acquired by Advanced Level TTD learners are inadequate especially in areas such as essential concepts in designing, computer aided designing, pattern making, use of industrial sewing equipment and business enterprise which are critical for business or employment in the clothing industry. Renowned academics have bemoaned that operational measures are not well defined for industrialisation (Shumba & Zhuwau, 2019; Tettey, 2020), Sithole , 2018). Findings from Stephen, Chigora, Hove and Ignatius' (2023) study confirm that TTD teachers lack the relevant training

to handle the comprehensive syllabus. The study further notes that low investment in staff development programmes and low engagement in staff professional groups are major handicaps. It advocates for regular staff development workshops, teacher training in the comprehensive syllabus and engagement in collaborative activities with other design teachers in the country and outside the country to guarantee quality teaching of the learning area in the secondary schools. Operations in schools are not compatible with the requirements of the clothing industry and entrepreneurship, content is not well taught and teachers are not proficient with new skills and knowledge in the updated Textile Technology and Design Curriculum (Sithole, 2018). Studies have proven that schools have stopped offering or including the TTD subjects in the curriculum because of many factors such as lack of information and finances (Manwa, 2018). However, and based on the studies above, operations improvement is a must since the TTD subjects risk suffering a natural death and being treated as non-existent in the Zimbabwean curriculum.

The TTD subject has been subjected to modification and reviews as a way to enhance its viability as a technological learning area in Zimbabwe's curriculum for secondary schools (Sibanda & Young, 2020). The TTD approach was adopted from curriculum developments in England and Wales in 1970 and it was noted that England, New Zealand and China have moved beyond mere technological aspects to connections between school operations which has brought improved quality and faster operational time (Mohapatra, 2023). The TTD subject in the Zimbabwean curriculum has also gone through changes to address this educational need that the country inherited a British system of education after independence in 1980. The government took into account the findings which had been reached by the 1999 Nziramasanga Commission of inquiry into Education in Zimbabwean and commissioned to transform the structure of curriculum in order to adequately meet the evolving development aspirations of the country (Nziramasanga, 2005). It is out of the Nziramasanga inquiry that the Ministry of Primary and Secondary Education decided that the educational curriculum taught in schools should change and construct its own vision of a radical philosophy of education in which the thrust was Education with Production (EWP) which sought to make the school experiences meaningful and worthwhile in terms of real-life activities (Nyathi & Shonhiwa, 2020). The aim of the EWP was to create a dynamic link between the world of work and school through enhancing the productivity. According to MoPSE, (2015), the government made stakeholder consultations which spanned a period of two years from 2014-2015. Technical education was changed to Technology Education (now called Design and Technology). Among the subjects that underwent the transformation was TTD which was formerly known as Fashion and Fabrics.

Despite the efforts made to improve the TTD subject, it seems it is not competitive enough to match the

rapid pace of globalization (Mberengwa & Charapa, 2021). The main reasons for this is their substandard operations as compared to the clothing manufacturing industry in Zimbabwe and their competitors which are found in East Asia and European countries. The substandard operations of the TTD subject are characterized by high waste, poor working conditions, low utilization of resources, absence of good work procedure, and poor work standardization (Sithole, 2018). Sithole also found that there was technophobia among teachers and learners who were not conversant with the available technological tools that were listed in the curriculum for it to function effectively as well as lack of motivation to use the tools; therefore, learners remained comfortable with the traditional tools. To survive the current and future influence of global competition in the use and advancement of technology in the TTD subject, it is vital to analyse the operation and adopt a technique that brings continuous improvement. It is with these observations that there was a need to carry out an analysis of the operations to establish where improvements can be made for the TTD subject so that learners' exit profile is attractive to industry and higher learning institutions (Chisosa & Chipambwa, 2018).

Concerns have been raised on the methods used in various TTD operations that are involved in the TTD subject. In a study on curriculum versus industry expectations by Donga and Tsatsi, (2018), it was concluded that practical operations in the education system are not matching with the industrial work methods. Teachers have used various methods in schools to execute the TTD subject with no yardstick to measure performance ((Zhuwau & Shumba, 2018). Considering the length of activity execution, it is logical to state that the TTD curriculum implementation will be accompanied by challenges (Holme, 2009). This is particularly true when a revised curriculum is in place. Exploring these challenges is a base for improving the TTD subject operations. There are a number of techniques that can be used towards continuous operations improvement in the TTD subject. There is need for regular review of the TTD subject operations alongside with curriculum reviews, as the world changes, people change, methods change, new techniques will be found and new equipment will be invented (Stephen, Crispen & Silas, 2022). To survive the current global trends, it is important for the education system to continuously look at ways to improve efficiency in operations and have new, easy and cost effective operations (Maryanti, Rohana, & Kristiawan, 2020).

In this study, it is assumed that the viability of the TTD subject can be improved by better organization and efficiency. This involves a close study of the needs and presentation through work study technique, method study and work measurement (Castro, 2022). Work study is a higher technological science that works for systematic examination of methods of carrying out activities so as to improve the effective use of resources and to set up standards of performances for activities carried out (Chisosa & Chipambwa,

2018). They also emphasised on the usefulness of analysis of operations through performance measure. However, to date limited studies have been carried out to improve TTD subject operations through work study in secondary schools. Applying the work study program for the TTD subject in secondary schools can offer several advantages over other methodologies like the Six Sigma Lean methodology. In this study, the work study programme takes a holistic view of the TTD subject operations (Brown, 2018). This comprehensive approach allows for a thorough analysis of TTD work practices and facilitates effective process optimization.

Furthermore, the work study program places a strong emphasis on time study for work measurement though studying the sequence of tasks and the workflow patterns, helps to identify inefficiencies and bottlenecks (Masniar., et al., 2023). This focus on optimizing time and motion can lead to significant productivity improvements in TTD curriculum implementation and operations. In addition, the work study program encourages active involvement and engagement of the workforce in process improvement initiatives. It provides opportunity for teachers, students and other stakeholders in TTD to contribute ideas, offer suggestion and participate in decision-making (Bousdekis, Lepenioti, Apostolou, & Mentzas, 2021). By analysing work processes and optimizing resource allocation, the work study programme will help in identifying cost-saving opportunities through examining the activities being distributed, simplified and modified so as to reduce unnecessary work or wasteful use of resources and fixing a common place for the activity (Chisosa & Chipambwa, 2018). This focus on cost-effectiveness can lead to efficient utilization of resources, minimizes waste, and reduces unnecessary expenses resulting in significant savings for the schools (Brown & Keep, 2018). In addition, the work study programme is known for its practical approach to process improvement. It involves conducting time studies, implementing work methods, and monitoring performance to ensure sustainable changes (Roberts, 2017). This hands-on approach allows organizations to see tangible results and implement improvements effectively.

Work study has been found to be a solution to operational challenges in China. The fusion of work study into the school curriculum has contributed to the growth and success of manufacturing sector (Sigh.MP., 2016). In the view of the Chinese, work study serves not only an ideological purpose but also meets vocational needs in secondary learning (Khan N. , 2014). Work study engineers within training institutions have helped to evaluate work efficiency. In India, all major fashion institutes teaching garment technology courses and industrial engineering are training students in work study (Reddy, 2020). In Sri Lanka, special courses have been designed for the same such as the Management Service Certificate in time and work study (Liyanage, 2014). Work study is an important tool to increase efficiencies and

improve operations and needs expert intervention in the TTD subject for operations improvement.

Zimbabwe will not be able to compete technologically with other countries in the textile and clothing industry if the TTD subject operations systems are not engineered by developing the most effective and efficient techniques. The educational landscape in Zimbabwe is constantly being transformed to improve operations in learning with the resources available (Sithole, 2018). Although documents have been prepared to monitor curriculum implementation, operations seem to be going down in the TTD subjects. To improve the efficiency in the TTD learning, there is need to carry out an analysis of TTD subject operations to see where the challenges are in the learning process (Chisosa & Chipambwa, 2018). To the best of the researcher's knowledge there are limited studies on how to apply work study techniques in secondary schools for operations improvement in the TTD subject in Zimbabwe. Research studies have shown that the application of method study and work measurement is widely used tools in the manufacturing industry and trying it would improve the TTD subject. The focus of this research is on operations improvement in TTD subjects by work study. This research investigates how operations can be improved through work study in TTD subjects in secondary schools in Zimbabwe. The aim is to develop a framework of work study methods that will be effective to the learner's exit profile. The proposition is that "work study will help in operations improvement which in turn will increase the quality of learner's exit profile".

1.3 Statement of the problem

The focus of TTD education has moved from planning and control to engineering for operations improvement because industry, clothing business and higher learning institutions need technically trained people (Islam, 2022); Chimbindi & Rembe, 2018). The TTD subject is not operating competitively to prepare the learners for the future (Chirapa & Mberengwa, 2021). There is little done in schools as far as the need in industry and universities is concerned (Manwa, 2018). Implementers face challenges and as a result the intended TTD curriculum plan of preparing learners for industry and self-sustenance is failing (Sithole, 2018). The implementation strategy needs benchmarks to direct educators on how to improve TTD subject (Chirapa & Mberengwa, 2021). Linking work study and the TTD subject could help analyse operations for secondary schools in Zimbabwe. Work study has proved to be an effective method for improving vocational education in China and India (Reddy, 2020). However, to date, limited studies have been carried out to analyse TTD subject operations through work study method for secondary schools in Zimbabwe. It is against this background that the study seeks to analyse current operations, find out the challenges the TTD subjects are facing through work study and develop an operational model that could be used as a yard stick to improve the TTD subject operations in secondary schools in Zimbabwe.

1.4 Aim of the Study / Purpose

The aim of this study was to analyse operations through work study in the TTD subject for secondary schools in Zimbabwe.

1.5 Research Objectives

The study's objectives are to:

- examine the current operations in the TTD subject in secondary schools.
- explore the methods used to execute operations in TTD subject in secondary schools
- ascertain the time taken to execute each operation in TTD subject.
- determine the challenges faced in TTD subject operations for secondary schools in Zimbabwe.
- establish how TTD subject operations can be improved through work study in secondary schools.
- develop an operational framework for improving the TTD subject operations for secondary schools in Zimbabwe.

1.6 Research Questions

1.6.1 Main research questions

What are the operations through work study in the TTD subject for secondary schools in Zimbabwe?

1.5.2 Sub research questions

- What are the current TTD subject operations in secondary schools in Zimbabwe?
- Which methods are used to execute operations in the TTD subject in secondary schools?
- How much time is taken to execute each operation in the TTD subject?
- What challenges are faced in TTD subject operation in secondary schools?
- How can operations in the TTD subject be improved for secondary schools?
- What conceptual model can be adopted by secondary schools to improve TTD subject operations?

1.7 Significance of the Study

Issues of operations in TTD subjects have in recent years become a major global concern; hence, this study could be of great importance as contributes to the existing debate on operations in the delivery of the TTD subject curriculum in Zimbabwean secondary schools. Since 2002, studies have shown that the introduction of TTD has not achieved the intended purpose of industrialising the operations in the curriculum. Studies have rarely investigated issues of improving operations in the TTD subject through work study method aimed at industrialising the learning area in secondary schools in Zimbabwe. Without

work study, TTD departments might operate in a vacuum with hardly any basis for comparison or control (Zhuwau & Shumba, 2018). According to Graves (2018), it is the responsibility of the education system to ensure students in TTD subjects have access to operations that reflect today's workforce, and an education that prepares them to compete in the skilled trades industry. Developing the right path in the TTD subject will ensure the best efficiency to the exit profile of learners. Hence this study attempts to fill these gaps and explore the operations of the TTD subject in Zimbabwe's secondary schools.

This study highlights the real challenges and identifies better methods to be used in the TTD subject operations and in secondary schools. It intends to find ways of cementing the relationship between work study and TTD subject operations improvement. The study may help to find an appropriate model for the work study in TTD curriculum in secondary school education. The study is likely to help TTD Associations and Curriculum developers in developing and presenting strategic visions and give them a strong voice when communicating to national policy makers, other government agencies and partners by revealing the operations in TTD subject in secondary schools. This research is relevant to academics, scholars and students as it adds to the existing body of knowledge. It agitates for the adoption of innovative practices in the education system by bringing an appropriate work study model for industrialising and improving the TTD subject operations. It could be a guide to the responsible statutory bodies and policy-makers in monitoring and ensuring useful and viable operations in TTD by revealing the work study method appropriate for industrialising the operation.

1.8 Scope of the Study

The study examined the operation, explored the methods used in the TTD subject operations, ascertained the time taken and determined challenges faced in the TTD subject. It also established work study methods that could be adopted by developing a conceptual frame work that addresses the problems identified and specified the intervention areas in TTD subject operations. The study was confined to the TTD subject for A' level secondary school curriculum of 2015-2022 in Zimbabwe.

1.9 Limitations of the Study

The study was limited to operations analysis for improvement in the TTD subject for advanced level secondary schools in Zimbabwe. On the subject of the TTD, there are many issues or problems that should be addressed, but this study only focused on operations problems due to lack of adequate time and data. Among the challenges, the following were assessed: equipment, working environment, teacher competency and funding. Funding was a challenge as the research was self-sponsored which affected the methods of collecting data; sample size which was limited to the least possible number, COVID-19

pandemic limited movement of the researcher and online observations became the best option while the researcher had intended to be a participatory observer to get first hand observation. Participants were not readily available online despite being sponsored with data. There were limited studies about the use of work study in secondary schools; the technique is mostly used in clothing industry only. The researcher was not able to separate the research set up from the normal running of the school events, the research had to run concurrently with the on-going school programme and just came as part of teaching exchange programme.

1.10 Chapter Summary

The chapter discussed the background of the TTD subject emphasising on the efforts that have been made to improve its operations. The statement of the problem has stated the gaps that have been identified by scholars which have compromised the achievement of the curriculum aim. Despite the efforts the stakeholders are making to improve, the subject seems to be going down and far from achieving the industrialisation goal. Work study has been used to improve operations in vocational education in China and India and therefore could be used to analyse and improve operations in the TTD subject. The main objective of the study is to analyse current operations and establish a conceptual framework that could be used to improve TTD operations. The next chapter presents the literature review that guided the researcher.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

Literature review is an overview of available studies that relate to the study. It provides Current knowledge, allowing identity of relevant theories, methods and gaps in the existing research which can be applied in the discussion. The chapter therefore aims to review various documented studies that were carried out to investigate the operations in the TTD subject in schools and advocate suitable methods to simplify and improve operations in TTD for secondary schools.

2.2 Background of the education system in Zimbabwe

The education system in Zimbabwe began with the Eurocentric education which offered Africans limited academic and foundational skills in order to promote labour exploitation (Mapako & Mareva, 2013). Limited access to a quality education kept Africans subordinate to white colonialists. This was meant to advance British political and economic gains. In 1979, a new Zimbabwe-Rhodesia Government called for an education reform that created a three-tier school system.

The Education Act of 1979 regulated access to each type of school through a zoning system based on residency. Segregation based on ethnicity and race determined the access to resources, funding and quality of teachers between Groups A, B and C schools. In 1980, the education system focused on fostering self-sufficiency in students that would be productive. This was premised on equal access to education by providing primary and secondary education to all children.

Education quality in Zimbabwe has faced challenges that have interfered with the intended output. The challenges include teacher shortages, infrastructural pressure and economic crisis in the past decade (Chireshe & Shumba, (2011)). UNICEF claims that only a third of schools are considered to be in "good condition." Schools also face capacity challenges, including double session schooling, or "hot seating," and overcrowded classrooms leading to quality declines as students are given less attention and time to learn. Quality of education is also impacted by the lack of trained teachers in secondary schools. A majority of teaching colleges in Zimbabwe are for primary education training, leaving less opportunity to meet the demand of trained secondary school teachers.

The Nziramsanga Commission was commissioned by the President of the Republic of Zimbabwe in January 1998. This Commission was led by Dr. Caiphaz Nziramasanga, whose mandate was to inquire into Zimbabwe's entire education system (Nziramasanga Commission Report, 1999; Mawere, 2013).

The government took into account the findings which had been reached by the 1999 Nziramasanga Commission of inquiry into the Education system in Zimbabwe and commissioned to transform the structure and curriculum in order to adequately meet the evolving development aspirations of the country (Nziramasanga, 2005). It is out of the Nziramasanga inquiry that the Ministry of Primary and Secondary Education decided that the educational curriculum taught in schools should change and fashion its own vision of a radical philosophy of education in which the thrust was Education with Production (EWP) which sought to make the school experiences meaningful and worthwhile in terms of real-life activities (Nyathi & Shonhiwa, 2020). The aim of the (EWP) was to create a dynamic link between the world of work and school through enhancing productivity. The education system in Zimbabwe consists of primary, secondary, and tertiary education. The primary level is a seven-year cycle from grade one to grade seven. Secondary school education comprises a four-year ordinary level cycle which starts in Form one (Grade 8) to Form 4(Grade 11) and a two-year advanced cycle from Form 5 to Form 6 (Ministry of Education, Sports and Culture, 2001). The Ordinary level cycle covers a wide curriculum and different schools offer different subjects such as Mathematics, English, Science, Shona, Geography, Textiles Technology and Design, Wood technology and so on. At the end of the four year cycle the learners sit for the Zimbabwe General Certificate of Education Ordinary Level(O'Level) examination where each student is expected to pass a minimum of five subjects.

Progressing to Advanced Level (A' Level) is based on the performance from the Ordinary level examinations. At A-Level, students major in a minimum of three subjects based on combinations such as pure science subjects, commercial subjects, arts and technical subjects. The Textiles, Technology and Design(TTD) subjects is one of the technical subjects that is studied at Advanced Level (A 'level). The choice of subjects at Advanced Level (A 'level) is usually based on the student's long term career goals. Like primary education, the secondary school curriculum is centrally designed by the Curriculum development and technical services in the Ministry of Education, Sport and Culture. This unit designs the syllabus and teaching materials for the various subjects in Zimbabwe.

According to (MoPSE, 2015), the government made stakeholder consultations which spanned a period of two years from 2014-2015. Technical education was changed to Technology education (now called Design and Technology). Among the subjects that underwent the transformation was TTD which was formerly known as Fashion and Fabrics. TTD is one of the technical subjects the secondary school

education and is offered in public school from Ordinary (O'level) to Advanced Level (A 'level). The TTD subject has gone through modifications and reviews as a breakthrough for its viability as a technological learning area in Zimbabwe's curriculum for secondary schools(Sibanda & Young, 2020). The government took into account the findings which had been reached by the Nziramasanga Commission of inquiry into the Zimbabwean education system to transform the structure and curriculum in order to adequately meet the evolving developmental aspirations (Nziramasanga,2005).

2.3 TTD Subject for Secondary Schools

In Zimbabwe, the focus of the revised TTD syllabus for secondary schools is to give a production-oriented learning experience (Curriculum Development Unit, 2015-2022). The subject is meant to help learners to start up clothing companies and introduce their own designs and patterns on the market based on the skills acquired in school (Chirapa & Mberengwa, 2021). The objective was to enable them to innovate and improve designs already existing in the market. The A-Level TTD syllabus recognizes the use of the subject as a tool to reduce the gap between education output and the changes in the manufacturing industry (Chirapa & Mberengwa, 2021). The syllabus aims to encourage learners to have an investigative approach to the study of Textile Technology and Design which includes technical and scientific problem solving skills, as well as creative skills. It also aims to expose learners to the historical, cultural, functional, economical, managerial, entrepreneurial and aesthetic aspects. The Textile, Technology and Design subject intended to foster an awareness of how textile and clothing manufacturers and consumers interrelate in a changing multicultural and technological society. It also sought to foster in learners the ability to make informed decisions and communicate ideas through appropriate terminology and media, as well as nurturing an informed awareness and appreciation of textiles as an applied field of study leading to higher education and a range of career options.

According to the Curriculum Development Services (2015), the main objectives of the TTD are that the learner upon completing the 2 years of Advanced level studies, should be able to explore creative use of materials, techniques and technologies to style, draft and make patterns for clothing for different functions and figure types, and apply quality assurance skills in textile production processes. This means that students should be in a position to design, make patterns, select suitable textiles fabrics, develop the product, and be able to market the final clothing product to the consumer.

The syllabus specifies that the time allocation for learning the subject is 8– 10 periods per week of 35 - 40 minutes, that is two blocks of four periods for practical and one double period for theory depending on the school timetable. The practical lesson is expected to have a minimum of 280 minutes (estimate

of 4 hours) and a maximum of 320 minutes (estimate of 5 hours) per week. This time is allocated to allow for effective operation in the TTD subject. After completing 'A' Level, it is anticipated that the learner should be able to run their own businesses and attain employment in the textiles and clothing sector with minimum training and supervision. Learners should also fit in the university curriculum which aims at implementing the doctrine Education 5.0. There is need, therefore, to analyse and align TTD subject operations with education 4.0 so that learners align their experience at secondary school, and prepare to engage into the future experiences (Chuma, 2022).

The research focused on the garment construction sector which contributes to 40% of the summative assessment examination as from 2017. The purpose of this research was to analyse the operations involved in garment construction in the TTD subject and propose methods for improving operations in the garment construction sector. The evaluation of the operations in the TTD subject was compared to the standard performance of the clothing industry.

2.4 Standard Operation Processes for Apparel Industry and TTD Present Operation

The apparel industry aims to increase its operating efficiency and it is a requirement to ensure that Standard Operating Procedure (SOP) are followed in every operating section which gives a written step by step guidelines for operating (SOP Manual for Apparel -1128, 2020) (Khan, Siddiquee, Moula, & Islam, 2020). The TTD subject needs to develop a proper standard operation manual for operations improvement and move with the world. The order of operations in apparel production may vary depending on the specific garment being manufactured, the production system employed, and the preferences of individual manufacturers. The order of operations will be reviewed in the next section based on the following industrial manuals (ISO 9001, 2015); ANSI/ASQC Q9001, 1994) (Krishan, 2018). The standards need to be checked as they may be revised over time as technology changes, the standard ISO 9001: 2015 is a revision of the ISO 9001: 2008 manual. Standard operations cannot be separated with supervision of standards of quality and time. In this study, a proposed operational management system that is installed according to ISO 9001: 2015 standard is discussed in detail in the operational model for TTD subject. The common order of work is as follows: design development, pattern making, marker making, cutting, fusing, sewing, finishing, quality control and packaging.

2.4.1 Design Development:

Design development is a crucial stage in apparel production, encompassing the generation of initial design concepts, meticulous fabric selection and the subsequent creation of patterns. It serves as the

foundation for transforming creative ideas into tangible garments, ensuring alignment with desired aesthetics, functionality and market requirements (Douglas, 2022). All technology components are enablers of the manufacturing process, yet the use and availability of technology components varies across the secondary schools in Zimbabwe (Chimbindi & Rembe, 2018). Technology is identified as the most significant in design development while human effort needs to be reduced by advancing from the traditional process (Geršak, 2022). Industry-focused learning provides learners with sequential and organised design development skills and procedures, compared to the traditional methods which have no organised order of designing (Jin, 2022). By using CAD in technology education, teachers can combine design with a digital tool and thereby give pupils opportunities to develop skills in areas like communication and problem solving (Brink, Kilbrink, & Gericke, 2023). Technology education syllabuses of many countries capture the need for pupils to learn to develop technical solutions for different problems and to communicate their ideas (NCCA, 2021; Finnish National Agency for Education, 2021; Ministry of New Zealand, 2017; Skolverket, 2011). CAD can be used as a tool to accomplish those syllabus goals. The pupils' abilities to design with CAD has been proven to be feasible by a number of researchers (Cil & Pakdil, 2007; Garcia et al., 2007; Hodgson, 2008; McGarr & Seery, 2011; Garikano et al., 2019). Students in Zimbabwe were proven to have the ability to use CAD pattern making using simpler and cheaper versions of software such as CorelDraw. These can be used by teacher and move away from the traditional methods (Linnet, Chipso, & Felisia, 2021). According to Mupfumbati, Chuma and Chimbindi, (2021), operations involved in designing are ideation, sketching, fashion Illustration, sampling, fit and review, design approval and production. They further explain that the processes can be made by following step by step screen casts that can serve as instructional materials to expose student to CAD. These can help teachers move from the traditional demonstrations to technological methods in design development.

2.4.2 Pattern Making

Pattern making is a crucial step in clothing and apparel production; it involves translating design specifications into precise templates that consider fabric properties, fit requirements, and construction techniques. According to Glock (2014), this meticulous process ensures that the patterns accurately represent the desired garment and serve as a foundation for efficient and accurate cutting and sewing operations. Pattern making is the art of translating a designer's basic idea for a garment into a real piece of apparel that fits the human body in a flattering way (Datta. {DB}. & Seal., 2018). There are different pattern making methods and these include the traditional pattern drafting methods that are commonly used in schools. Technology is making it easier to speed up the pattern making process (Mupfumbati,

Chuma, & Chimbindi, 2021). The different types of pattern making within the apparel industry according to Boris (2022) are the flat pattern technique, modelling, computerised pattern making and sloper/block pattern making. Many companies use CAD systems to make patterns and CAD saves time during the design process. There are different CAD software systems that are used like Lectra Systems, Gerber Technologies, Tukatech, and Optitex. The use of these software enable garment development to be easier and more interesting (McKinney, Cho, Eike, & Sanders, 2020). They support the use of digital pattern creation as a valuable tool for increasing efficiency and productivity. Dibyendu (2018), asserts that new technologies in pattern making are necessary in the improvements of operations in the TTD subjects (Halili, 2019).

2.4.3 Marker-Making

Marker making is an essential process in apparel manufacturing. It entails creating a marker, which is a layout plan that optimizes fabric utilization during the cutting phase (Hora, Gruescu, Bungau, & Bodea, 2022). Yanni (2020) explains the pattern making process which begins by strategically arranged on a marker sheet to minimize waste and maximize the number of garments that can be cut from a single piece of fabric. Tsao, Delicia and Vu (2022) state that by carefully planning the marker layout, material costs and overall production efficiency can be improved. Moreover, the exposure to practical marker engineering increases the value of production as less waste is experienced. CAD software has been used by many companies for marker planning and this has led to faster production and increased fabric efficiency (Chaudhary, Kumar, & Johri, 2020).

There are two different methods usually used for marker making in the apparel industry, the manual and the computerised methods. CAD/CAM is expensive, though it has a number of economic and technological advantages over the traditional methods (Jankoska & Stojanovska, 2023).

Table 1: Computerized and manual marker making

	Computerized Method		Manual Method
01	Computerization is the best method of marker making and widely used.	01	Manual is not the best method of marker making and not widely used.
02	In this method, every component of patterns is kept in the memory of the computer and Grade ruler is also mentioned.	02	In this method, every component of patterns is kept in the memory of the marker maker and Grade rulers are not mentioned.
03	Suitable for large scale production.	03	Suitable for small scale production.
04	Marker efficiency is higher than manual methods.	04	Marker efficiency is comparatively lower.
05	Least amount of wastage of fabric.	05	Large amount of wastage of fabric.
06	If required, printout of marker is possible anytime.	06	Printout of marker is not possible anytime.
07	Automatic grading.	07	Only manual grading.
08	Less time required, so productivity is higher.	08	Productivity is lower.
09	High initial investment.	09	Lower initial investment.
10	Skilled operator needed.	10	Workable without a skilled operator.
11	The information of patterns can be stored by computer.		

2.4.4 Fabric Spreading

Fabric spreading is a crucial step in the apparel production process. Multiple layers of fabric are carefully spread on a cutting table, following the marker layout. This process ensures that the fabric layers are aligned properly, free from wrinkles or distortions, and smooth, ready for the cutting phase (Islam, 2022). Proper fabric spreading is essential for achieving accurate and consistent cutting results, minimizing fabric waste, and maintaining production efficiency (Bahja, Kuhail, & Hammad, 2021). There are two methods used in industry for the fabric spreading process. The manual method is totally hand spreading method therefore this process is quite slow, on the other hand, the mechanical method is automatic and fast (Jankoska & Stojanovska, 2023).

2.4.5 Cutting

Cutting is a pivotal stage in apparel production where fabric layers are transformed into individual pattern pieces (McQuillan, 2020). The cutting process involves following the outlines of the pattern pieces and separating them from the fabric layers. It can be performed manually using specialized cutting shears or through the use of advanced automated cutting machines (Todeschini, Cortimiglia, & de Medeiros, 2020). Manual cutting requires skilled craftsmanship, while automated cutting machines offer higher precision and faster production (Jayasekara, Lai, Wong, & Zhu, 2022). Choosing the appropriate cutting

method depends on factors such as production volume, fabric type, and desired accuracy. The cutting is nothing without cutting machines; there are various cutting tools used to cut the fabric in clothing manufacturing. To make work easier the following tools are used for cutting: the straight knife cutting machine, band knife cutting machine, round knife cutting machine, die cutting machine, drill cutting machines, computer controlled knife cutting machine, features of computer controlled knife cutting m/c, laser beam cutting machine, water jet cutting machine and plasma torch cutting machine. Lin (2024), in a study on collaborative pathways between sustainable digital Innovation and Fashion Design Education, revealed that the use of digital technologies in cutting were not well implemented in schools and recommended revision of pedagogical standards to improve operations in schools. Work study for manual cutting measures the standard time through time study. To improve the efficiency of garment cutting and the standardization of operation time, a time standard is needed that will decrease production cost and increase economic benefits (Fromhold-Eisebith, Marschall, Peters, & Thomes, 2021). According to Sookdeo (2021), standard time is calculated by recording the number of persons involved in cutting and collecting the different processes in different units. The total standard minutes for each process will help in determining the cutting room capacity and standard minutes needed to complete a task. The data can then be used for future planning.

2.4.6 Marking and Notching

Marking and notching are essential steps in apparel production that enhance accuracy and facilitate the construction process. During marking, critical points, lines, and match points are indicated on the fabric pieces, providing guidance for seam placement, pocket positioning, and other construction details (Matthews-Fairbanks, 2018). This helps to ensure precise alignment and consistent assembly. Notches, small cuts or markings, are also added to indicate seam allowances, match corresponding pieces, or identify specific construction steps. These markings and notches act as valuable references for seamstresses or sewing machine operators, enabling them to achieve precise and efficient garment assembly. The purpose of the marking tool is to transfer all the little notations that appear on your pattern, the ones that tell you where to cut, fold, sew, or place adjoining pieces (Sonye & Adeniji, 2017). The pattern instructions work together with these notations to tell one how to manipulate each pattern piece. Datta and Seal (2018), in their research on approaches used in the garment sector in India, concluded that new technology platforms facilitate greater flexibility in the areas of pattern designing, grading, marker making, waste reduction, increase in efficiency and accuracy of the cutting room and create accurate samples in time to help reduce costs are some advantage of using computer-aided design (CAD) system in composite garment manufacturing. However, use of technological resources requires electricity supply of which most of the rural secondary schools in Zimbabwe are not electrified.

2.4.7 Fusing

Fusing is the process of joining two or more fabric layers together using heat and pressure, typically with the help of an adhesive or thermoplastic film. It is a widely used technique in the textile industry for various applications, including garment manufacturing, home textiles, and industrial textiles. The fusing process involves the application of heat and pressure to activate the adhesive or thermoplastic film, which then bonds the fabric layers together (Shen, Li, Zhou, Jiang, & Bao, 2023). This creates a strong and durable bond that is resistant to washing, dry cleaning, and normal wear and tear. Fusing also offers design flexibility, as it allows for the bonding of different types of fabrics, such as woven, knitted, or non-woven materials. This enables the creation of unique textile structures and combinations, leading to innovative and functional products (Díez, Villa, López, & Iraurgi, 2020). Moreover, fusing provides enhanced garment comfort and appearance. It eliminates the need for traditional sewing and stitching, which can create bulkiness or stiffness in the fabric (Venkatraman & Scott, 2018,). Fused seams are flat and smooth, resulting in improved drape, flexibility, and overall aesthetics of the garment. Additionally, fusing offers durability and longevity to textile products. The bonded layers create a strong bond that withstands repeated washing, stretching, and usage. This ensures that the fused fabric retains its integrity and functionality over time. Fusing can be done using automatic machines, hand irons and steam irons depending on the bulk of the pieces to be fused (Sudhakar & Renjini, 2022).

2.4.8 Sewing operation

Sewing is a critical stage in apparel production where fabric pieces are skilfully joined together using a range of sewing techniques, this includes creating seams, darts, pleats, and other structural elements that give shape, fit, and style to the garment. Both machine sewing and hand sewing operations are employed, depending on the complexity of the design and the desired finish. Sewing operators follow the pattern instructions and employ their expertise to ensure accurate stitching, proper tension, and neat finishing. The sewing stage brings the garment to life, transforming the fabric pieces into a cohesive and wearable product. Without good sewing we cannot introduce our products worldwide. Many factors are related to sewing like needle size, machine type, thread count, worker capacity, and production line. The sewing section is not only fabric joining, it is the core part of a garment manufacturing industry. Sizwe & Charles, (2017), explain the process of sewing which begins with the detailed specifications are the beginning of sewing followed by design development, pattern design, laying and cutting, fusing or pressing, sewing and finally finishing and quality control. Sizwe and Charles (2017), also recommended quality management and close supervision, adequate equipment and workflow guide and adequate operators in clothing manufacturing so that there is quality production.

The following machines are used in the sewing industry: plain machine, overlocking machine, bar-tack machine, buttonhole machine, button attaching machine and feed of the arm. A production system follows an organised process that helps to plan the work flow and produces a complete apparel (Rama, 2020). Rama explains that in all manufactured products, there are different ways to organize the actual production of garments, according to the type, amount and diversity of products to be made. The type of production system in garment construction is determined by the quantity of production. According to Rama (2020), the apparel production system depends on the affordability, equipment involved, number of tasks, curriculum policy and personnel training. The first production system is the individual production or make through system sometimes called whole garment system. This is a traditional method where the entire garment is assembled by one person (Mazharul, 2022). Each product is made only once or in very small quantities. The system requires highly skilled, experienced operators and efficient machinery. The personnel do pattern making, fabric cutting and finally finish the garments for completing the garment. The second system is the sectionalisation or bundle, more skilled operators are needed to sew garment parts from beginning to the end. This system includes a small influence of personnel changes and easy style changes. To complete all the operations for every garment component requires more versatile operators. When one operation ends then it is passed on to the next Varum, (2021). The last system is the mass production system where large quantities of identical products are made continuously. The high utilization of machinery and labour allows a high level of automation and specification that need the implementation and development of the process control charts for recording all activities (Muhammad, et al., 2022).

In a study by Tilahun, 2020) on optimization of the production process in sewing work for Ethiopia, it was concluded that sewing should improve in terms of quantity and quality to maintain competitiveness and validity of the enterprise. This can be achieved through deployment of improvement techniques that can enhance the use time and improve operator's performance. Work study is carried out in the sewing section to identify sewing faults and reworks to eliminate them for saving time, cost and improved product quality and quantity (Beloor, Shekar, & Hegde, 2020). Nabi, Mahmud and Islam, (2015), in their study on improving sewing section efficiency through utilization of worker capacity by time study technique in Bangladesh concluded that the sewing section can be improved through time study technique as Standard Minute Value (SMV) can be calculated for all operations and establish each operator's capacity and work challenges. They emphasise the significance of time study in improving the effectiveness of the sewing section.

2.4.9 Finishing

The finishing operation entails final inspection, pressing and packaging. The purpose of the finishing operation is to improve the quality of garments (Islam, 2022). Garments presentation is very much dependable on the garments finishing section (Rajesh & Naidu, 2022). In the TTD subject the finishing of the garment impresses the examiner and determines the pass mark of the learner. Teachers are responsible for prior checking before the final pressing and packaging. Inspections are done though inspecting the operations in the production system, they can be done face to face or online (Genta, Galetto, & Franceschini, 2020). Before the inspection, the inspection service provider should provide a detailed product specification, including size charts, material requirements, and any specific quality standards that need to be followed. This information will help the inspectors understand the expectations and prepare for the inspection Hoque & Maalouf, (2022). Garments are cleaned and checked for hanging and loose threads (ISO 9001, 2015). Quality control is a crucial stage in the apparel production process; garments undergo thorough inspection to assess their adherence to quality standards and specifications (Di Cataldo, et al., 2021). Skilled inspectors examine the garments for any defects, flaws, or inconsistencies in stitching, fitting, and overall construction. If any issues are identified, necessary adjustments or repairs are made to rectify the problems and bring the garment up to the desired quality level (Díez, Villa, López, & Iraurgi, 2020). The quality control stage ensures that the final product meets the expected standards of durability, functionality, and aesthetics. It plays a significant role in maintaining customer satisfaction and brand reputation. Quality means customer needs are satisfied. Failure to maintain an adequate quality standard can therefore lead to failure. Every garment manufacturer ensures the quality first, because if garments are unable to ensure quality then the garments cannot find good consignment in future. These properties are known as quality characteristics. For example, fibre length is known to be one of the important quality characteristics of a fibre (Hossain, 2021). According to Wright (2015), when constructing garments or selecting a garment, details of construction are important. In schools, garments are made for a contest to attract the quality inspector who is the teacher and the examiner or marker's eyes. Those marking a contest seek to be impartial and fair as well as critical and discriminating. Personal preferences must be set aside so entries can be evaluated objectively. Wright (2015) explains the construction techniques that can be used to achieve an acceptable end garment. The end garment should be functional, durable and inconspicuous. Quality assurance is fundamental to instructional design projects, ensuring that deliverables meet established standards and objectives. By implementing effective strategies, including content review and accuracy, design and usability evaluation, accessibility compliance, continuous improvement and evaluation, collaboration and peer review, documentation and standardization, and effective project management, instructional designers can consistently deliver instructional materials of the highest quality. This, in turn, empowers learners,

supports inclusive education, and contributes to advancing quality instructional design practices (Maryanti, Rohana, & Kristiawan, 2020). They also found that there was a great improvement in product quality in some schools in South Sumatra as they tried aligning education quality with the demands of the Industrial Revolution 4.0.

Pressing is a crucial step in apparel production that enhances the overall appearance and quality of the garment. It involves the application of heat and pressure using tools such as irons or steamers to shape, flatten, and set seams and fabric details (Lave, 2021). This process helps to remove wrinkles, create crisp edges, and ensure smooth and well-defined garment elements. Proper pressing techniques are essential for achieving a professional finish and improving the overall aesthetics of the garment. The presentation of the garment or task a learner makes at school should impress the assessor who is the teacher or the examiner. Garment presentation should be appealing to the examiner, poorly presented garments have a detrimental effect on the final grade given to the learner, and therefore it is an important step in the TTD subject (Sudhakar & Renjini, 2022). Pressing equipment varies from pressing tables, to hand irons that are heated using coal or electricity. Industry has improved irons from the pressing iron below to the use of a seam press, automatic operations, carousel press, steam air finisher and the steam tunnel (Ahmed, 2018).

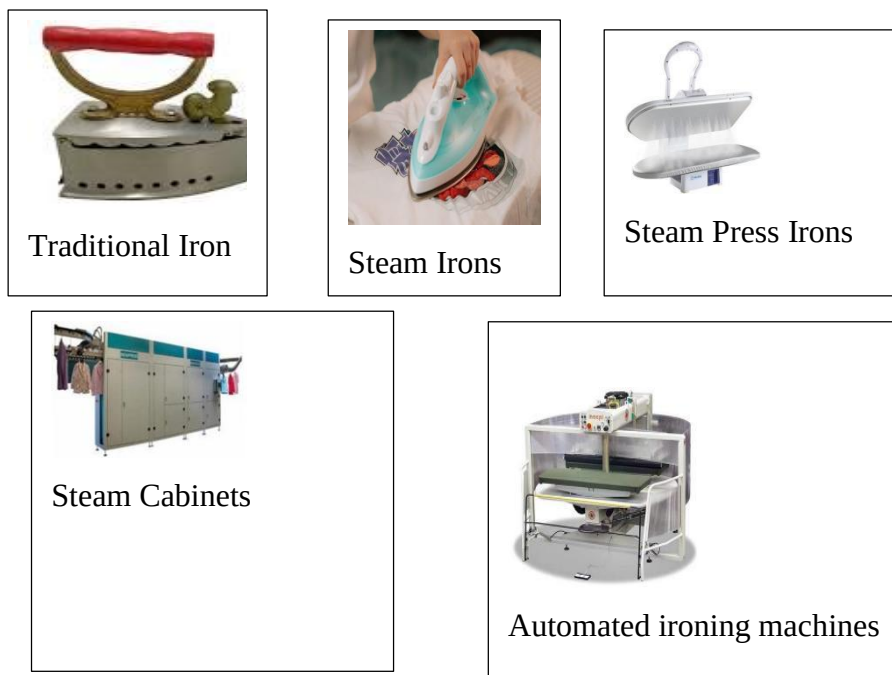


Figure 1: Development of pressing tools in the clothing industry. Hand Iron: (Vinitha, Prabhu, Bhaskar, & Hariharan, 2020)

The electric hand iron is the most commonly used iron generated from the charcoal iron. There was also an iron with a metal casting which was heated by the gas flame. Nevertheless, steam and electric irons have now been widely used in recent times (Vinitha, Prabhu, Bhaskar, & Hariharan, 2020). Packaging is the final stage of the apparel production process. Finished garments are carefully folded, tagged, and packed according to specific packaging requirements (Fromhold-Eisebith, Marschall, Peters, & Thomes, 2021). Packaging includes placing the garments in appropriate bags, boxes, or containers, and affixing labels or tags that provide essential information such as size, colour, and product details (Mahamud, 2021). Proper packaging ensures that the garments are protected during transportation and storage. This preserves their quality and presentation and facilitates easy identification and handling of the garments, whether for distribution to retailers or direct delivery to customers (Samsul, Manuarul, Md Hasibur, Faysal, & Ranjan Kumar, 2022). After passing the quality section, garments are packed. Packing section is a place where many accessories, trims, fabric and other important elements of garments are kept. Basically, there are two types of stores, one is a normal store and another machine store (Islam, 2022). The packing section and storage are crucial components of the textile industry; they ensure the efficient handling, preservation, and distribution of textile products. The packing section plays a vital role in preparing textile products for shipment and delivery. It involves the careful packaging of finished goods, ensuring their protection during transportation and storage. The primary purpose of the packing section is to safeguard textile products from damage, contamination, and environmental factors such as moisture, dust, and sunlight (Mahamud, 2021). Proper packaging materials, such as bags, boxes, or shrink-wrap, are used to provide physical protection and maintenance of product quality.

The packing section is responsible for labelling textile products with relevant information, such as product name, size, colour, barcode, and other details necessary for inventory management and tracking. Clear and accurate labelling facilitates efficient sorting, storage, and retrieval of textile products. In the packing section, textile products are often unitized and bundled together to optimize handling, storage, and transportation. Unitization involves grouping products into standardized units, such as cartons or pallets, to facilitate easy counting, handling, and tracking (Salmi & Kaipia, 2022). Proper storage of textile products is also crucial to maintain their quality, prolong shelf life, and enable efficient inventory management. Textile storage areas should meet specific requirements to ensure product integrity and accessibility. Textile products are also sensitive to temperature and humidity fluctuations. Storage areas should maintain controlled environmental conditions to prevent moisture absorption, mild growth, and fabric deterioration (Freichel, Wollenburg, & Wörtge, 2020). Clean and dust-free storage areas are essential to prevent contamination and to maintain the cleanliness of textile products. Regular cleaning, pest control measures, and adherence to hygiene protocols are necessary to preserve product quality.

Efficient storage systems, such as shelving and racking, help maximize space utilization and facilitate easy access to textile products (Fromhold-Eisebith, Marschall, Peters, & Thomes, 2021). Proper organization and labeling of storage units contribute to improved inventory management and timely order fulfillment. By effectively managing the packing section and storage, textile companies can ensure the safe handling, preservation, and timely delivery of their products, leading to customer satisfaction and operational efficiency (Mahamud, 2021). It is important to note that the order of operations may vary based on factors such as garment complexity, production system, and individual manufacturer preferences. Additionally, different apparel categories, such as woven garments, knitwear, or tailored garments, may have specific variations in their order of operations. Therefore, this study examined how the above reviewed operations aligned with what is done in the TTD subject.

2.4.10 Operation and Time Supervision

Supervision is a way of monitoring what is happening in a system, it assists in identifying problems in the system or errors in the operations (Ramdass & Mokgohloa, 2022). The presence of a supervisor motivates the workers to be productive and should be professionally undertaken so that it benefits the teachers and learners (Nyathi & Shonhiwa, 2020). The education sector in Zimbabwe has also placed TTD subject supervisors at different levels from the higher education office trickling down to the heads of departments and teachers. Internal supervisors are the teachers, heads of departments and the administration. Garment construction operations are supervised from the start through different stages, all the way to final inspection and submission of projects for external assessment. External supervisors also assist in the smooth running of the intended curriculum, this include the curriculum development personnel, provincial directors and inspectors.

The traditional role of a supervisor was to command-and-control with authority; the 21st century role of a supervisor is expected to become shop-floor coaching were the supervisor becomes part of all stakeholders of the system who motivate employees and leverage the symbiotic technology-employee relationship in the quest to produce products effectively, efficiently, and with the necessary agility and speed. (Ramdass & Mokgohloa, 2022). The current supervising system in Zimbabwe is traditional as prescribed by the MOPSE regardless of the supervisees' individual differences and the circumstances they would be operating in and compliance as a measure of performance (Ngwenya, 2017). In schools both teachers and learners need motivation and a good work culture to remain productive (Mulang, 2021). Empirical research has shown that the Zimbabwean supervision in schools advocates for a developmental supervisory process were professional growth of both external and internal supervisors is embedded in it. This rules out the “hit and run” type of supervision tactics which characterised the previous supervisory

practices (Ngwenya 2020). Ngwenya, further elicits an ideal supervisory process, which enables both the supervisor and supervisee to jointly identify weaknesses and strengths which would constitute a self-renewal purpose. Ngwenya, also argued that knowledgeable supervisors, if well supported in their supervisory practice, would minimise the role of the external inspectorate teams if school-based supervision is adopted in Zimbabwean schools. With the data provided by inspectors, subject supervisors, Heads of departments, curriculum developers can make informed decisions to drive efficiency and optimization of operations in the TTD subject. The information provided from supervision can have a direct impact on the performance of the learners. Curriculum developers can review the subject with crucial information to make adjustments in real time as needed to develop solutions to specific problems. Education supervisors find it challenging to continuously visit schools in person due to limited resources like time. Communication and growth can be difficult to achieve because of geographically distant. With the increase of schools in the past few years, new information and communication technologies into current practices have developed. This includes online supervision. Online-supervision is the latest educational teaching technology, using email, video, and other online resources to enhance the teaching process for pre-service teachers. The costs of using online supervision technology are defrayed by effective learning, decreased travel time and costs, and flexible scheduling. There are no travel expenses incurred, it helps reduce the time subject supervisors need to visit schools allowing them to analyse a teacher's practice via video. There is also quick and continuous access to their learner's information, which enhances effective communication. According to Zacharia (2022), there is need for technology training prior to implementation to ensure smooth and effective use by supervisors.

The clothing industry has different supervision categories that assist in the monitoring of all aspects of the manufacturing process. Supervision ensures that operators adhere to standard of quality, and allows for the review of the operation system. This enables the supervisor to identify and rectify potential bottle necks, ensuring quality training, getting feedback, ensuring compliance with legal and ethical standards, as well as encouraging a culture of continuous improvement (ISO, (2015). Student prefer online-supervision as proved by Bousdekis (2021) found that the students at Iowa State University e-supervision and traditional face-to-face visits found no statistically significant difference between online supervision and face-to-face supervision on performance evaluation scores. The students and the teachers overall found the online supervision process to be beneficial to their professional development.

2.5 Time taken in TTD subject Operations

Time taken is the amount of time used in order to complete a task, it is measured in real-time. That way, it would be easy to find which operation is the challenge (Merriam-Webster, 2024). To establish the real

time, there is need for calculating the time taken to execute an operation using time study (Meenakshi & Balasankar, 2023).

2.5.1 Procedure for Time Study

Time study plays a pivotal role in the clothing industry as aptly captured by Mekala, Sanju, Thamaraiselvan, and Kavya (2021). Time study is a work measurement technique commonly used by apparel engineers to determine the rate at which a specific operation is performed. It is done by directly observing and measuring the time needed to perform a specific task (Mbawankar, 2023). The objective of a time study is to develop and check production standards and procedure for time study (Amal, 2022). The whole exercise of timing different operations is done to calculate the SAM (Standard Allowed Minute) or SMV (Standard Minute Value) of a garment, which is a common way of expressing work content of a garment in terms of minute value. The work content (Standard Allowed Minute) of a job or operation is calculated as:

basic time (observed time) + operator rating + relaxation allowance + additional allowance (e.g. bobbin replacement).

Operation are broken-down in order to analyse the production process. It involves breaking down the manufacturing process into smaller, manageable operations or tasks. Time is allocated for each operation and the total time of all operations determine the total time used for a garment. A time study sheet is used to record the time taken for each task. In the TTD subject, garment specification is sent to schools as the selected garments for that particular period or year. For the years 2015 to 2022, the Paper 2 which is the practical examination consisted of processes breakdown like pattern drafting, laying out, cut out and construction of the article in two consecutive days (15 hours). The paper specifies 30 minutes' allowance between session which means the total allowance time (Education, (2015-2022)). The TTD curriculum specifies the standard time for continuous assessment in the TTD subject and this serves as the standard time for the learning area at implementation which can be used to estimate the number of garments expected per year. According to the ZIMSEC (2018) report, the expected time to complete a garment was 6 months and the subject is allocated 8–10 periods per week of 35 - 40 minutes, and each candidate is expected to have done at least 5 practical tasks. These are not complete garments, they can test on a topic such as making different types of pocket samples and two projects which are complete garments showing the manipulation of the processes learnt in summary (Textile Technology and Design Syllabus, 2015-2022; Education, 2015-2022).

Table 2: Time allocation for TTD subject practical lessons

Minimum Number of lessons per week	Time allocated per lesson	Total minutes per week	Total minutes per month	Total minutes per term
4 periods	35	140	560	1680
4 periods	40	160	640	1920
Maximum Number of lessons per week	Time allocated per lesson	Total minutes per week	Total minutes per month	Total minutes per term
6 periods	35	210	840	2520
6 periods	40	240	960	2880

Shoko, Dapira and Mpala (2022) conducted a study in secondary schools in Zimbabwe and found that 62.5% of learners took 18 months to complete a skirt or blouse, 25% worked on garments in 4 months and only 12.5% indicated that pupils worked on coursework garments over 6 months which is the expected time. According to Shoko, Dapira and Mpala (2022), the TTD policy has afforded learners ample time to work and complete their coursework garments. Furthermore, they observed that despite the benefits of doing one garment at reduced costs, ample time to finish the coursework garment and time to concentrate on other components of the syllabus, pupils were not being exposed to adequate practical skills. This led to the recommendation that the number and types of garments made by pupils should be increased and that teachers should encourage students to always complete a project that they started. Further, the government should always encourage teachers to participate in in-service training, workshops. The use of time study will then bring a standard performance that could be used to bridge the gap between learner's performance and expectations of the planned curriculum for the purpose of improving the TTD subject operations (Amankwa & Agra, 2015). Nkwodimmah and Okoh, (2019), recommended that TTD should be given more time in the timetable so that learners are exposed to different techniques.

The above studies clearly show the need to determine if there are any fluctuations in TTD operations. Time studies ought to be done, so as to monitor the accuracy of operations. If there are dips in the TTD operations, cause and loss studies could be done to determine the time taken and the challenges could be dealt with and can lead to new operations improvement.

2.6 Indicators for Operations and Challenges in TTD Subjects in Secondary Schools.

Operational indicators are a set of measures used for focusing on those aspects of the performance that are the most critical for the current and future success of a system (De Silva & Seneviratne, 2022). When analysing the TTD subject operations, choosing the right indicators is a critical aspect for improvement in performance. Indicators and improvement are tightly and inevitably linked to each other. An improvement plan without indicators and a proactive measure to ensure a sustainable future for the TTD subject is useless (Wijewardhana, Weerabahu, Nanayakkara, & Samaranayake, 2021). The operational impediments for the TTD subject include operations resources and equipment, teacher competency, funding and working environment (Zindi, 2018).

2.6.1 Teacher Competency in TTD Subject Operations

A professional teacher should possess essential competencies that develop as a result of changing needs of our educational community, diversity of student groups and rapid industrial growth which is of critical importance for operations improvement in the TTD subject (Shankar, Gowtham, & Surekha, 2020). The teachers need a lot of orientation as the implementers of the new curriculum for the TTD subject and they need to revisit their competence profiles for 21st century challenges so that they are able to integrate technology into their lessons (Nayak & Pani, 2021). The United Nations office in Zimbabwe claims that thousands of teachers are unmotivated due to low salaries, limited resources, pressure, political harassment and the shortage of teachers. Chireshe and Shumba, (2011)) assert that teachers believe their teacher training did not prepare them for the classroom or to teach special education. The researchers also believe that teachers will continue to threaten to strike or actually strike in the future unless their needs are better addressed by the government.

New syllabuses were printed and in-service workshops were held in 2015 to train teachers, but not all professionals in TTD were retrained in line with the new focus of industrialising the learning area (Services, 2015-2022). The set performance standards of the curriculum were confusing and could not be followed and the objectives from which teachers derived the content for TTD subject were open to different interpretation, resulting in graduating students lacking uniform competencies (Sithole, 2018). The implementation strategy needed a yard stick or framework to direct educators who seem to be uncertain of their roles. Since programme implementers greatly influence the curriculum offered or followed in the schools, having implementers who are not sure of their role is detrimental to the operations of the TTD subject (Chirapa & Mberengwa, 2021). Teacher competency in A-Level TTD subject is affected by the teachers' lack of exposure to industrial equipment, and inadequate time for practical work (Mupfumira, 2020). Teachers need to be trained in order to industrialise the TTD subject

and the actual learning activities should be done in the training workshops concerns have been raised on the absence of knowledgeable professionals to direct proper implementation of the operations (Makuvire, Mufanечиya, & Dube, 2023).

Kennedy (2019) noted that after teacher training, the transfer of this learning to the classroom was not always well planned. He emphasised that a strategic approach needs to be adopted including planning for before, during and after training. There is a need therefore to interrogate the schools monitoring instruments and find out the actual operations needed in the TTD learning area in secondary schools through work study. Teachers use commercial patterns instead of CAD because of lack of pattern making skills arising from the failure by schools to afford the software. All clothing factory managers indicated that they preferred to employ people with basic knowledge of pattern drafting. While there is need to improve operations in the TTD subject, there is need for the government and the education system to reskill and upgrade implementers for new ways because education has moved from conventional learning paradigm towards more technology-based learning. This calls for teachers to enhance their competencies that match global challenges in this digital era (Jafar, Hamid, Suhairom, Hisham, & Zaid, 2020).

When the Ministry conducts monitoring visits, it is important to generate a report on the spot for any particular teacher who has worked extra hard to achieve a reward. This approach would (Osman & Warner, 2020) be good motivation for hard-working teachers who themselves have motivated students in the classroom. Such a report would also be effective as it would encourage teachers to further promote student motivation, class participation and individual learning strategies for improved student learning outcomes. It is also important to note that the teaching and learning will be successful only if administrators and educators are adequately prepared with the skills, knowledge and positive attitudes (Gulhane, 2017). Collaborative and collective professional development by teachers will improve their skills and capacities to effectively teach the curriculum in schools. Teacher professional development is the bridge that links whole-school improvement with the changes in teaching practice that are fundamental to improved student learning (Osman & Warner, 2020). Similarly, Slemple, Field, and Cho, (2020), present evidence from case studies of improvements in student reading abilities. Evidence shows that the relationship between teacher learning and student learning outcome is the fundamental issue in the operations improvement of education outcomes. Should be offered quality teachers who can teach current content knowledge and skills competently for learners to be abreast with changes in the TTD industry. Furthermore, there is need for teachers to update their content and pedagogical knowledge and skills, and improve their interpersonal relationship with students and experts in TTD. Upgrading teachers' competence in the era of industrial revolution 4.0 creates an acceptable exit profile and experience for

graduate competent and ready graduates who are ready to join Industry (Maryanti, Rohana, & Kristiawan, 2020). Vázquez-Cano, Sáez-López, Grimaldo-Santamaría, and del Pilar Quicios-García, (2023), concluded that age and years of experience were important factors in the ability to use technology in the teaching process. Furthermore, teachers with more years in the teaching profession are least likely to be proficient with the use of technology

2.6.2 Funding for the TTD subject in Secondary Schools

High quality education is the total effect of the funding for operations and performance in the classroom (Chisosa, 2018). This view of quality applied to the TTD learning area can be measured by comparing the TTD operations with the quality in the standard industrial operation. Education is the apparatus for enabling learners for a viable change of the nation and this goal cannot be easily achieved with lack of funding to the operating instructions (Amaechina, Obioha, & Obioha, 2020). Amaechina, Obioha and Obioha (2020), went on to explain how funding is less cumbersome for government, if there the private sector could assist and induce adequate funds into the educational sector. The education in Zimbabwe is not completely funded due to historical government expenditures focusing on infrastructure for education and recent years of global economic crisis. According to UNECEF, teaching materials are allocated less than one percent of the federal budget for education. Parents have to meet the needs of the learners and the cost and financing of practical subjects also perpetuate negative operations in schools (Mupfumira & Nyaruwata, 2021). The TTD subject is not adequately budgeted for, leading to lack of resources and equipment to operate like industry (Terry, 2020). According to Kehoe (2017), the vision for the subject operation has declined due to inadequate funding. Parents have to incur extra costs to buy materials for practical subjects for practice before examinations. This has led students to be trained for examination purposes only and not for lifelong skills (Sithole, 2018). Poor staffing, inadequate teaching and learning materials, obsolete equipment, and negative attitude towards the subject by head teachers are results of the inadequate funding from both head teachers and government (Kaala, 2022).

2.6.3 Working Environment

The TTD syllabus specifies the requirements for the learning area which include the classroom, library and a purpose designed workshop. (Ministry of Primary and Secondary Education, 2015-2022). A good learning area will help in quality improvement in the TTD learning area (Sukwadi, 2021). As the education system reforms policies regarding TTD subject operations, the environment where the curriculum is executed should be adequate as it will determine the exit profile of the learners. Facilitators

should manage the learning area layout, construction process, supervision, quality control, equipment usage, safety supervision, material control and engineering activities for best results. The operation environment can trap the learner's interest and quality of work done (Hashan, 2017). Laboratories should be easily made available for the teaching and learning of Home Economics by the school administration (Ogbonnaya, Chukwuone, & Ezeaku, 2022)

Workshop layout is part of the working environment, it is the systematic and efficient functional arrangement of various machines, equipment, tools, furniture in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of handling in processing the product from the receipt of raw material to the final product (Gasnesan, 2019). The layout design is a strategic issue and has a significant impact on the efficiency of operations; poor layout can subsequently lead to poor results (Islam, 2022). The layout in the TTD department differs from school to school, location to location and influenced by materials, machinery and the learners. A good workshop layout for TTD in schools may also be directly associated with good work flow, right from fabric receiving till the finished tasks. According to Akomaning (2020), efficiency is affected by poor workplace organization characterized by narrow space, improper placement of equipment and materials. Moreover, sewing industries may gain higher productivity and profitability by proper line balancing and systematic layout the workshop. Most schools in Zimbabwe teach with inadequate workshop facilities, laboratories are grossly inadequate and obsolete (Chuma, 2022).

The TTD operations in the learning environment should be organised like the industrial manufacturing sequences. All stages of production should be done such as laying, marking, cutting, stitching, checking, finishing, pressing and packaging (Textile School, 2019). According to Islam (2021), work-time study can be applied to the layout to find alternative solutions to increase the efficiency of the sewing line. Islam (2021), in a case study on an optimal layout design in an apparel industry by appropriate line balancing concluded that a good layout can be designed and productivity can be increased by appropriate assembly line balancing.

2.6.4 Equipment and resources in the TTD

Learning must take place in an environment where all the necessary tools, machines, equipment and facilities are in place and resemble the place for real work environment. Equipment, machinery, human expertise and sustainable resource management are integral to the TTD subject operation, ensuring enough resources and equipment will improve operations in the subject.

Chirapa and Mberengwa (2021), in their study on A' level TTD curriculum compatibility with industry requirements have revealed that some schools do not have basic tools and equipment that are needed for the TTD learning area as stipulated by the curriculum for proper operations. Another study by Mufumira (2021) on challenges in teaching and learning TTD in Masvingo District in Zimbabwe came to the conclusion that the poor work organization, unsatisfactory supervision, and working environment in the schools was the result of poor resources and lack of equipment in schools. Schools lack facilities for effective teaching and learning of Textiles; they lack personnel, requisite infrastructure, equipment and consumables. Onyeche and Angelina, (2022), in their study on managing TTD subjects in Yobe State for international development, concluded that there is need for regular maintenance services of the equipment and tools to enhance maximum utilization. A well balanced combination of resources, efficient equipment and technological tools contributes significantly to operational efficiency.

2.7 Theories and Methods of Operations Improvement

This section examines different theoretical frameworks and approaches that are used in industry to improve operations. The Lean, six sigmas theory of constraints and work study methods used to improve manufacturing system performance are examined in this section. The theory of constraints was chosen as a guide for the work study method to form a framework that can be followed to help study the TTD subject so as to improve operations.

2.7.1 Lean manufacturing system.

Lean manufacturing was tested as a method of improving operations and it witnessed production performance better than competitors in terms of quality and cost (Hardcopf, Liu, & Shah, 2021). Lean manufacturing method needs adequate resources, tools and techniques. Applying lean tools in the manufacturing industry will reduce overproduction, re-work, excess movement, transportation, excess inventory, waiting time and defects (Gallo, Cagnetti, Silvestri, & Ruggieri, 2021). Applying lean manufacturing and the teaching and learning of TTD subject could be challenging as lean is about speed and obtaining it right the first time which does not happen in a learning situation. Learners try and improve as they repeat the process at the next level until perfection is achieved in the final project which

is summative evaluation (Pakdil, 2023). The emphasis of standardization and waste reduction might inadvertently stifle creativity by imposing rigid structures (Majo, 2022).

2.7.2 Six Sigma Method

Six Sigma's principal idea is that if the imperfections can be measured, the solution can be planned to eliminate them. Six sigma brings structure to the improvement process by providing users with a more detailed outline-plan-do-check-act cycle by guiding initiatives through a five stage termed define-measure-analyses-improvement-control (DMAIC) cycle (Alcantara & Garcia-Vigonte, 2022). Training of key staff is critical to following the DMAIC cycle effectively and achieving significant results, such as support from senior management if the initiative takes root. Management must play an active role in project selection for the newly trained six sigma team's focus and ensure that all necessary resources are available (Ali, Younus, Khan, & Pervez, 2020).

Despite the merits of using the Six Sigma method, the researcher did not use it to improve TTD subject operations because it focuses on quality only and this leads to an increase in operation costs and chances of increasing the time taken to complete projects (Rodriguz, 2022). Rodriguz argues that six sigma needs the best and latest technology to reduce defects and highly skilled personnel which does not work in secondary schools. Most of the school products are never used again therefore there is a need to minimise cost and time taken so that students grasp all intended concepts. The learning experience of the TTD subject will need a more holistic approach that will integrate technical skills needed in the curriculum (Mäkelä, 2021)

2.7.3 Goldratt's (1984) theory of constraints (TOC)

The research follows theory of constraints (TOC). The theory of constraints is a management concept which helps organisations identify operations which disturb its growth and improvement. The theory suggests that in the global performance of a system is obtained by focusing on issues that leverage the goals. The core concept of the TOC is that every process and system has a constraint and because of that, the goal can only be improved when the constraint is improved. A constraint is anything that prevents the system from achieving its goal. TOC seeks to provide focus on improving the constraint until it no longer limits throughput, at which point the focus moves to the next constraint. TOC focuses on removing the constraint in order to achieve more of that goal. TOC is a methodology for identifying the most important limiting factor or the constraint that stands in the way of achieving a goal (Goldratt, 1998). It also involves systematically improving that constraint until it is no longer a limiting factor. It hypothesises that every system consists of linked operations, some of which act as a constraint upon the entire system. TOC has two major components; first, a philosophy which underpins the working principle of TOC

(Chaudhari, Dohale, Khanzode, & Iqbal, 2023). The second component of TOC is a generic approach for investigating, analysing, and solving complex problems called the thinking process (TP). In addition, TOC prescribes new performance measurements, which are quite different from the traditional system or methods. TOC describes a series of four steps to define the core conflict correctly: identify a list of undesirable operations, generate three conflict clouds from the list of unwanted operations, construct a generic conflict cloud from the three clouds, and build a current reality framework that shows both the core conflict and how it inevitably leads to the undesirable effects that are being experienced in the system (Gupta, Digalwar, Gupta, & Goyal, 2024). The application of TOC to this study is discussed below in combination with work study.

2.7.4 Work study Technique

Work study is the systematic examination of the methods of carrying out activities so as to improve the effective use of resources and to set-up standards of performance for the activities being carried out and serves as a tool that management can use to improve productivity (Castro, 2022). This method tracks constraints from both the learners and the teachers as implementers in making school operations mini industries in the TTD subject (Chisosa & Chipambwa, 2018). Work study is an investigation process, focusing on the means of a consistent system of the work done, in order to attain the best possible use of the people, machines and materials available in the schools (Ewnetu & Gzate, 2023). Work study aims at examining the method and work measurement currently used and then finding ways of simplifying or modifying the operation (Sigh.MP., 2016). Work study has been recommended by (Mauwa & Felisia, 2021) as a method of enhancing productivity in manufacturing companies as it will help in meeting lead times and reducing costs.

2.6.5 Theory of Constraints as Paramount to Work Study

While TOC significantly impacts organisational performance, the success of its implementation in the TTD subject in this study is combined with work study approach. The study will measure the scales of operations using the TOC production process. The following table summarises the link between work study and the theory of constraints. TOC emphasises on the amount of money one can make by optimizing production for customer demand while work study in the TTD learning area will optimise on the exit profile of the learner and their value in the world of work (Goldratt, 1998). TOC is a generic approach for investigating, analysing, and solving complex problems called the thinking process (Neisyfitri, Ongkunaruk, & Ongcunarak, 2023).

Table 3: Theory of constraints (TOT) and Work-study

	Theory of Constraints	Work study in TTD subject
Goal	Increase Profit by increasing Throughput	Improve operations and learners exit profile
Measures	• Throughput • Inventory • Operating Expense	• work measurement • Time study • Effectiveness
What to Change?	Constraints: eliminates the "weakest links" in the system	Eliminate Waste of time and ineffective methods
How to Implement the Change:	Five-Step, Continuous Process emphasizing <i>acting</i> locally	Continuous Improvement Process emphasizing thinking globally
Time	Both can achieve immediate results, but require a long term effort to sustain the results	

Work study technique helps reduce the time and has also proved useful in numerous other departments in industry such as inventory control, operations, quality, labour, and at various machines in a machine shop to develop process variation (Ewnetu & Gzate, 2023). Work study methods have proved to be the most effective solution after researching various methods and novelty theories used in improving operations. In the TTD subject, the goal is the exit profile of the learner. Firstly, there is a need to examine the current operations in line with the objectives of the revised curriculum of 2015. Identifying the challenges faced in the TTD subject operations is necessary for analysing and resolving the challenges and coming up with a method of measuring performance and guiding decisions in operations. The TTD revised curriculum needs a systematic study and improvement on the operations by considering all factors that affect the working efficiency and conditions to reduce the work content in the subject. Work study was used as the best method to improve TTD subject operations. Sigh (2016) explains the two major methods of work study as method study and work measurement. Method study and work measurement are two principal activities of work study which originated in the work of F. W. Taylor's scientific management imperatives. This was followed to investigate the operations, challenges and how the operations can be improved:

2.7.6 Method Study for TTD subject

Method study reveals operations and challenges of a system and aims to eliminate the unnecessary operations and to achieve the best method of performing the operation (Chisosa & Chipabwa., 2018).

Method study is also called methods engineering or work design as it is used to describe a collection of analysis techniques which focus on improving the effectiveness of men and machines (Moktadir, Ahmed, Zohra, & Sultana, 2017). Method study can be used for analysing methods used in the TTD operations for the continuity of the subject so that it is competitive in the world of improving technology (Sookdeo, 2021).

According to the International Standards Committee (ISC 9001:2000), method study is the systematic recording and critical examination of existing and proposed ways of doing work as a means of developing and applying easier and more effective methods and reducing cost. Fundamentally method study involves the breakdown of an operation or procedure into its component elements and their systematic analysis. In this study, the TTD subjects were divided into the expected clothing industry operations which act as the proposed operations for the learning area.

Method study helped to identify unnecessary operations that could be avoided or changed in the TTD subject. Improvement in efficiency through, improved layout and design of workplace, improved and efficient work procedures, effective utilisation of machines and materials and improved design (Islam, 2022). Furthermore, method study was used to present and analyse true facts concerning the operation, examine those facts critically to develop the best answer possible under existing circumstances based on critical examination of facts. The basic approach to method study in the TTD subject started with investigating the operations and identifying the gap between the curriculum objective of industrial training and current operations thus placing emphasis on data gathering and rational analysis. The researcher then selected the work to be studied and defined its boundaries (skirt). The next step was to gather relevant information and examine the facts by direct observation as learners make their garments in schools. Then, identify the most practical intervention strategy and effective method which will give a new improved method. The efficiency of the selected new method should be compared with the existing method. Finally, the new method will be presented to the concerned curriculum development unit. If the new methods are applied, there is a need to prevent drifting back by continuous operations improvement through work study. The steps for analysing method study are: selecting the work to be studied, recording all relevant information, examining the recorded information, developing an improved way of doing things, installing the new method as standard practice, and maintaining the new standard (Amal, 2022).

Work measurement is the standard time for an activity that is the time specific for completing an operation by using the predicted method (Islam, 2021). Standard time can be defined as the time utilized by an average learner to complete an operation with provisions for delays beyond the learner's control (Rao, 2021). Moreover, work has to be measured to identify and eliminate missing or ineffective time in the

TTD subject, to install standard times for performance and quality measurement, to measure performance rate against original expectations of the curriculum and to set operating objectives. The main objective for work measurement in the TTD subject is to find alternative methods, set completion date for tasks, focusing in schools, identifying substandard operations, training teachers and finding better, cost effective operations (Islam, 2021). The table below shows the different techniques that are used for work measurement according to Shahriar, (2019), who summarised the work measurement techniques and their applications in the apparel industry.

Table 4: Work measurement techniques and their application

Techniques	Applications	Unit of measurement
1. Time study	Short cycle repetitive jobs. Widely used for direct work.	Cent minute (0.01 min)
2. Synthetic Data	Short cycle repetitive jobs.	Cent minutes
3. Working sampling	Long cycle jobs/heterogeneous operations.	Minutes
4. Methods-Time Measurement (MTM)	Manual operations confined to one work centre.	TMU (1 TMU = 0.006 min)
5. Analytical estimation	Short cycle non-repetitive job.	Minutes

2.7.7 Time Study

Time study is work measurement which technique consisting of careful time measurement of the task with a time measuring instrument (Shahniriar, 2019). Work measurement can be done using the time study technique to establish time for a learner to carry out specific tasks under specified conditions and at a defined level of performance (Nabi, Mahmud, & Islam, 2015). Time study reveals efficiency of a system and can be used to evaluate the TTD subject operations and its efficiency (Christiansen., 2023.). Time study is a work measurement technique consisting of careful time measurement of the task with a time measuring instrument, adjusted for any observed variance from normal effort or pace and to allow adequate time for such items as foreign elements, unavoidable or machine delays, rest to overcome fatigue, and personal needs (Mbawankar, 2023). The objectives of time study in the TTD learning area are to standardise the efficient method of performance and conditions for operations improvement in the TTD subject.

2.7.8 Standard time for TTD subject

Standard time is the average time of completing a task. An observer uses a stopwatch and records the time taken to execute each operation. Time study will help to establish the gap of operations between

TTD subject and industry and higher learning institution expectation from the TTD learners (Rao, 2021). The calculation of the standard time is given by Konnully (2015) in two illustrations which give the standard time and the efficacy of the operator. The first illustration is assuming that the total observed time for an operation of assembling an electric switch is 1.00 min. If the rating is 120%, find normal time. If an allowance of 10% is allowed for the operation, determine the standard time. The solution is *observed time (or) selected time = 1.00 min, Rating = 120%, Allowance = 10%, normal time = Observed time $\times$ Rating % $\div$ 100 = $1.00 \times 120 \div 10 = 1.20 \text{ min}$, Allowance @ 10% = $1.20 \times 10 \div 100 = 0.12 \text{ min}$, Standard time = Normal time + Allowances = $1.20 + 0.12 = 1.32 \text{ min}$.*

The second illustration is for an operator who manufactures 50 jobs in 6 hours and 30 minutes. If this time includes the time for setting up his machine, calculate the operator's efficiency. Standard time allowed for the job was: Setting time = 35 min Allowed time per piece = 8 min. The solution is: As Standard time = Set up time + Time per piece $\times$ No. of pieces produced Standard time for manufacturing 50 jobs = $35 + 8 \times 50 = 435 \text{ min} = 7 \text{ hours and } 15 \text{ min}$. Efficiency of operator = $\text{Standard time} \times 100 \div \text{Actual time} = 435 \times 100 \div 390 = 111.5\%$.

The table shows the steps involved in time study.

Table 5: Steps in time study (Masniar, et al, 2023).

Steps in Time Study		Time study in the TTD subject	Specification for TTD
Step 1	Obtain and record all the information available about the job, the operator and the surrounding conditions, which is likely to affect the carrying out of the work (working conditions).	Obtain information on the students and teacher profile, the subject specifications and operations, and the surrounding challenges, which is likely to affect the carrying out of the work (working conditions).	1.Demographic profile 2. Current operations 3. Methods used 4. Time taken in school 5.Challenges faced
Step 2	Record a complete description of the method, breakdown the operation into "elements"	Record the standard operations and methods used in schools.	Record
Step 3	Examine the detailed breakdown to ensure that the most effective method and motions are being used, and determine the sample size.	Determine the methodology sample size.	Methodology
Step 4	Measure with a timing device (usually a stopwatch) and recording the time taken by the operator to perform each "element" of	Measure the time taken for the learner to complete each operation using a stopwatch.	Time taken in school Tools

	the operation.		
Step 5	Assess the effective speed of working of the operator relative to the standard rating.	Compare learner performance with the standard assessment requirement for the A Level syllabus	Experiment on time taken in improved conditions
Step 6	Extend the observed times to “basic times”	Extend observed time to basic time	Calculate basic time
Step 7	Determine the allowances to be made over and above the basic time for the operation	Determine the allowance time	Allowance time
Step 8	Determine the “standard time” for the operation.	Determine the standard time using improved conditions for TTD subject.	Standard time

2.7.9. Opportunities for the TTD subject operations

Several scholars have discussed work study in relation to industry. There are few studies that explore TTD subject operations as the base of industry and work study. The current research seeks to establish the use of work study approach for the TTD subject operations improvement for secondary schools in Zimbabwe. A single process operations improvement framework could assist educationists to continuously improve the TTD subject operations (Masniar., et al., 2023). When the system has a stipulated operational framework in place, it lightens the duty of supervision and teacher confidence could be increased as there is a yardstick to measure performance in the TTD subject. Learner interest and attitudes could be positive if there is continuous improvement through work study. When a work-study is properly done, it saves time and money and ensures that intended standards are maintained. The use of work study in the TTD subject, reveals weaknesses overlooked day to day, materials and equipment used in the teaching and learning of TTD. (Moktadir, Ahmed, Zohra, & Sultana, 2017), stated that operations improvement is an important issue in industry and production depends on productivity improvement. Work Study will help operations in the TTD subject to run smoothly as it will reveal the weaknesses and challenges in the learning area. (Muhammad, et al., 2022) elaborates that with the use of work study challenges can be identified and the subject will flow with minimum interruptions. Work study impacts in a productive manner on operations improvements.

2.8 Conceptual framework

The work study conceptual framework below was constructed to guide the study on the analysis of Textile Technology and Design (TTD) subject operations for secondary schools in Zimbabwe. After careful review of empirical studies and the theoretical framework, the constructs in the framework were found very relevant to guide the study to construct research instruments, and in data analysis.

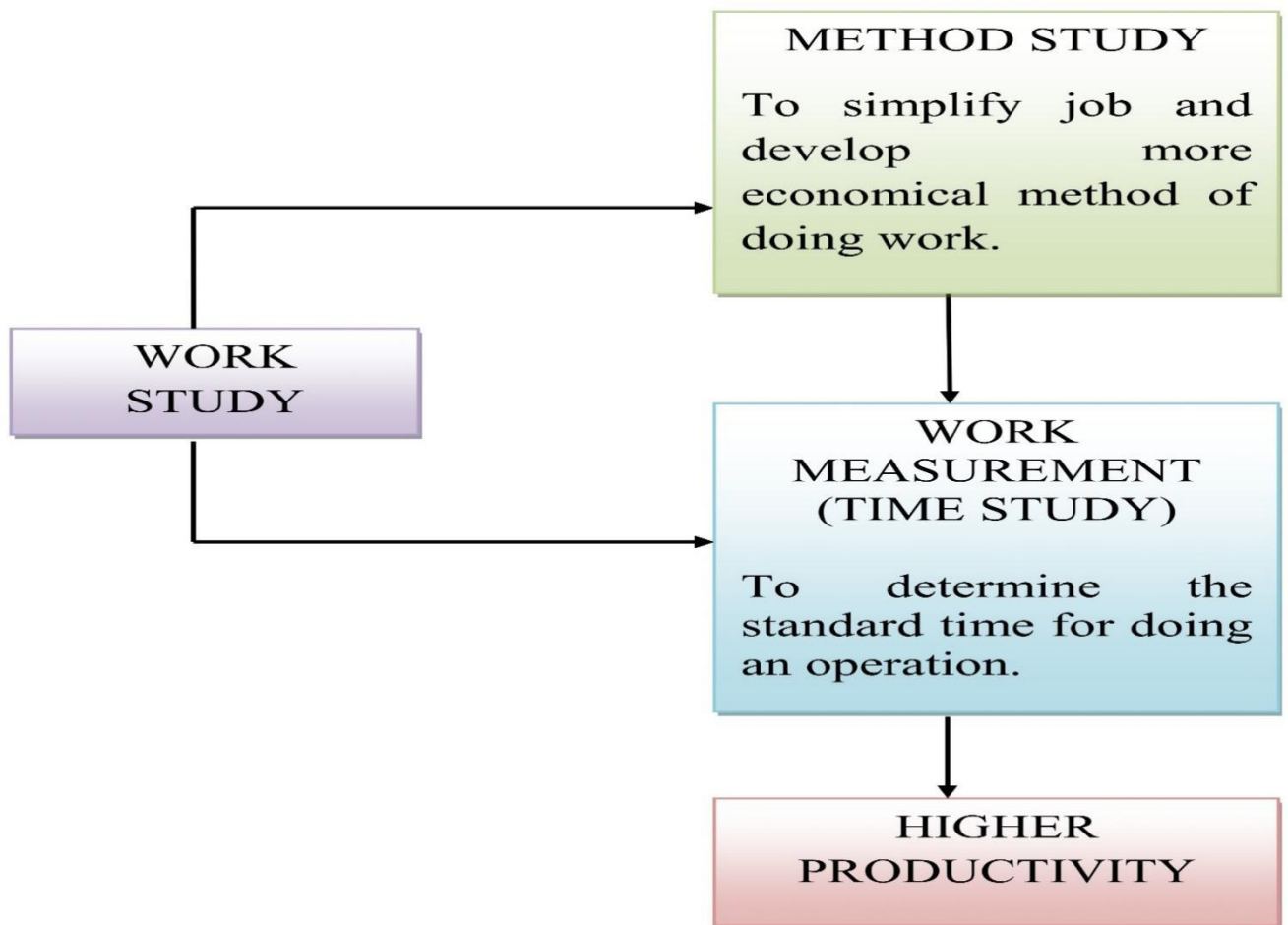


Figure 2: Conceptual framework that guided the study on Improving TTD Subject Operations in Secondary Schools in Zimbabwe (Castro, 2024).

The conceptual framework involves the following:

Work Study

The current TTD operations were examined in this study using work study method. The intention was to conduct a continuous comprehensive analysis of the existing TTD subject operations in secondary schools. The intention was also to compare what has been stipulated in the syllabus and what is done in the clothing industrial set-up.

Work Measurement

In this study, work measurement was done to assess current operations. In this case, a continuous comprehensive analysis of the existing TTD subject operations in secondary schools was conducted to identify inefficiencies, bottlenecks /challenges and areas that need improvement, such as slow and clumsy movements, lack of interest, and inadequate operational performance. This was also done to identify key

operational indicators (OPIs), define measurable OPIs to evaluate the effectiveness and efficiency of TTD subject operations. These OPIs could include the time taken to complete specific tasks, the number of garments produced, and the quality of finished products.

Method Study / Operational Analysis

A study of the sequence of operations was done to compare with what is done in the clothing industrial set up. Based on the standard operational manual, the following sequence was explored: design development, pattern making, marker making, cutting, marking and notching, sewing, pressing, finishing, quality control, packaging.

Operations Improvement/higher productivity

It was noted from the review that there is need for thorough method study and work measurement in the TTD subject. Alternative methods should be found, completion dates for tasks must be set, focusing on schools, as well as identifying substandard operational time, training teachers and finding better, cost effective operations. These were examined in this study to better find ways of operations improvement in TTD subject.

2.9 Literature review summary and gap

The chapter has made reference to a number of studies on the analysis of the TTD subject operations in secondary schools in Zimbabwe. Existing literature has been presented which evaluates the subject's operations and challenges. There are few studies that analyse the time taken in executing operations in the TTD subject through work study. Theories used for operations improvement like the theory of constraints among others have been used to improve operations in the clothing industry but work study approach has not been used for operations analysis for secondary schools in Zimbabwe. Work study technique aims to analyse operations in TTD subject operations, reveal challenges, standardize methods and time used to complete tasks and bring proposed intervention strategies for TTD subject operations improvement. Very little literature is available on operations improvement through work study that focuses on the TTD subject in Zimbabwe. The implementers are not able to reap out the full benefits of the revised TTD curriculum due to lack of proper work study. The next chapter presents the methodology adopted for this study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction

This chapter gives a detailed description of how the research was conducted. The research methodology answers the question of how information on present operations, methods used, time taken to complete operation and challenges in the TTD subject in secondary schools in Zimbabwe was obtained. It presents the research paradigm, research approach, research design, population, sample and sampling techniques research instrumentation and data collection and analysis.

3.2 Research Paradigm

Research paradigm is a perspective about research held by a community of researchers. It is based on a set of shared assumptions, concepts, values and practices (Khatri, 2020). The research used a post-positivism approach which promotes the triangulation of qualitative and quantitative methods that explore the diversity of facts researched through various kinds of investigations but respecting and valuing all findings as the essential components for the development of knowledge (Clark, 1998 and Fischer, 1998). The Post-positivist paradigm supports multiplicity of research methods in social and educational research in a natural environment, it also allows the use of multiple-methodologies to achieve less biased and more objective results (Phillips and Burbules (2000). Post –positivist paradigm indicates that there is no perfect method which will bring 100% accurate findings, all methods have their limitations (Panhwar, Ansari, & Shah, 2017). Therefore, post-positivism puts emphasis on using the hybrid design, a combination of both quantitative and qualitative approaches to avoid standardized methods that might give uncertainty to the results, it ensures that the subject is analysed from more than one angle (Cooper, 1997). Post-positivist paradigm gives an option of an open investigation of the research questions, data analysis and justifiable interpretation from different sources (Pease, 2020). The subjects are investigated contextually and many people's views and personal experiences are appreciated and contribute to the phenomena. Post positivist approach allows for re-study of the phenomena and keeps the findings open to be criticised, challenged, and evaluated for further refinement by other researchers which make it suitable for TTD subject continuous operations improvement. The post-positivism approach prioritizes quantitative data and emphasizes strengthening the findings with the help of qualitative data through the process of triangulation. This is the best approach for studying operations

in TTD subjects in secondary schools. Post-positivist paradigm and mixed methods research in post – positivistic framework is likely to be more effective as it encourages and promotes investigation and reinvestigation of the operations in TTD subjects from different perspectives with various tools and methods in different contexts.

3.3 Research Approach

The study adopted a mixed method approach which enabled the researcher to effectively synthesize ideas from respondents on the current operations, challenges and the work study methods that can be used to improve TTD learning area in secondary schools in Zimbabwe (Alase, 2017). (Dawadi, Shrestha, & Giri, 2021). Mixed research method relates to the analysis of both quantitative and qualitative data in a single study in which the data was collected sequentially. The sequential mixed method research approach was considered as the appropriate approach for this study as the operations and the challenges were sought from learners and teachers and the data was used to determine the appropriate work study method that can be used in TTD subject operations. According to sequential mixed method research, qualitative and quantitative approaches are used at different times. research methods. The use of quantitative data in this research enabled the researcher to get reliable data that could be generalised to the entire population from which the sample was derived. The use of quantitative research methods enabled the researcher to be precise in the description of the parameters and coefficients in the data that were gathered, analysed and interpreted, so as to understand the operations in the TTD subject. Therefore, a questionnaire was used for quantitative data which allowed the researcher to obtain information pertaining operations (research question 1), methods used to execute operations (research question 2), time taken to execute operations (research question 3) and what challenges are faced by TTD subject operations in Zimbabwe’s secondary schools (research question 4). In this study, questionnaires were administered to learners, and teachers.

Furthermore, qualitative methods of data collection, interviews, and observation were also used to examine the operations (research question 1), methods used, Time taken to execute each operation (research question 3), challenges faced by TTD subject operation (research question 4) and to obtain how operations could be improved (research question 5) for operations improvement in Zimbabwe’s secondary schools. Both quantitative data and qualitative data was used to design a conceptual framework that may be used by TTD teachers to improve operations in the subject area.

The quantitative methods helped in the manipulation of learners to determine whether changes in methods of operating, methods used, resources and equipment, teacher competence, funding and working environment can cause improvement in learner’s performance. An experimental observation was done to

control what happens in the learning situation for TTD subject using the improved set up and syllabus recommendations. Using both qualitative and quantitative methods needed sufficient skills and resources to collect and analyse both quantitative and qualitative data, which was time-consuming and costly. There were many contradictions and potential conflicts because of using different paradigms, assumptions, and methods, and how to resolve them. The data were compiled over a period of two terms to spread resources and costs over a long period of time.

3.4 Research Design

The mixed method approach was used to get the qualitative and quantitative data on operations in the TTD subject (question 1), methods (question 2), time taken to execute operations (question 3), challenges faced (question 4) and TTD operations improvement (question 5) by using sequential triangulation. In the sequential design data were collected over the period of time in two consecutive phases. Thus, a researcher first collects and analyses the quantitative data from the questionnaires and interviews. Qualitative data was then collected in the second phase of the study from observational experiment and then related to the outcomes from the first quantitative phase. The collected qualitative data complemented and clarified the quantitative findings by helping the researcher to identify common themes (Pease, 2020). Qualitative data helped in understanding operations in the TTD subject and the challenges. When you use methodological triangulation, you use different methods to approach the same research question. Sequential procedures involve collecting both quantitative and qualitative data at the same time during the study (Mitchella, McMillanb, Lobchukb, & Nickelb, 2021).

Data were collected using qualitative and quantitative methods. The qualitative and quantitative methods were used to find out the present operations, methods used, time taken to execute operations and operations improvement in TTD subjects. Quantitative data were obtained on operations and challenges through the use of questionnaires. Questionnaires were administered to the selected participants; interviews were done through face to face and online interviews using a WhatsApp platform to triangulate the information obtained from the questionnaire. Observations were done and videos were recorded as students continued with their daily activities to get the observed time under natural school settings with the help of teachers and compiled by the researcher through WhatsApp. Two observational time study experiments were done to get the time taken to execute operations in an improved environment for the whole garment and sectionalisation method. The researcher integrated the information in the interpretation of the overall results. This enhanced the researcher's understanding of the phenomena from various angles. This design uses quantitative and qualitative methods as means to offset the weaknesses inherent within one method with the strength of the other method.

3.5 Selection of participants

3.5.1 Population of the study

Population refers to the complete set of individuals (subjects or events) having common characteristics in which the researcher is interested (Stratton, 2021). The population for the study were A' Level TTD secondary school teachers and learners in Zimbabwe. A target population of 121 A' Level secondary schools that offer the TTD subject and 476 learners was used for the study (Zimsec Textile Technology and Design Database).

3.5.2 Sample and Sampling Techniques

Non- probability and probability sampling methods were integrated. Quantitative and qualitative sampling was done sequentially and dependently, allowing for exploration and explanation of the findings (Charles & Fen, 2012). Snowballing was used for sampling since none of the literature had significant information about the number of schools offering the TTD subject in Zimbabwe and it was difficult to recruit the subject manager as a participant (Gill, 2020). The researcher linked to the subject manager for TTD subject and the representatives of the subject in the curriculum development unit to get a direct link to the information about the number of schools offering TTD subject. The database was shared with researchers and a list of schools and the students registered for the year 2020 and 2021 in the TTD subject in Zimbabwe. It was not possible to carry out the study in all the schools and a sample was selected for the study. Non-probability sampling was used to deliberately avoid using all the schools in Zimbabwe and few schools represented the country (Nikolopoulou, 2022). Purposive -Judgmental sampling was used by the researcher intentionally to select schools with high registration, median range and low numbers at Advanced Level for the year 2018 and 2019.

Sample size for schools.

To determine the sample size for schools a sample calculation formula known as Andrew Fisher's formula was used (Franklin, 2021). The population size for schools offering 'A' level textile technology was 121 and a confidence interval of 5% at a confidence level of 95% was used. The confidence level was then converted to a Z-Score of 1.96.

Table 6: z-scores for the most common confidence levels.

Confidence level	z-score
80%	1.28
85%	1.44
90%	1.65
95%	1.96
99%	2.58

Franklin (2021), avails an online sample calculator from easy calculations which is used to calculate the sample size.

Table 7: Sample size for schools

Measurements	Calculation
Confidence Level	70%
Margin of error	5%
Population proportion	92%
Population Size	121
Sample size	26

This means 26 or more schools are needed to have a confidence level of 70% that the real value is within $\pm 5\%$ of the 26 schools.

The confidence level, population size, the confidence interval and the sample size of 25.9 was calculated. The sample size for schools was calculated to be 26 for the schools. In each province 3 schools were selected using the least, median and most number of garments for the year 2018 submissions. Purposive-random sampling was used to select 26 schools from the 30 schools to be used in the study.

Sample for teachers and learners

Authoritative sampling is a non-probability sampling technique where the researcher selects units to be sampled based on professional judgment (Franklin, 2021). This sampling technique was used to select 26 teachers using availability sampling, each school had one teacher for A' Level TTD subject. The teachers for the TTD subject in the selected schools were selected for the research. The researcher used simple random sampling to select learners for the study. The researcher generated numbers 1-5 to select 2 learners doing 'A' level TTD at each school. The students who picked numbers 1 and 2 were selected as respondents. As a result, a total of 52 learners were used for the study to represent the population of 476 Advanced Level (A' Level) learners. 52 learners were used for the observational experiment group for the whole garment method and sectionalisation method in an improved set-up for TTD learning

according to the syllabus requirement.

Table 8: Sample size for learners

Measurements	Calculation
Confidence Level	90%
Margin of error	10%
Population proportion	30%
Population Size	476
Sample size for learners	52

Table 9: Table for sample size for teachers, schools and learners

Sample	Size
A Level Schools	26
Teachers	26
Learners	52

3.6 Methods and procedure used for Data Collection

This study used a mixed methods approach to collect both qualitative and quantitative data. Data collection methods were manual questionnaires, online questionnaires (quantitative), online interviews and observations (which were qualitative augmented by qualitative records). TTD subject teachers from all provinces helped in coordinating data collection for the researcher, all the videos and questionnaires were coordinated and sent to the researcher. Interviews were done by the researcher using WhatsApp and face to face interviews. These methods were employed to determine the present operations and methods used as well as time taken and challenges related to TTD subjects in secondary schools. Qualitative research helped in finding the operations and challenges through observation (Busetto, Wick, & Gumbinger, 2020). Experimental observations were done in an improved set up in schools set up to get the time taken by learners to execute operations when recommended methods and tools are available using the whole garment method and the sectionalisation method. The findings were integrated to find how TTD subject operations can be improved and also to come up with an operational framework that could be used for the TTD subject operations.

3.6.1 Interview

According to Jain, (2021), an interview is a discussion between two or more people that is introduced by the interviewer for the purpose of obtaining relevant information. Semi-structured interview questions were conducted with teachers and learners to get information about operations and challenges. Questions were also asked to get verbal understanding of work measurement (time taken to complete operations) as a basis for experimental assessment for the time taken. The researcher used an interview schedule guide to keep the participants focused on the questions. Audio responses were summarised and message

responses were also noted for later reference. Online interviews were used and were cost effective. They could not be used in some remote schools and therefore face-to-face (in-person) interviewing on mobile devices and paper surveys were also used for data collection. The individual being interviewed is unable to provide false information during screening questions such as gender and age, or race. Verbal cues, emotions and behaviours can be seen and even the body language which cannot be done online and surveys. Face-to-face interviews would cost a lot of travelling and data for the conversations to be completed because the population sample was wide apart. Transferring data from paper is taxing and delays analysis while mobile data information is easy to transfer and is ready for analysis.

3.6.2 Questionnaire

A questionnaire is a primary research tool for researchers to gather data from a target audience (Taherdoost, 2022). Online questionnaires were used together with manual questionnaires with open ended and closed ended questions to allow the researcher to collect qualitative and quantitative data. According to Phillip, online questionnaires have the ability to provide anonymity, this immediately puts respondents at ease and encourages a true, honest and accurate picture of the operations and challenges in the TTD subject. The questionnaire helped to bring greater structure to the research. The questionnaire was used to get information from teachers and learners on the operations and challenges and to get information on how to improve operations through work measurement using the time study guided questionnaire. The researcher distributed manual and online questionnaires to the selected respondents through email. A QR code was created for downloading the online questionnaire. The respondents were able to choose when and where they completed the questionnaire. They were flexible to start it and finish it off later and this boosted the overall response rates. Questionnaires designed online are cost effective and also helped in creating a professional-looking questionnaire using ready-made templates and questions, reducing the expenses incurred on research and human resources. Questionnaires are the simplest and fastest means of collecting data as they reach the audience instantly. The online questionnaire made it easier to get back to respondents for queries. Respondents choose their convenient time to give answers. The online questionnaire creator ensured the anonymity of the respondents, keeping respondents' identities private. Respecting privacy provides better data as respondents feel free and comfortable to share their thoughts. The data was neatly laid out, ready for analysis at the click of a button, allowing the researcher to crunch the numbers, spot patterns, and draw conclusions much faster, thereby saving precious time and effort. The challenge faced was lack of motivation from teachers who were too busy with other teaching responsibilities affected the response time. Paper questionnaires were administered and mailed to the researcher while others were sent as an email attachment, speed was a factor. Other questionnaires took a long time to reach the researcher. The paper surveys required some scanning to collect and organise the data.

3.6.3 Observation

The researcher used the structured research method where an observation checklist was used to guide what to record. Participant observations were used where both observer and participant were part of the study. The teachers assisted as observers while learners were fully aware of the study and its purposes. The disadvantage of this stance is that teachers as part of the observed group were less likely to divulge personal details. Hence, there is a trade-off between the depth of data the researcher was able to collect and the level of confidentiality available to group members (Marshall, Zelinsky, & Bryan, 2023). The TTD operations in schools, methods used, challenges, time taken were observed and recorded for further analysis. The teachers in the schools assisted in the collection of data by taking videos and recording time taken. The actions and observations were coded by the researcher to get the operations, methods used and the time taken. Most videos were bits and pieces (uncompleted) which made it difficult to deduce the time taken. The researcher could not get the time taken to complete the skirt in the schools. By combining multiple observers, researchers can hope to overcome the weakness or intrinsic biases and the problems that come from a single method and single observer.

3.6.4 Experimental Time Study Observation

Two experimental surveys were done for time study observation and were also used to give secondary information about time taken to execute TTD subject operations. The time study experiment plays a supportive role and facilitates the understanding of standard time in the TTD subject (Maciejewski, 2020). The 52 students from the 26 schools case study were chosen because it allowed for an in-depth examination of standard time for the TTD subject. It provided a rich and detailed understanding of the context, processes, and dynamics surrounding standard time for the TTD subject operation. The researcher could gather comprehensive and nuanced data, to explore the time taken (ur Rehman, et al., 2019). It also helped to facilitate the exploration of standard time for the TTD subject operation in a real-life situation. By focusing on the actual case or example, the researcher could investigate the TTD subject operation as it naturally occurs in its authentic settings (Maciejewski, 2020). This enhanced the external validity of the findings and increased the relevance and applicability of the research outcomes about the use of line production methods. Furthermore, the case study allowed for the integration of multiple sources of evidence. The researcher could combine various data collection techniques, such as interviews, focus group and observations, to triangulate and validate the findings (Dawadi, Shrestha, & Giri, 2021). This multi-method approach strengthens the credibility and reliability of the research outcomes. The case study also promotes practical applications and informs decision-making. The insights gained from the case studies can be directly applicable to real-world settings, allowing

practitioners and policymakers to make informed decisions and develop effective strategies (Dawadi, Shrestha, & Giri, 2021). The detailed analysis and understanding of specific cases can guide the development and implementation of interventions, policies, or practices that address practical challenges or issues. The laboratory that was used was inspected to ensure that it resembles an average industry for line production, equipment and working environment. All the particular operations were observed with the help of a stopwatch. The time taken to complete operations in the TTD subject was compared with the time taken in an improved environment for garment construction. After observing all the operations, the results were compared with the existing operations from their schools. A work study analysis method was used for the calculation.

3.7. Reliability, Validation and trustworthiness of research instruments

Validity in this research is concerned with an evaluative closure about the TTD curriculum assessment (Kember & Leung, 2008). Two types of validity were considered, these are face and content validity. The relevant evidence includes the measure's reliability, whether it is correlated with other variables or expected to be correlated. The reliability and validity of a measure is established by the pattern of results across multiple studies. Content validity is assessed by checking the measurement method against the conceptual definition of the construct. In this study, the questionnaire content was reviewed and validated by the supervisors. The questionnaire was subjected to a pilot study to test reliability of the instrument. The online questionnaire answers were automatically inserted into spreadsheets reducing the risk of human error and enabling automatic validation of the data. The usability and effectiveness of the interview guide instrument was also tested. The pilot study was conducted at one secondary school which was not part of the study. After pilot testing the instruments, necessary changes were done and effected on the final research instruments. The question on classroom tools was irrelevant to the TD subject operations therefore was removed which also helped in reducing the length of the questionnaire.

Table 10: The Internal Reliability of Instrument

Questions 1 and 2: Current Operations and methods used in TTD	Cronbach's Alpha	Number of responses
Domain average	0.767	31
Question 4: Challenges in TTD	Cronbach's Alpha	Number of Items
Domain Average	0.975	20
Overall Cronbach's Alpha	0.871	

The results of measurement analysis in the Cronbach Alpha analysis shown in the Table above prove that

all scales have satisfactory validity. The factor loadings of question items are more than 0.7, mostly ranging between 0.767 and 0.975 (Chan & Idris, 2017). Coefficient of Alpha Cronbach reliability of 0.871 was obtained and deemed the questionnaire reliable.

3.8 Procedures for Data Analysis

The qualitative data were captured into the computer in stages and tabulated. Descriptive statistics of mean and standard deviation were used to summarise the findings on the demographic characteristics of the respondents, operations, methods used and challenges in the TTD subject operations. The responses from questionnaires were coded, edited and analysed separately according to themes such as methods used, time taken, resources and equipment, teacher competency, funding, working environment. These descriptive codes were used to code provinces, schools and learners, PV 1 to PV 10 for provinces, P1 to P26 for schools and p1 to p52 for the learners. The results from the Likert scale in the questionnaire were also coded and subjected to SPSS version 23 analysis to give the mean agreements of the respondents.

The researcher had to go through the scripts several times to find a point of saturation before proceeding to the next stage to ensure that the possible themes had been established. A deductive approach was used where the researcher had preconceived themes that were expected to reflect based on present operations in the TTD subject. All the similar codes were then consolidated into methods used, challenges and time taken which were further grouped together according to their similarities in tables. The themes were used to interpret the data by explaining the meaning in terms of the relationships in the data with the help of the participants' responses. Narrative analysis helps understand the underlying events and their effect on the overall outcome. Work measurement was done through a time study analysis method. Content analysis was used for the analysis of qualitative data. The experiment results were computed using a Welch t-test online calculator to compare the mean time taken between the existing operations in schools and operational performance in an improved environment to get the percentage of operations.

3.9 Ethical Considerations

An introduction letter and research ethics letter was obtained from Chinhoyi University of Technology. Permission was sought from the Ministry of Primary and Secondary Education and provinces to carry out the research in the schools. After permission was granted, appointments were done with the participants through the provincial TTD inspectors.

Participants and institutions were assured of the confidentiality of the information provided. Sensitivity of participants was observed, names of schools and persons were coded. Participants were pre-educated on the purpose and scope of the study. The researcher ensured that the respondents were informed about

what participation entailed and re-assured them that participation and decline would not affect any service they received. The participants were assured that the recorded information was not going to be public consumption but would be used only for analysis of operations in the TTD subject. The following ethical considerations were observed:

- Right to privacy and participation by asking for permission to use a voice recorder during the interviews and videos, the participants were assured that the information will be used for the purposed of research and not for any public consumption.
- The researcher applied for permission to carry out the research from the ministry of primary and secondary education and a permission was granted. The permission letter was sent to provinces who also granted the permission and the school concerned were made aware of the ongoing research.
- Teachers and learners were consulted as individuals and they agreed to be part of the respondents for the study before sending questionnaires and carrying out observations in schools.
- A consent form was also given for parents to allow their children to be used for the research as this would involve some movement especially with the observation experiment and permission was also granted.
- For the right to confidentiality and anonymity schools under study were identified as school A-T respectively, PV 1 to PV 10 for provinces, P1 to P26 for teachers and p1 to p52 for the learners. The raw data from questionnaires was captured by the computer in stages for editing, coding, classification and tabulation.
- The participants' phone numbers were hidden to ensure everyone was protected. A broadcast list was created which only allowed the participants to see the administrator's number but no other participant's numbers. The research outcome was treated with vigilance to avoid harm or damage to any learner, teacher and the school.

3.10 Chapter summary

The researcher used a post-positivism approach where mixed methods were used. Quantitative and qualitative methods were used for the descriptive survey design. A convenient sample of 26 schools, 26 teachers and 52 learners represented the A Level schools that offered TTD. Questionnaires and interviews were done online, administered and coded into themes by the researcher, observations for a natural school outcome and for the experimental time study were captured with the help of teachers, supervisors and inspectors who had an opportunity to visit the schools on different occasions. The captured videos were observed and analysed into themes. Permission was sought from the Ministry of Primary and Secondary Education and provinces to carry out the research in the schools. After permission was granted appointments were done with the participants through the provincial TTD inspectors and procedures were done to seek their consent. The usability and effectiveness of the interview guide instrument was also tested through a pilot study.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter focuses on data presentation, analysis and discussion of operations improvement through work study. Collected data were presented and analysed in tables, graphs and charts supported by expects and observations. Below are the research questions that guided the study:

What are the current TTD subject operations for secondary schools in Zimbabwe?

What are the methods used to execute operations in TTD subject in secondary schools?

How much is the time taken to execute each operation in TTD subject?

Which challenges are faced in TTD subject operation in secondary schools?

How can operations in the TTD subject be improved through work study for secondary schools?

What conceptual model can be adopted by secondary schools to improve TTD subject operations.

4.1: What are the current TTD subject operations for secondary schools in Zimbabwe?

This research question sought to elicit the operations in the TTD subject. Data were collected using a questionnaire, interviews and observations. The focus of the revised Advanced Level TTD subject syllabus (2015-2022) emphasized empowering the learner to function in the prevailing economy which is production oriented to prepare them for the world of work. The researcher wanted to get a deeper understanding of the extent to which the operations breakdown during the design and construction development in the TTD subject reflected what is expected in the clothing and apparel industry standards operating procedures.

Table 11: Operation breakdown in the garment construction section in TTD subject in Zimbabwean schools.

Present operation	Teachers			Learners		
	Never	Sometimes	Always	Never	Sometimes	Always
Design Development	16.7%	66.7%	6.6%	16.7%	66.7%	6.6%
Pattern making	16.7%	66.7%	6.6%	16.7%	66.7%	6.6%
Marker making/ laying out	5%	6.3%	88.7%	5%	7%	88%
Cutting	0	0	100%	16.7%	66.7%	16.7%
Notching/ transferring markings	5.7%	5.5%	85%	5.7%	5.5%	85%
Fusing/Ironing	8.3%	16.7%	75%	8.3%	16.7%	75%
Sewing operation	0	0	100%	0	0	100%
Quality control	6.7%	8.3%	85%	0	0	100%
Finishing	75%	10.3%	14.7%	75%	10.3%	14.7%
Packaging	75%	10.3%	14.7%	79%	19.3%	1.7%

The data in the table above presents the findings on what is involved in the making of garments in the TTD subject in secondary schools. The data show that the design development and pattern making operations were never done by 16.7% of the respondents, 66.7% indicated that they did design development sometimes and 6.6% always do design development. Marker making/ laying out was always done by some learners as shown by a response of 88.7%, 6.3% of the learners and 7% of the teachers indicated that they sometimes did marker making /laying out and 5% indicated that they never did marker making/laying out. The data also shows that sewing and cutting operations recorded 100% on “Always”, showing that the processes were done by all the sampled schools. The data indicated that fusing /ironing was done by 75%, 16.7% respondents indicated that they sometimes do fusing/ironing and 8.3% indicated that they never did the fusing/ironing operation. Quality control recorded 85% of learners and 100% teachers who agreed that it mostly done in schools, against 6.7 % of learners who reported never doing quality control and 8.3% who did quality control sometimes. Packaging and finishing showed a response of 75% of the learners 79% of the teachers who agreed that the processes were not done. For notching and transferring, 5.7% of the respondents indicated that they have never done notching/transferring markings. 5.5% indicated that they sometimes did while 85% have always done notching/transferring markings. There was no significant difference between the responses from the teachers and the students on most processes. These results were confirmed by one of the teachers(P14) who was asked how operations are done in garment construction and she said:

Students do their own garments in the fastest way they can, those who can use commercial

patterns use them, those who can design do design but very few manage to complete all the garment construction processes during the time allocated for the TTD subject

It was also observed that learners were free to do patterns the way they want, the teacher seemed to have little input on order of operating. The data above shows that some processes were not always done in some schools such as design development, pattern making, marker making, finishing processes and packaging. This shows that the starting and the ending operations were not done in the TTD subject in secondary schools in Zimbabwe.

4.2 What are the methods used to execute operations in TTD subject in secondary schools?

This research question sought to examine the methods used to execute operations in the TTD subject. Data were collected using a questionnaire, interviews and observations. As the focus of the revised TTD subject syllabus for secondary schools is production oriented, the researcher wanted to compare the extent to which the methods used in each operation in garment construction in the TTD subject in the schools matches those methods needed in the clothing apparel and fashion industry. The findings are presented in the sections below. This operation starts with a design development which is a crucial phase in the making of apparel, which involves creating initial design concepts, and carefully choosing the fabrics

4.2.1 Design Development Methods

Table 12: Methods used in design development operation

Design Development operation	Learners			Teachers		
	Never	Sometimes	Always	Never	Sometimes	Always
Open access CAD software	100%	0	0	94%	6%	0
Original CAD software	75%	16.7	8.3%	70%	13.3%	0
manually sketching	6.6%	16,7%	66.7%	6.6%	16,7%	66.7%
Design illustration	3%	80.3%	16.7%	3%	80.3%	16.7%

4.2.2 Pattern making methods

Table 13:Methods used in pattern making and development.

Patternmaking operation	Learners			Teachers		
	Never	Sometimes	Always	Never	Sometimes	Always
Open access CAD software	100%	0	0	94%	6%	0
Original CAD software	75%	8.3%	16.7%	70%	13.3%	0
manually pattern making	0	16,7%	66.7%		16,7%	66.7%
Commercial patterns	0	83.3%	16.7%	3%	80.3%	16.7%
Flat method	50%	16.7%	25%	50%	16.7%	25%
Draping method	83.4%	8.3%	8.3%	73.4%	18.3%	8.3%

The results in the tables above show the different methods used in design development and pattern making operations in the TTD subject. It came out that open access software, and original CAD software were rarely used in the TTD subject shown by a percentage of 100% for learner, 94% for teacher respectively. When respondents were asked about the use of commercial patterns, they indicated that they sometimes used them as indicated by (83.3%) for learners and 80% for teachers. Flat pattern making was never used by 50% of the learners and 50% of the teachers. Draping method was never used by 83% of the learners and 73.4% of the teachers. When learners were interviewed they confirmed that the software was known theoretically and they have never been used in their daily operations as one learner (p17) said:

I have never seen or used the CAD software for designing but we have an idea of what CAD is.

When participants were asked to explain how they did their patterns, it was revealed that the domestic methods dominated the pattern marking operations as one of the learners(p23) said:

I prefer to use manual pattern drafting because that is what I have been taught from form 1

Another learner(p34) said:

The teacher makes patterns for us, sometimes we try to draft ours from the teacher's patterns and we use pins and khaki paper to transfer the marking and pattern making can take a month or more

Teachers also confirmed their lack of knowledge of the CAD software. They said they just teach theory and make use of YouTube videos to make learners understand the concept behind using the CAD software. One of the teachers (P23) said:

I use manual pattern making and show learners You tube videos so that they appreciate the new technologies as they will meet them in industries

It was observed that learners and teacher have access to the CAD software; they relied on phones for research and some schools had no dress forms to do other methods like draping. Therefore, the data above revealed that the manual drafting method dominated most of the schools.

4.2.3 Marker making Methods

Table 14: Methods used in the Marker making operation

Variable	Response %				Mean score	Standard deviation
	Never	Sometimes	Always	Total		
Manual marker making	8.3	24	67.7	100	2.92	.289
Computerized marker making	100	0	0	100	1.00	.000

The data provided about the frequency of usage of maker making methods is presented in a tabular form 67.7% answered that they never used manual marker making, 24% answered that they sometimes used manual maker making and 8.3% always used the maker planner. The mean score for use of computerised marker making is 1.00, with a standard deviation of .000. Which shows that all the samples have the same score of 1.00. This indicates that some schools never use the computerised marker making methods and a standard deviation of .289 shows that a few learners never used the manual marker making method. Computerised marker making was not used by schools as shown by a response of (100%) and a standard deviation of .000. This shows that manual marker making was mostly used while computerised marker making was never used.

4.2.4 Cutting Methods

The table below shows the use of the cutting tools in the TTD subject. The given data presents descriptive statistics for different types of cutting machines, cutting tools and their average score, based on a sample.

Table 15: Methods used at the cutting operation in TTD

Cutting Methods	Always	Sometimes	Never	Mean	Standard Deviation
Cutting tables	75	25	0	2.50	0.905
Straight knife cutting machine	0	0	100	1.00	.000
Band knife cutting machine	0	16.7	83.3	1.00	.000
Hand Operated cutting scissors	100	0	0	1.33	.778
Round knife cutting machine	0	0	100	1.00	.000
Trimming scissors	0	25	75	2.75	.452
Automatic cutting machine	0	0	100	1.00	.000

Cutting average				1.5119	.21501
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The data represent the percentage distribution of responses from a sample regarding the methods used for cutting. The analysis shows the following statistics in the use of different tools at the cutting operation:

The mean score for use of cutting tables was 2.50, with a standard deviation of .905 and 75% indicated that they always use tables while 25% indicated using tables sometimes. This indicates that the scores for cutting tables varied quite a bit, with a range likely between 1.595 and 3.405 (mean plus or minus one standard deviation). This means there were some schools which did not have enough cutting tables. Observations also showed that some learners used their desks as cutting tables.

The mean score for use of straight knife cutting machines is 1.00, with a standard deviation of .000. The mean score for use of bent knife cutting machines was also 1.00, with a standard deviation of .000 and 100% indicating that they had never used the straight knife cutting machine. This indicates that all the samples have the same score of 1.00. The mean score for a round knife cutting machine was 1.00, with a standard deviation of .000. This indicates that all the samples had the same score of 1.00. The mean score for an automatic cutting machine is 1.00, with a standard deviation of .000. This indicates that all the samples have the same score of 1.00. This indicates that all the schools never used the straight knife, round knife, bent knife and automatic industrial cutting machine shown by a 100% response for never using the methods of cutting.

The mean score for the use of hand operated cutting machines was 1.33, with a standard deviation of .778. This indicates that the scores for hand operated cutting machines varied quite a bit, with a range likely between 0.55 and 2.11 (mean plus or minus one standard deviation) and 83.3% indicating that they always use the hand operated. The mean score for use of trimming scissors is 2.75, with a standard deviation of .452. This indicates that the scores for trimming scissors are quite consistent, with a range likely between 2.298 and 3.202 (mean plus or minus one standard deviation). The respondents agree that they always used hand cutting machines with 83.3% and the trimming scissors which are domestic methods of cutting. The mean score for the average of all the cutting machines is 1.5119, with a standard deviation of .21501.

The data suggest that there is a significant variation in the scores of different types of cutting machines and cutting tools, except for the straight knife cutting machine, bent knife, round knife cutting machine, and automatic cutting machine which all have the same score of 1.00 meaning that they are not commonly used in schools, while the highest score is for trimming scissors and hand scissors which are domestic tools thus making it clear that schools use domestic cutting tools.

When learners were asked what they used for cutting one learner (p40) said:

The scissors are the tools that we use for cutting because we do not have the machines used in industry and there is no need for the machines, we do not have bulk material for us to cut

It was also observed that each learner cut their own garment pieces and mostly learners used the manual scissors, only three schools out of the sampled schools used the straight knife cutting machine. Based on the observations, it appears that among cutting tools most industrial cutting machines were not used in schools. The data above indicate that the cutting operation was done manually in most schools. Observations also revealed that students used the scissors only and cutting was done on single layers of fabric.

4.2.5 Transferring and Marking Methods

Table 16: Method of transferring markings

Variable	Response %				Mean score	Standard deviation
	Never	Sometimes	Always	Total		
Tailor's chalk	8.3	0	91.7	100	2.92	.289
Use of notchers	91.7	8.3	0	100	1.92	.289
Pins	0	33.3	66.7	100	2.67	.492
Thread marking	0	25.0	75.0	100	2.75	.452
Tracing wheel					3.00	.000

The data above represent the frequency and percentage distribution of responses from a sample regarding the usage of tailor's chalk. The result shows that (91.7%) always used tailor's chalk, while only (8.3%) reported using it sometimes. The table shows that 8.3% used tailor's chalk. These data therefore suggest that the majority of respondents (91.7%) always used tailors chalk when working on their projects. This shows that learners' in the sampled schools used manual methods for transferring pattern markings. The data in the table above also represent responses to a survey question about the frequency with which the learners used notchers to transfer markings. Of these responses, 91.7% reported that they never used notchers to transfer markings and 8.3% reported they used notchers sometimes. Based on this data, it can be noted that the majority of respondents never used notchers to transfer makings, while a smaller proportion used them, and a few respondents reported using notchers sometimes.

The data also represent the responses of participants to a survey question about their use of pins, (33.3%) indicated that they used pins "Sometimes", while (66.7%) indicated that they used pins "Always".

The data indicate that the majority of participants (66.7%) used pins "Always", while a minority (33.3%) used pins "Sometimes" for transferring markings.

The table above shows the use of thread makings for transferring pattern markings. The data show the results of a survey or study on thread markings, where respondents were asked how frequently they used

thread markings. Thread markings were sometimes used by (25%) and (75%) indicating that they always used thread markings. The data suggests that the majority of respondents always used thread markings. When learners were asked what they used for transferring markings from their patterns one learner(p13) said:

We use what we were taught during the topic for pattern marking but we have never used notchers in particular

The table above also shows the methods used in schools for transferring pattern markings. The data show the results of a survey or measurement of six different tools or methods used in the clothing making process. The Mean column shows the average score given to each tool/method, while the Std. Deviation column shows the variability or spread of the scores around the mean. The Tracing wheel has a mean score of 3.00, which indicates that it is rated highly among the six tools/methods. However, its standard deviation is very small (0.000), which means that all respondents gave it the same score. This could suggest that the survey was not sensitive enough to detect any differences in preference among respondents for this tool.

Tailor's chalk has a mean score of 2.92, which is slightly lower than the Tracing wheel. Its standard deviation of 0.289 suggests that there was some variability in respondents' ratings of this tool, but it was not very large. Use of notchers to transfer markings has a mean score of 1.92, which is the lowest among the six tools/methods. Its standard deviation of 0.996 is the largest among the six, indicating that there was a lot of variability in respondents' ratings of this tool. Using pins has a mean score of 2.67, which is higher than notchers but lower than Tracing wheel and Tailors chalk. Its standard deviation of 0.492 suggests that there was some variability in respondents' ratings of this tool.

Thread markings have a mean score of 2.75, which is slightly higher than Using pins. Its standard deviation of 0.452 suggests that there was some variability in respondents' ratings of this tool, but it was not very large. Marking average has a mean score of 2.65, which is between Using pins and Thread markings. Its standard deviation of 0.24309 is the smallest among the six tools/methods, indicating that there was very little variability in respondents' ratings of this tool.

The data above suggest that tracing wheel and tailors chalk were the most preferred tools/methods among the six, while use of notchers to transfer markings was the least preferred method of transferring markings. However, there is some variability in respondents' ratings of the tools, especially for notchers, using pins, and thread markings.

4.2.6 Fusing Methods

The table below shows the methods used for fusing in the TTD subject.

Table 17: Use of the automatic fusing machines

Responses	Percent
Never	83.3
Sometimes	16.7
Total	100.0

Table 18: Use of iron for fusing

Response	Percent
Always	83.3
Sometimes	16.7
	100.0

The data above show the responses from a survey that includes a question about the usage of fusing equipment such as "automatic fusing machine and iron. The table shows that (83.3%) answered "Never" indicating that they have never used the automatic fusing machines. The remaining 16.7% have answered that they sometimes use the automatic fusing machine. The high percentage of respondents who reported never using the fusing machine may imply possibilities that they used an ironing method. It could be due to limited access to the equipment, lack of training or knowledge on how to operate it, or the fusing machines may not be commonly required or utilized in their specific schools. It is essential to consider the context in which the survey was conducted and the characteristics of the survey participants, as these factors can influence the usage patterns and familiarity with certain equipment.

The relatively small percentage of respondents indicated that they used the automatic fusing machine. These respondents might have been trained in the use of the fusing machine or work in industries where its use is more prevalent. Their responses could provide valuable insights into the benefits, challenges, and applications of the fusing machine.

4.2.7 Sewing Operation Methods

The table below shows the use of the production system in the TTD subject during garment development.

Table 19: Production systems used in the Sewing section

Variable	Response %				Mean score	Standard deviation
	Never	Sometimes	Always	Total		
Whole garment system: one learner does all the processes of a garment	0	0	100	100	2.58	0.669
Departmental whole garment: learners specialise in sections e.g. cutting, sewing a particular garment, pressing and packaging sections.	66.7	33.3	0	100	2.17	0.937
Sectionalisation: one learner specialises on a specific operation e.g. pockets, collar, sleeve	66.7	33.3	0	100	1.67	0.985

The data above represent the responses of a sample of participants who were asked about their experience with a "whole garment system," where one person does all the processes of a garment. The table shows that none of respondents answered "Never" and "Sometimes," while 100% of respondents answered "Always," suggesting that they consistently worked using the whole garment system. It can therefore be said that they always work using the whole garment system.

Departmental whole garment system use in the TTD subject is shown by the response of 66.7% of the learners who responded that they never used the specialisation method, while 33.3% of the learners used specialisation sometimes. There was no response for "Always using departmental whole garment system. The data therefore suggests that the majority of the learners never used the departmental whole garment system, with only a minority of the learners using it sometimes.

The responses for the Sectionalisation System use in the TTD subject operations is shown by the response of 66.7% of the learners who responded that they never used the sectionalisation method., while 33.3% of the learners used sectionalisation sometimes. There was no response for "Always using sectionalisation system. The data therefore suggests that a majority of the learners never used the sectionalisation method system, with only a minority of the learners using it sometimes.

When learners and teachers were asked about the production systems used in the TTD subject operations one teacher (P1) said:

Mostly learners make their own garments as individuals and we have used line production when we make uniforms for sale and when we went for attachment in a clothing industry

Another teacher(P4) said:

Learners make their own designs and learners construct their own garments. Though we have taught about other methods of production, we have no facilities and time to practice them within the time allocated for the subject

The another teacher (P14) had this to say:

My learners had an opportunity to use other methods when they went for industrial attachment which has given them exposure to use industrial machines and other tools that I did not know how to used but are needed for A' Level.

A learner (p34) explained and said:

We make designs, patterns together, cut together and transfer pattern markings together then we do other processes as individuals.

It was also observed that most learners made their own garments; just a few schools were seen using other methods of garment construction like line production. Some schools really have industrialised their TTD departments.

The data from the table above show descriptive statistics for four different garment production systems: Whole garment system, departmental whole garment, and sectionalisation. Based on the mean and standard deviation values, it appears that the whole garment system has the highest average score and the lowest variability, while the line production system has the lowest average score and the highest variability. The departmental whole garment construction systems fall somewhere in between. Therefore, the data reveals that the whole garment system is commonly used in schools.

4.2.4 Finishing Operations

The finishing operations involve checking for loose threads, fitting, pressing and packing.

Table 20: Equipment used for checking and fitting in TTD subject

Variables	Always	Never	Sometimes	Mean	Standard Deviation
Dress forms	0	83.3	16.7	1.33	.651
Full-length mirrors	50	41.7	8.3	2.08	.996
Tape measures	83.3	16.7	0	2.67	.778
Checking Average				2.1000	.60000

The table above shows that the mean value for dress forms is 1.33, indicating that, on average, there were 1.33 dress forms available for finishing activities in TTD. The standard deviation of 0.651 suggests some variability in the availability of dress forms across different schools or classes.

The mean value for full length mirrors is 2.08, implying that, on average, there are 2.08 full length mirrors used for finishing in TTD. The standard deviation of 0.996 indicates some variation in the availability of full length mirrors among different schools or classes.

The mean value for tape measures is 2.67, suggesting that, on average, there are 2.67 tape measures utilized for finishing tasks in TTD. The standard deviation of 0.778 suggests some variance in the number of tape measures available across different schools or classes. The mean value for the finishing average is 2.1000, indicating the overall average rating for the adequacy of equipment used in finishing tasks in TTD. This value represents a collective assessment of all the equipment types mentioned above. The standard deviation of 0.60000 suggests some variability in the perceived adequacy of equipment across different schools or classes.

The table also shows the equipment percentage used in finishing garments in the TTD subject. The data provided is about the frequency of usage of dress forms and is presented in a tabular form. 83.3% answered that they never used dress forms, 16.7% answered that they sometimes used dress forms. The data provided displays the responses of individuals regarding their usage of full-length mirrors. 41.7% indicate that they never used a full-length mirror, 8.3% indicate that they sometimes used a full-length mirror, and 50% indicating that they always use a full-length mirror. From this data, we can infer that half of the respondents frequently used full-length mirrors, while the other half either never used them or used them infrequently. When a learner (p25) was asked what they use for checking/fitting they seemed to be familiar with the word “fitting”. She said:

We do not have fitting equipment like mirrors, dress forms and even rails to hang our garments

The data represent the frequency and percentage of the respondents when they were asked about their

usage of tape measures. 83.3% reported that they always used tape measures. On the other hand, only 16.7% reported that they never use tape measures. The majority of respondents (83.3%) reported that they always used tape measures, while a minority (16.7%) reported that they never used them.

4.4.8 Pressing and Ironing Methods

Table 21: Pressing and ironing methods

Pressing	Always	Never	Sometimes	Mean	Standard. Deviation
Steam irons	91.7	8.3	0	2.83	.577
Seam presser	8.3	75	16.7	1.67	.888
Adjustable ironing boards	33.3	58.3	8.3	1.33	.651
Sleeve boards	16.7	50	33.3	1.75	.965
Industrial steamers	0	100	0	1.67	.778
Charcoal irons	58.3	16.7	25	1.00	.000
Pressing Average				1.795	.686

The table above shows the use of charcoal irons in the TTD learning area. The response options include "Never", "Sometimes", and "Always". The given data presents the frequency and percentages of respondents who indicated how often they used steam irons. 8.3% indicated that they never used steam irons, while the remaining respondents 91.7% reported that they used steam irons. The data therefore indicates that the majority of respondents always use steam irons, while a small minority never use them. The data shows that 58.3% reported never using charcoal irons, 16.7% reported using them sometimes, and 25% reported always using them. The data therefore suggests that a majority of respondents did not use charcoal irons, with only a quarter reporting always using them.

The data represent the frequency and percentage of responses from a group of people regarding their usage of a seam presser. Seventy-five percent of the respondents have never used a seam presser; responses for sometimes were 16.7% and only 8.3% of the respondents always used a seam presser. This data therefore indicates that most of the respondents have not used a seam presser, while a small percentage of respondents use it either sometimes or always. The data provided show the frequency and percentage of respondents' usage of adjustable ironing boards. 58.3% reported that they never used adjustable ironing boards, while 33.3% reported always using them. Only 8.3% reported using them sometimes. The data, therefore shows that the usage of adjustable ironing boards was relatively low among the respondents, with a majority reporting that they never used them. The data show that 50% of them reported that they never used sleeve boards, while 33.3% reported using them sometimes and 16.7%

reported always using them.

According to the data, 100% of the respondents answered "Never", indicating that they have never used industrial steamers. When the learners were asked to explain how they carried out the pressing operation one learner (P6) said:

We use steam irons and ironing boards and we used a seam presser when we were taken to a university for a visit and we used the industrial irons

Observations revealed a range of pressing experiences from the use of a charcoal iron to the industrial iron in a few schools. The table presents the means and standard deviations for steam irons, charcoal irons, seam pressers, adjustable ironing boards, sleeve boards, and industrial steamers. From the data presented, we can see that steam irons have the highest mean value of 2.83, followed by adjustable ironing boards with a mean of 1.75. Charcoal irons and sleeve boards have mean values of 1.795 each, while industrial steamers have the lowest mean value of 100 and in terms of variability showing that the responses were homogeneous showing that all the learners agreed that they did not use the industrial steamers. Steam irons have a standard deviation of 0.577, indicating that the data is tightly clustered around the mean value. Adjustable ironing boards have the highest standard deviation of .965, suggesting that most schools used the ironing board compared to the other types of equipment.

4.4.9 Packaging Methods

The table below shows the packaging methods used in the TTD subject.

Table 22: Packaging and storage used in TTD subject

Variable	Responses			Mean score	Standard deviation
	Never	Sometimes	Always		
Plastic packets	66.7	16.7	8.3	1.36	.674
Boxes	8.3	50.0	33.3	2.27	.647
Bales	83.3	8.3	0	1.09	.302
Storage spaces	8.3	66.0	25	2.27	.467
Dress rails	41.7	8.3	50.0	2.08	.996
Packaging average				1.5972	.34420

The table above shows the plastic packaging used in the TTD subject. The given data presents the frequency and percentage of respondents' usage of plastic packets. Those who never used plastic packets were 66.7%, for sometimes using plastic packets it was 16.7% and 8.3% reported always using plastic packets.

The table shows the use of boxes for packaging in the TTD subject. The data appear to be a frequency distribution table for a variable called Boxes. Eighty-three (8.3%) reported that they never used boxes, 50.0% reported that they were using boxes sometimes, and 33.3% reported always using boxes. This means they sometimes used boxes, yet boxes offer more robust protection compared to plastic packets, especially for delicate or bulky textile products. Boxes are often used for packaging items like large fabric rolls. They provide stability, stack ability, and additional branding opportunities. The data show that 83.3% selected "Never" as their response, while only 8.3% selected "Sometimes for the use of bales. The "Missing" row indicates that 8.3% of the total did not provide a response to the question. When learners were asked about packaging one learner(p8) laughed and said:

Ah you expect us to pack the things that we make why?

Another learner(p17) from another school said:

We use plastics for packing things for sale but most of our products are not packed we just hang them in the tuckshop for sale”

It was observed that other schools use the TTD subject as a production sector in the school and sell uniforms to parents. The table shows the use of dress rails for keeping garments in the TTD subject. The data represent responses to a survey question about the frequency of use of dress rails for hanging garments. The table shows that 41.7% of the respondents never used dress rails for hanging garments, 8.3% indicating that they sometimes used dress rails, and 50.0% indicating that they always used dress rails. Some respondents used dress rails for hanging garments indicated by 50% choosing “sometimes”, while 41.7% did not use them at all. When asked about what they used for storing their garments one learner (p21) said:

We just do our work and make sure it is neat and keep it in our work bags(p21)

Another learner(p51) said:

We have to fit, check for any defaults so that we get marks and then hang in the cupboards

A teacher responded by complaining as she said “We never get to that stage. These students are very slow, they never finish making projects, they need a lot of time so they end up taking their projects with them” (P20). Observations varied with some schools displaying work done during the term and hanging in bulk for selling, some displayed on dress forms and some schools had fitting rooms with full length mirrors. In other schools there was no trace of tangible work. The data represents the frequency of use of storage cupboards by learners. The table shows that 66.7% reported using storage cupboards sometimes, 25.0% reported always using them. One response is missing, which represents 8.3% of the total sample

size. The majority of the group used storage cupboards, with most of them using them sometimes and a smaller portion always using them.

The data provided include descriptive statistics for four variables related to packaging: plastic packets, boxes, bales, and the average of all three. Analysis of the data shows that the mean (average) value for plastic packets is 1.36, for boxes is 2.27, and for bales is 1.09. The standard deviation (SD) for plastic packets is .674, for boxes it is .647, and for bales it is 0.30. The mean value for plastic packets (1.36) is lower than the mean value for boxes (2.27), which suggests that participants used more boxes than plastic packets for packaging. The mean value for bales (1.09) is the lowest among the three types of packaging, indicating that it was used less frequently. The standard deviation for plastic packets (0.67) is larger than the standard deviation for bales (0.30), which suggests that there was more variability in the use of plastic packets. The standard deviation for boxes (0.65) is between the other two, indicating a moderate amount of variability in the use of boxes. The results were influenced by the fact that learners did not reach the stage of completing their projects thus the boxes had incomplete garments not ready for packaging. Production rate was low resulting in no packaging needed and the few learners who completed used plastic packages for their own garments.

4.4.10 Supervision Methods in the TTD subject operations

Table 23: Supervision methods in TTD subject

Variables	Never	Sometimes	Always	Mean	Standard. Deviation
Online supervision	66.7	33.3	0	1.33	.492
face to face supervision	8.3	75	16.7	1.92	.515
Right to left hand chart	66.7	33.3	0	1.33	.492
Flow diagram chart	93.3	missing	6.7	1.82	.751

The responses show that 66.7% reported that they never experienced online supervision, while the remaining 33.3% reported that they experienced it sometimes. The data therefore, shows that a majority of the respondents have never experienced online supervision. The responses show that (75%) chose "Sometimes," and 16.7% chose "Always." Only 8.3% of respondents reported experiencing face to face supervision always, which suggests that it was not a common occurrence. The responses according to the table above show that 66.7% never used the right to the left hand chart, while 33.3% responded that they sometimes used it.

There is a missing response categorised as "System", which accounts for 6.7% of the total responses. The

data suggests that the flow chart is not used as shown by 93.3% responding 'never'. When teachers were asked how they supervised the learners, they were quoted saying:

I just tell them when the work is due and then help them when they come for help" (P11).

The type of supervision was not clear but from the way students operated, it showed that they were supervised more on the examination requirements. From observation, most teachers and students did not operate like industry where supervision is strict and focused; they looked relaxed. It can be noted that the mean rating for "Online supervision" and "Right to left hand chart" is the same, at 1.33, while the mean rating for "face to face supervision" is higher at 1.92. Meanwhile, the mean rating for "Flow diagram chart" is 1.82. The standard deviation for each item ranges from .40 to .75. This indicates the variability in the ratings provided by the respondents. The larger the standard deviation, the more spread out the ratings are from the mean. In this case, "Flow diagram chart" has the largest standard deviation, indicating more variability in the ratings compared to the other items. This means that the responses were less consistent making it difficult to use the sample to make predictions about the flow chart. When a teacher (P24) was interviewed to comment about their supervision experience she had this to say:

Personally I am afraid of supervisors because I feel I have not fulfilled the requirements of the curriculum but at least they do not come frequently".

Face to face supervision was sometimes done and the charts were not part of the supervision schedule.

4.2.10(a) Operational time supervision Methods

The table below shows the results of the methods used for operational time supervision in the TTD subject

Table 24: Operational time supervision

Operation time	Never	Sometimes	Always	Total	Mean	Standard. Deviation
Analytical estimation: time for completing a task is estimated by the teacher	8.3	33.3	33.4	75.0	2.33	.707
Comparative estimation: time to complete a task depends on other learners' speed.	33.3	50.0	16.7		1.83	.718
We follow set performance standards of time to complete sewing tasks and projects	75	25.0	0	100	2.75	.452
We have no time limit measurement for completing our tasks.	50.0	33.3	8.3	91.7	1.55	.688
Time average					2.1181	.25490

The given data present descriptive statistics for four different approaches used when supervising to

estimate the time needed to complete a task. The responses were categorized into three options: "Never," "Sometimes," and "Always." The first approach was analytical estimation, where the time for completing a task is estimated by the teacher. The mean estimated time was 2.33 with a standard deviation of 0.707. The second approach is comparative estimation, where the time to complete a task depends on the speed of other learners. The mean estimated time is 1.83 with a standard deviation of 0.718. The third approach involved following set performance standards for completing sewing tasks and projects. The mean estimated time was 2.75 with a standard deviation of 0.452. The fourth approach has no time limit measurement for completing the tasks. The mean estimated time was 1.55 with a standard deviation of 0.688. Finally, the Time average (presumably time average) column gives the overall mean estimated time across all approaches as 2.1181 with a standard deviation of 0.25490, based on a valid leastwise sample size of 8. These descriptive statistics provide some insight into how different approaches can result in different estimates of the time needed to complete a task. The standard deviations suggest that there was some variability in the estimates within each approach, and the overall mean and standard deviation in the time average column indicate that the estimates tended to cluster around 2.12 with relatively low variability.

The table shows the use of the analytic estimation method in the TTD subject. The given data represents the frequency and percentage distribution of analytical estimation of the time required to complete a task as estimated by a teacher. The data is divided into three categories: "Never," "Sometimes," and "Always." The data also shows that there were three missing responses categorized under "System." It shows that 75% of the participants provided valid responses while the remaining 25% of the responses were missing. Among the valid responses, 33.3% of the participants sometimes estimated the time required to complete a task while another 33.3% always estimated the time required to complete a task. The remaining 8.3% of the participants never estimated the time required to complete a task. In terms of cumulative percentage, 11.1% of the participants never estimated the time required to complete a task, 44.4% of the participants sometimes estimated the time required to complete a task, and the remaining 44.4% of the participants always estimated the time required to complete a task.

The data presented the use of comparative estimation of how much time it takes to complete a task is affected by the speed of other learners. The data show that 50% reported that it sometimes affects their completion time, 16.7% said that it always affected their completion time. These results suggest that the majority of learners believed that the speed of other learners sometimes affected their completion time, while a smaller percentage felt that it always affects them. The minority of learners reported that they were never affected by the speed of other learners.

The data shows the frequency and percentage of responses regarding adherence to set performance standards time to complete sewing tasks and projects. It was revealed that 75% reported always following the set performance standards, while 25% reported sometimes following them. This data suggests that a majority of respondents strived to meet the performance standards of time to complete sewing tasks and projects.

The table above shows the use of the unlimited time system in the TTD subject. The data shows the responses of a group of individuals regarding the time limit for completing their tasks. There is one response marked as missing. Of the valid responses, 50% reported that they never had a time limit for completing their tasks, 33.3% reported that they sometimes had a time limit, and 8.3% reported that they always have a time limit. Thus, at the end of the table, 54.5% of respondents reported that they never had a time limit, 90.9% reported that they either never or sometimes have a time limit, and 100% reported that they have some experience with time limits. This data therefore suggest that the majority of individuals did not have a time limit for completing their tasks, but there were still a significant number who sometimes or always have a time limit.

When teachers were asked about the operational time one of the teachers (17) said:

Personally I use the syllabus and the dates for submitting the project then we learn and toward submission we can complete the garment within a week and submit then train them for the final exam practical when they are ready if you do it too early they are never serious.

Another teacher(P41) said:

Some students are fast, others are slow, so they encourage each other to finish tasks and they motivate each other to complete tasks.

Another teacher(P1) said:

We set targets together and draw a work plan that will guide the students on their project and then we also consider the syllabus assessment objectives on how many garments to make per term.

Operational time supervision for performance varies in the TTD subject. Standards are clustered around the speed of other learners and the teacher. Most learners agreed that there are no set standards of performance during the term for completing tasks and projects.

4.2.10(b) Work flow supervision methods

Table 25: Work flow methods

Time Study Methods	Percentage			Mean	Standard. Deviation
	Always	Never	Sometimes		
1. Right hand to left hand chart		16.7	83.3	1.67	1.073
2. Student to machine chart		25	75	1.75	1.138
3. Multiple activity chart		34.3	66.7	1.75	1.138
4. Relaxation time chart		34.3	66.7	1.67	1.073
Domain Average				1.4167	2.6827

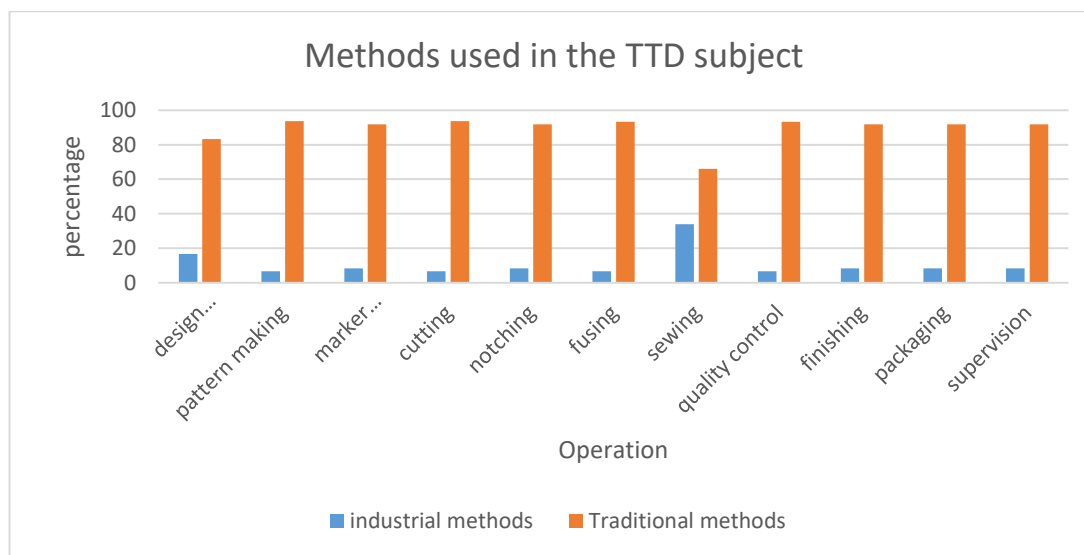
Table 26: Verbal interpretation for Time study

Scale	Response	Mean Range	Verbal interpretation
4	Agree	3.51-4.50	Highly used
3	Slightly Disagree	2.51-3.50	Used
2	Strongly Disagree	1.51-2.50	Slightly used available
1	Disagree	1.00-1.50	No time study

The responses show that time study charts were not available in schools with the average mean of 1.42 and a standard deviation of 0.27. Observations revealed students were relaxed, charting and going out of

classes leaving work for a long time with no time study guiding them.

Figure 3: Summary of Methods used in the TTD subject Operations



The data above presents the findings of the nature of methods used in the execution of operation by learners and teachers at the sampled schools in Zimbabwe. The data shows that domestic methods were more commonly used by both learners and teachers than industrial methods. This pattern is consistent across all the operations in garment construction. There was no significant difference between the responses from the teachers and the students. This means that the teachers have no other sources, they rely on what the school offers. The result above suggests that domestic methods were more commonly used by learners and teachers in the sampled secondary schools.

4.3. Time taken for executing operations by learners in the TTD subject.

This research question sought to observe the time taken to execute operations for the TTD subject in secondary schools. The observation was in the garment construction section where learners were constructing a skirt. Students were placed conveniently in different places that had enough machines for each learner for the whole garment construction method. The table below shows the observed performance time for operations on a skirt for the learners. The 52 learners were observed in their school setting during the garment construction.

Table 27: Observations of the time taken to execute operations in making a skirt in schools.

Skirt	Time taken to design and construct a skirt				
	Time taken to complete an operation in minutes				
Operation Name	Number of learners	Minimum time in minutes	Maximum Time in minutes	Average Time in minutes	Standard Deviation
Design development	52	120	322	221.61	64.157
Making patterns	52	112	248	184.67	51.891
Laying out	52	30	167	110.24	46.802
Cutting out	52	30	96	59.89	25.726
Sewing darts	52	30	36	33.00	101.263
Working on seams	52	122	62	213.48	95.736
Attaching Zip	52	119	370	234.41	124.560
Prepare Waistband	51	145	254	188.55	28.269
Attaching Waistband	52	112	368	233.09	126.470
Sew the button and buttonhole	52	34	257	143.91	94.408
Hemming the skirt	52	15	245	114.46	104.765
Finishing	17	45	119	80.5	168.313
Packaging	17	15	55	35	148.567
Valid Total	51	929	3099	2014	

The data show that there is considerable variability in the operational time for each task, as indicated by the standard deviations. Some tasks have larger spreads in their times, suggesting potential inefficiencies or inconsistencies in the time taken among learners. To improve, the focus should be on tasks with higher

mean times and high variability which means the learners took more time to execute the operations. Additionally, identifying outliers or tasks with unusually long times can provide insights into areas for improvement. Individual operations observation revealed that zip attachment consumed an average of 234.41 minutes which was the longest time among operations, followed by waistband attachment with 233.09 minutes showing that there is need for improvement in the methods of execution among these processes.

Similarly, pattern making, design development, seams, button sewing and hemming recorded lengthy times compared to other operations. It was observed that learners spent most of the time moving around to get equipment and queuing for consultation on the teacher's table. In some schools, learners were found idle waiting for equipment which affected the time taken on some construction operation. The average domain for making the skirt had a maximum of 3099 minutes and a minimum of 929 minutes in TTD subject operations.

Curriculum time allocation for the TTD subject.

The summative assessment time to complete a garment was specified in the TTD subject syllabus (2015-2022). Each year garment specification is sent to schools as the selected garments for that particular period. For the years 2015-22 Paper 2: Practical Examination, the paper consisted of pattern drafting, laying out, cutting out, construction of the article, pressing and packing in three consecutive days (day 1: 3 hours, day 2: 6 hours split into 2 x 3 hours and day 3: 6 Hours split into 2 x3 Hours), totalling to 15 hours (900 minutes). The paper specifies 30 minutes' allowance break per session which means the total allowance time is 90 minutes for 900 minutes (TTD syllabus, 2015-2022).

Time allocated for garment construction continuous assessment in TTD Subject Practical

The table below shows the time allocated to the TTD subject for practical lessons per lesson, per week, per month and per term. The total time per term was used to calculate the possible number of garments that a learner can make within a term.

Table 28: Time allocation minutes.

Minimum Number of lessons per week	Time allocated per lesson	Total minutes per week	Total minutes per month	Total minutes per term
4 periods	35	140	560	1680
4 periods	40	160	640	1920
Maximum Number of	Time allocated per lesson	Total minutes per week	Total minutes per month	Total minutes per term

lessons per week				
6 periods	35	210	840	2520
6 periods	40	240	960	2880

Calculations for time taken in schools

Average observed time for a skirt =minimum observed time +maximum observed time/2

$$=929\text{minutes} +3099 \text{ minutes}/2$$

$$= 4028/2$$

$$=2014 \text{ minutes}$$

This means in the natural setting in schools the average time to complete a skirt was 2014 minutes. According to the summative assessment a garment is supposed to be completed in 900 minutes. Learners used more time, there was an increase of 123.8% in the time taken to make a skirt and it therefore calls for concern. The results were consistent with the findings of Shoko, et al. (2018) who conducted a study in secondary schools in Zimbabwe and found that 62.5% learners took 18 months to complete a skirt or blouse, 25% worked on garments in 4 months and only 12.5%. The results from the observed operation from schools could be used for calculating the number of garments a student can make per term.

The time allocation for TTD subject practical operation according to the TTD syllabus is two blocks of 35-40 minutes per week (Curriculum Development Unit, 2015)

The curriculum time for making a garment is 900 minutes or less according to the summative objectives of the 2015-2022 syllabus test time. When teachers were asked how long learners took to finish a garment, one teacher(P6) said:

Learners take their time and most of them hardly finish a full garment in a term

Another teacher(P12) said:

The learners come for extra time to complete their tasks, they are able to do at least one item per term with extra time.

Observations showed that TTD operations were very slow, clumsy, fumbling movements; some learners appeared half-asleep, with no hurry in their operations. In some schools it was found that some learners were waiting for equipment while others were hanging around not doing anything, holding their work aimlessly leading to longer times used to complete tasks. Huge amounts of semi-finished garments were kept, waiting to be processed and some left unfinished from the previous years.

Based on the data found in this section, learners were slower than the expectations of the curriculum plan.

The result brings a cause for time analysis and improvement strategy. The researcher therefore had to explore the challenges faced in TTD operations and conduct a time study in an improved garment construction environment that provided learners with basic industrial equipment to establish the best operational framework for A' Level TTD subject operations. The results on challenges encountered are presented in the following section.

4. 4: Challenges faced in TTD subject operation in secondary schools

This research question sought to determine the challenges faced by TTD subject operations for secondary schools in Zimbabwe. Data were collected through a questionnaire, interviews and observations.

Table 29: Verbal interpretation for the challenges faced by TTD subject learning area.

Scale	Response	Mean Range	Verbal interpretation
3	Most available	2.5-3.5	Not challenging
2	Moderately available	1.5-2.5	Challenging
1	Not available	0.5-1.5	Highly challenging

The given table provides a verbal interpretation of challenges based on a response scale that ranges from 1 to 3. The mean range for each response category is also provided, indicating the range of scores that fall within that category. From the findings, a response of 3, with a mean range of 2.5-3.5, indicates that the challenges are perceived as "not challenging" or relatively used frequently. A response of 2, with a mean range of 1.5-2.5, indicates that the challenges were perceived as challenging, indicating a moderate level of availability. A response of 1, with a mean range of 0.5-1.5, indicates that the challenges are perceived as highly challenging or not available. The table provides a simple and straightforward way to interpret the level of challenge based on a numerical response scale.

4.4.1 Tools and Equipment

Table 30: Availability of industrial tools and equipment used in the TTD subject operations.

Tools and equipment.	Frequency	Mean range	Standard. Deviation
Designing tools	52	1.8333	0.38925
Pattern making tools	52	0.4583	0.62915
Marking Tools	52	0.0556	0.52864
Cutting Tools	52	1.4524	0.13392
Construction Equipment	52	1.5833	0.45965

Fusing tools	52	0.4286	0.21101
Finishing Tools	52	2.0000	0.38041
Fabric spreading tools	52	1.8333	0.38925
Quality Control Tools	52	2.8333	0.23570
Time Supervision tools	52	0.4583	0.62915

The given data represent the averages of different types of tools with their mean and standard deviation values. The mean value for each tool category represents the average rating of that tool category, and the standard deviation represents how much the data values deviate from the mean value. By analysing the data, we can see that the highest mean value is for quality control tools (2.8333), which indicate that these tools were highly available and not a challenge compared to other tool categories. The lowest mean value is for time study tools (0.4583) pattern making tools, (0.4583), fusing (0.4286) time study tools (0.4583) and cutting tools (1.4524), which means that the tools category are the least rated among all the categories. The standard deviation values vary for each tool category. Marking tools (0.52864) and finishing tools (0.38041) have relatively higher standard deviation values, which suggest that the ratings for these tool categories vary significantly among the participants. On the other hand, fusing equipment (0.21101) and quality control tools (0.23570) have lower standard deviation values, indicating that the ratings for these tools were more consistent among the participants.

One of the teachers (P5) had this to say:

We possess the machinery, although the quantity is insufficient for the students. The real challenge lies in acquiring an adequate supply of cutting tools, especially when there is a need to perform tasks on a large scale, which is frequently the case.

It was observed that quality control tools were highly rated while cutting tools and time supervision tools were least rated among the given tool categories. However, the ratings for marking tools and finishing tools have high variability, which may need further investigation.

Table 31: Teacher competency

4.4.2. Teacher Competences

Teacher Competence	Mean	Standard. Deviation
I can use CAD/CAM software for designing and grading patterns.	2.17	1.267
2. I can make patterns from commercial patterns	4.08	.996
3. I can draft patterns	4.42	.900
4. I have been trained to use CAD/CAM software	1.91	1.136
5. I have constructed samples of garments as a demonstration to learners.	3.75	1.288
6. I have been trained in industrialising the TTD subject.	2.88	1.458
7. I want to upgrade my TTD knowledge.	3.75	1.288
Domain Average	3.3294	.79090

Table 32: Verbal Interpretation for teacher competence

Scale	Response	Mean Range	Verbal interpretation
1	Agree	3.51-4.50	Highly competent
2	Slightly Disagree	2.51-3.50	Competent
3	Strongly Disagree	1.51-2.50	Less competent
4	Disagree	1.00-1.50	Incompetent

The provided scale and verbal interpretation were used to assess teacher competency in the use of machines based on the respondents' mean scores. Those who agreed (3.51-4.50 - Highly Competent), indicate a high level of agreement with the statement about being competent in using machines. Teachers in this category are perceived as highly competent.

Those who slightly disagreed (2.51-3.50 - Competent) express a moderate level of competency. While they do not strongly agree with being highly competent, they are still considered competent in the use of machines. Those who strongly disagreed (1.51-2.50 - Less Competent) have a lower level of competency. Teachers in this category may face challenges or limitations in using machines effectively. Those that disagreed (1.00-1.50 - Incompetent) are categorized as incompetent in the use of machines. This implies a significant lack of competency in handling machines.

The data represent the teacher's self-reported competence in various aspects of teaching and learning, with a focus on how they execute TTD operations. The mean for each question ranges from 1.91 to 4.42, with a domain average of 3.3294. This indicates that, on average, the teachers feel relatively competent in the areas being assessed. The standard deviation for each question ranges from .900 to 1.458. This suggests that there was some variability in teacher competence across the different areas being assessed, with some

teachers feeling more confident in certain areas than others. Variable 4 has the lowest mean (1.91) and the highest standard deviation (1.136), indicating that there is more variability in teacher responses to this question compared to the others. This question relates to whether the teachers have been trained to use CAD/CAM software, and it appears that some teachers may have had more training than others in this area. Variable 3 has the highest mean (4.42) and the lowest standard deviation (.900), suggesting that the teachers feel more competent in drafting patterns compared to the other areas being assessed.

Variables 2, 5, 6, and 7 have means and standard deviations that fall within a relatively narrow range, indicating that teachers felt competent in these areas, but with some variability in their responses. When one teacher (P17) was asked about her ability to use CAD, she pleaded:

I need to be trained because I have no knowledge on using the CAD software, I only know how to teach theory about CAD/CAM.

When learners were observed while working on their projects in some schools, they seemed not to be sure about what to do, and upon consulting teachers, they were not assisted with confidence. Most teachers did not have their sample of garments as an example to learners. One of the teachers(P13) was quoted saying;

We need to find videos on YouTube that can be used to show the processes involved in making a collar for I do not have samples of the garments.

Upon observation, teachers with enough equipment were more confident than those who had compromised equipment as they did not have confidence in teaching and demonstrating. In overall, the data suggests that the teachers have a moderate to high level of competence in TTD education, with some variability in their confidence across the different areas being assessed. It may be useful to further investigate the reasons behind this variability, and to identify opportunities for targeted training or support in areas where teachers may feel less confident.

4.4.3 Funding

The table below shows the verbal interpretation for funding in the TTD subjects.

Table 33: Verbal interpretation for Sources of funding in the TTD subject.

Scale	Response	Mean Range	Verbal interpretation
4	Agree	3.51-4.50	Highly funded
3	Slightly Disagree	2.51-3.50	Slightly funded
2	Strongly Disagree	1.51-2.50	Less funding
1	Disagree	1.00-1.50	Not funded

If a respondent's mean score falls within the range of Agree (3.51-4.50 - Highly Funded), it indicates a high level of agreement with the statement about having adequate funding. Teachers in this category

perceive the funding for the TTD subject as highly sufficient. Those who Slightly Disagree (2.51-3.50 - Slightly Funded) expressed a moderate level of agreement. While they do not strongly agree with the high level of funding, they still consider the funding for the TTD subject to be somewhat sufficient. Those who Strongly Disagree (1.51-2.50 - Less Funding) had a lower level of agreement with having adequate funding. Teachers in this category feel that the funding for the TTD subject is not entirely sufficient. On the other hand, those who Disagree (1.00-1.50 - Not Funded) are categorized as disagreeing with having any funding for the TTD subject. This implies a perception of no funding or extremely insufficient funding.

Table 34: Funding sources

Funding	Mean	Standard. Deviation
1. The budget allocated to TTD is satisfactory	3.08	1.311
2. Material for TTD is purchased in time	2.58	1.782
3. We launch Fund raising activities to raise money for buying materials.	1.08	.289
4. Department is funded by NGO	1.08	.289
5. The department is church funded	1.08	.289
6. The department is funded by other organisations.	1.08	.289
Domain Average	1.6667	.47673

The table presents data related to the sources of funding for TTD, with mean and standard deviation scores for each funding item. The mean score is a measure of central tendency that provides an overall picture of the perceived satisfaction with each funding source. The standard deviation is a measure of variability that shows the degree of agreement or disagreement among respondents. Based on the mean scores, we can see that the budget allocated to TTD is the most satisfactory funding source with a mean score of 3.08, followed by material purchases with a mean score of 2.58. On the other hand, fundraising activities and funding from NGOs, churches, and other organizations contribute the least funding to schools with a mean score of 1.08 for each item.

The standard deviation scores indicate that the responses for material purchases have a greater degree of variability compared to the budget allocation, which indicates that there would be different opinions or

experiences with this funding source. Additionally, the standard deviation for the three items related to external funding sources (fundraising activities, NGO funding, and church funding) are all the same, which could suggest a lack of consensus or information about these sources.

The domain average score of 1.6667 indicates that the respondents were generally satisfied with the funding for TTD, with most funding sources receiving scores above average. However, there is still room for improvement in certain areas, particularly in the development of alternative funding sources beyond the reliance on external organizations.

However, some respondents were not satisfied with the funding levels. This was affirmed by some a teacher (P12) who said:

There is no practical fee to subside the TTD subject's needs, we are limited in what we want to do, we end up doing what we can just to get learners doing something"

Another teacher (P10) said:

There is a need for a practical fee or else the government should sponsor the subject.

According to most responses the budget allocated to schools is satisfactory, only a few indicated that the budget was not satisfactory. Funding expectations depend on the amount of tasks and projects done by the learners suggesting that most schools are not doing many products thereby finding the budget satisfactory. On the other hand, other schools need more funding due to the work and vision that they have for the subject.

4.4.4 Working Environment in TTD subject

Table 35: Working environment in the TTD subject.

Working Environment	Mean	Standard Deviation
Machines have permanent positions	2.18	1.401
There is enough sanitary equipment	2.30	1.767
There is adequate sewing space	2.36	1.629
working rooms are well ventilated	2.58	1.975
There is a first aid kit in the sewing room	2.45	2.018
There is enough supervision during sewing	7.33	10.629
There is enough cutting space	3.08	1.443
Learners are aware of the safety precautions	1.17	0.835
Learners talk to each other during sewing lessons	3.92	1.084
Learners are given relaxation time during sewing	1.00	1.859
Domain Average	3.3755	1.18661

The table presents the mean and standard deviation for various aspects of the working environment in the TTD subjects. The average rating for the overall working environment, represented by the domain average, is 3.3755. This suggests a moderate level of satisfaction with the working environment as a whole.

When analysing the individual components, it can be observed that the aspect with the lowest mean rating is "Machines have permanent positions" with a score of 2.18 and a standard deviation of 1.401. This indicates that there is plenty of dissatisfaction regarding the permanency or stability of the machines in the working environment. On the other hand, the aspect of "There is enough supervision during sewing" received the highest mean rating of 7.33, but it also has a significantly higher standard deviation of 10.629. This indicates a wide variation in the responses, with some individuals perceiving adequate supervision while others had a different opinion. Considering the domain average and the individual ratings, it can be concluded that while there were areas that needed improvement, the working environment in the TTD subjects generally achieved a moderate level of satisfaction.

Table 36: Verbal interpretation for working environment

Scale	Response	Mean Range	Verbal interpretation
1	Strongly Disagree	3.51-4.50	Inadequate
2	Slightly Disagree	2.51-3.50	Unsatisfactory
3	Agree	1	Adequate

The respondents who strongly disagreed, have mean scores falling within the range of 3.51 to 4.50. This indicates that the working environment is considered inadequate. This suggests that they have significant concerns or dissatisfaction with their working conditions.

Those who slightly disagreed, have mean scores falling within the range of 2.51 to 3.50, implying that the working environment was unsatisfactory. Those who agreed are within the mean scores range from 1.51 to 2.50, which indicates that the working environment was considered satisfactory, and there was no major concerns or dissatisfaction. The responses showed the working environment was inadequate in most schools as was shown by the average mean of 3.37 and a standard deviation of 1.19. When teachers were asked about the working environment one teacher (P12) said:

We do not have space to execute the industrial format, we share classes with the junior learners and the same class is also used for theory.

A learner (p18) said:

We are never comfortable, there is too much congestion and we are always in a hurry to give space to the next class.

Observations showed that the working space was limited in some schools where O' and A' Level practical lessons were done concurrently in the same workshop. In addition, a haphazard sequence of activities and improper machine layout was observed during operations. There were a lot of unclear instructions from the teachers. A teacher (P10) confirmed by saying:

The challenge is that I am not sure of what the syllabus requires of us and some of these operations are new to me, I need training in industry for me to get the confidence to teach and direct learners on what they should do. Based on the results from the observations and analysis of interview responses, the challenges faced by the TTD subject were lack of technological tools that are used in industry such as CAD software, Automatic cutting, fusing machines and industrial irons. Teachers were highly skilled in the use of manual equipment and methods but they lacked confidence in using technological tools; most teachers were willing to be trained in the new technologies. TTD subject relied on the schools' budget for funding. Some teachers complained of not getting enough funds to execute the practical lessons on time and ended up hurrying only for examination projects. The working environment was unsatisfactory. The working space, machine position, ventilation and cutting space were unsatisfactory. Supervision during practical lessons were inadequate and learners indicated that they had adequate relaxation time. After noting the challenges that were faced in TTD operations, the researcher had to conduct a time study experiment where the working environment during garment design and construction were improved. Each selected participant worked at their own cubicle section where there was a designing kit, pattern making equipment, cutting table with cutting tools, straight industrial sewing machine, overlocking machine and industrial ironing equipment. The learners were time studied whilst working on the skirt to establish the time the participants took under an improved working workshop environment. The results are presented in section 4. 7 below.

4.5. How Operations can be improved in the TTD subject for Secondary Schools

This research question sought to examine how operations can be improved in TTD subjects for secondary schools. A time study experiment was done to get the time taken for operation in an improved environment. The whole garment system and sectionalisation system were used for the experiment in two days starting with the whole garment and then the sectionalisation method. The standard industrial processes and all recommended basic industrial equipment needed for the TTD subject according to the TTD syllabus were made available for each student. The same 52 students from selected provinces were used for the experiment and teachers assisted in setting up the experiment and recording time. Data were

collected through observation with the help of a stopwatch for each operation performed. The results were analysed through SPSS software to get the minimum time and the maximum time for each operation.

4.5.1 Time study after improved conditions using the whole garment method

Table 37: Time study after improved conditions using the whole garment method.

Basic Skirt		Average time taken to complete an operation in minutes			Standard Deviation
Operation Name	Number of learners(N)	Minimum time taken in minutes	Maximum time taken in minutes	Average Time Taken in minutes	
1.Design development	52	30	64	47.50	0.894
2.Making patterns	52	23	60	46.50	0.683
3.Laying out	52	15	34	24.33	1.211
4.Cutting out	52	30	45	38.83	1.366
5.Sewing darts	52	10	30	20.50	0.730
6.Working on seams	52	20	37	29.67	1.483
7.Attaching Zip	52	45	62	54.50	1.366
8.Prepare Waistband	52	15	33	24.75	0.930
9.Attaching Waistband	52	30	45	38.83	2.338
• Hemming the skirt	52	15	45	25.58	0.930
11.Sew the button and buttonhole	52	15	33	24.75	0.683
12. Finishing	52	10	18	14.0	0.683
13. Packaging	52	10	14	12.0	0.365
Total	52	268	530	449	

The data in the table above show a reduction in the time taken for most tasks in the improved environment compared to the observations in the school settings before improved conditions. In almost every task, the mean time has decreased significantly after the improved conditions using the whole garment method. Design development Time taken decreased from an average of 221.61 to 47.50 minutes which was 78.6% decrease, pattern making decreases by 74% from 184.67 to 46.50 minutes, waistband attachment decreased by 83.4% from 233.09 to 38.83 minutes and zip attachment decreased by 76.6% from 234.41

to 54.50 and other processes showed a decrease in time taken. The learners took an average of 449 minutes to complete the skirt in the improved setting using the whole garment method which was a decrease of 77.7% from the time taken in school operations and 50.1% decrease from the curriculum plan. Additionally, the standard deviations are generally lower, indicating less variability in the time taken for each task. This suggests that the changes made in the improved conditions have led to more efficient operations. The data therefore suggests that the improvements have had a positive impact on reducing operational times and increasing consistency.

4.5.2 Observations after improved conditions using the sectionalisation method.

A time study experiment was done to get the time taken to complete a skirt in an improved environment using the sectionalisation method. The sectionalisation method is an individual system, each of the 13 learners in a group specialises in one component and sews it from beginning to end. The sewing rooms were set up such that each student performed all the operations required for a specific component. The standard industrial processes operational chart was prepared as a guide for the set up and all recommended equipment was listed and provided according to the TTD syllabus for each student. s. The same 52 students were used for the experiment and teachers assisted in the setting up of the experiment and recording of time. Students were placed conveniently in 4 groups with, each group had 13 sections and each student specialised in a section until it was completed. The analysis of major sections of making a basic skirt were done manually and time was recorded with the help of stopwatch. Pattern making, laying out and cutting out were done in bulk for 26 skirts and the time taken for these operations was only included in the first skirt thereafter production was recorded hourly with a target of 26 skirts per group in 5 hours. The last operator tallied each completed skirt in a prepared sheet and time it was completed then kept it for the other operator to record the data. The results were analysed through SPSS software to get the minimum time and the maximum time for each operation.

The results are presented in table 38 below.

Table 38: Time taken to make 1 skirt using sectionalisation method

Skirt 1	Time in minutes					
Operation Name	Line 1	Line 2	Line 3	Line 4	Mean time observed	Std. Deviation

1 Design development	30	32	30	32	30.8	0.251
2. Making patterns	23	25	24	25	24.2	0.373
3. Laying out	15	15	13	17	15.2	1.180
4. Cutting out	32	30	30	32	30.4	1.143
Total time for 26 skirts	100	102	107	106	104	
Time for (Design development, drafting , laying out and cutting out) for 1 skirt.	3.8	3.9	4.1	4.08	4.15	0.341
1.Sewing darts	10	10	10	12	10.4	0.730
2.Working on seams	22	18	21	22	20.4	1.483
3.Attaching Zip	43	47	45	47	45.6	1.366
4.Prepare Waistband	16	18	15	17	16.6	0.930
5.Attaching Waistband	32	25	30	30	29.8	2.338
6. Sew the button and buttonhole	15	13	14	15	14.2	0.683
7. Hemming the skirt	16	16	14	15	15.6	0.930
8. Finishing	10	10	11	9	9.8	0.683
9. Packaging	5	5	5	5	5.2	0.365
Total Time for 1 skirt	169	162	165	172	167	

The minimum and maximum times for skirt 1 included all the sections from pattern development to cutting which was done for 26 skirts. The table above shows a reduction in the time taken to make a skirt compared to the whole garment method and observed time taken in schools before improved conditions. Design development Time taken decreased 47.50 minutes using the whole garment method to 30.8 minutes in the sectionalisation method which was a 35% decrease of time taken. Pattern making decreased by 48% from 46.50 to 24.2 minutes, waistband attachment decreased by 23% from 38.83 to 29.8 minutes and zip attachment decreased by 16% from 54.50 to 45.6 minutes, and other processes showed a decrease in time taken. The average time taken for the first skirt was 167 minutes that is 81.4% decrease from the curriculum plan and 91.7% decrease from the time taken in schools. Additionally, the standard deviations were generally lower in the first skirt, indicating less variability in the time taken for each task which may suggests that the sectionalisation has led to more efficient and fast operations.

The table below shows the continued production after the first skirt. Production was recorded hourly for

3 hours and learners were given time to relax for 30 minutes and continued for the next 2 hours.

Table 39: Hourly Operations Report for sectionalisation method

		Skirt 1	1hrs	2hrs	3hrs	30min	4hrs	5 hrs	Total time taken
Line 1	Skirt Quantity	1	4	9	14	A	19	24	
	Minutes Worked	169	229	289	349	L	409	469	469
Line 2	Skirt Quantity	1	6	12	18	L	23	26	
	Minutes Worked	162	222	282	342	O	402	462	462
Line 3	Skirt Quantity	1	5	10	15	W	20	25	
	Minutes Worked	165	225	285	345	A	405	465	465
Line 4	Skirt Quantity	1	4	6	10	N	15	20	
	Minutes Worked	172	232	292	352	C	412	472	472
						E			
Average time taken									467

The data shows that learners managed to produce an average of 23 skirts in 467 minutes. The results suggest that to produce 1 skirt the learner could use $467/23$ skirts which is 20 minutes. The data therefore suggests that the sectionalisation method has had a positive impact on reducing operational times and increasing consistency across tasks. This implies that the processes had become more consistent and predictable for learners. Observations during the sectionalisation experiments showed that learners were business-like and time conscious.

4.5.3 Comparison among curriculum plan, observed time, time study using whole garment and sectionalisation in an improved environment

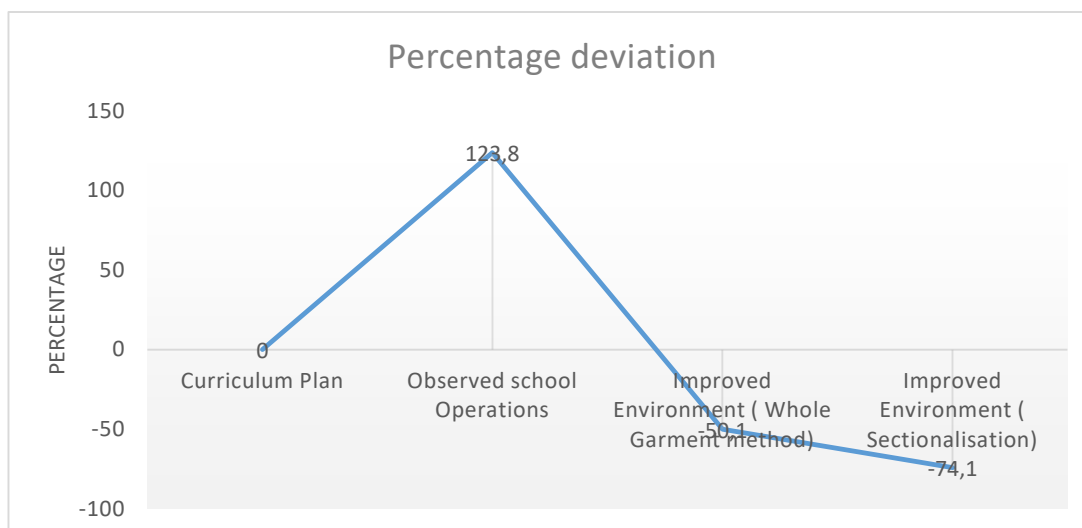


Figure 4: Percentage deviation be observed time taken in school operations from the curriculum plan.

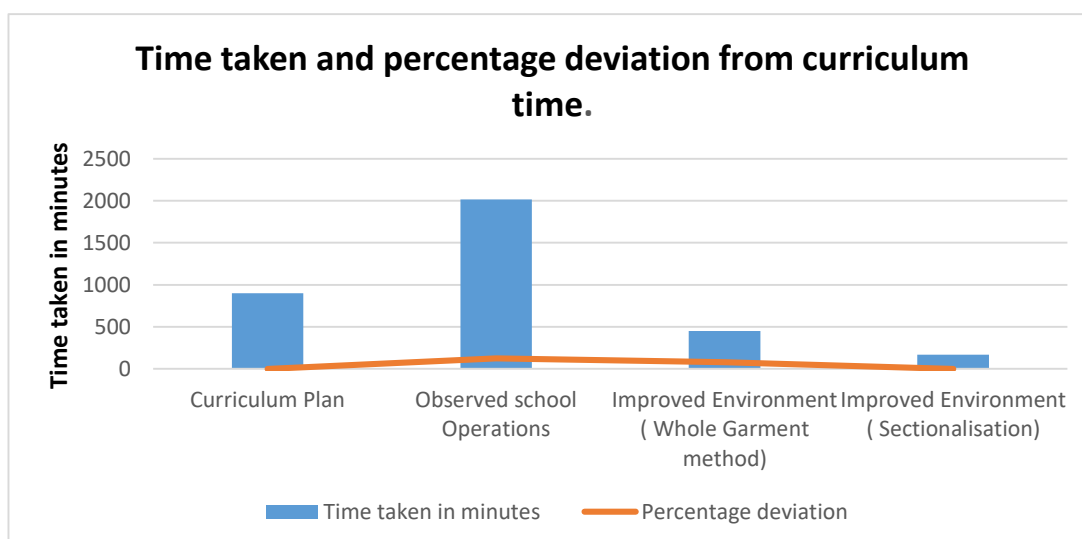


Figure 5: Percentage deviation of observed time taken in school operations from the curriculum plan and time taken to finish a skirt.

The average time taken to make a garment according to the syllabus assessment objectives was 900 minutes (TTD syllabus 2015-2022). The table above shows that the observed school operations average time to make a skirt was 2014 minutes which was a 123.8% increase from the curriculum plan time. The average time taken in an improved environment using the whole garment method to make a skirt was 449 minutes which showed a decrease of -50.1% from the curriculum plan and use of the sectionalisation method revealed that learners used 167 minutes to make skirt which is presented in the graph by a -74.1% decrease from the observed school operation time used to make a skirt. In the sectionalisation method the production time taken decreased after the first skirt. More skirts were produced and recorded at hourly intervals and the results revealed that learners are able to make an average of 23 skirts in 20 minutes. The

data therefore suggests that the improvements have had a positive impact on reducing operational times and increasing consistency across tasks. The data above therefore showed that the sectionalisation method has had a better positive impact than the whole garment method on reducing operational times and increasing consistency across operations.

A T-test was used to compute the difference in the time taken to execute operations in schools and in the improved environment using the whole garment and the sectionalization methods. The results showed a significant difference in the time taken. P value equals 0.0002, by conventional criteria, this difference is considered to be extremely statistically significant. The school operations minus improved environment (Whole garment method) equals 111.6208, which is 95% confidence interval of this difference: $t = 5.2696$ showing that there was a significant difference in the time taken to execute operation between school and improved environment using the P value equals 0.0002, by conventional criteria, this difference is considered to be extremely statistically significant. The school operations minus improved environment (Whole garment method) equals 111.6208 which is 95% confidence interval of this difference: $t = 5.2696$ which shows that there was a significant difference in the time taken to execute operation between school and improved environment using the whole garment method. The difference = 12, standard error of difference = 21.182.

4.5.4 Opportunities for Improving Time Taken in the TTD subject operations.

Production is an important part of the clothing industry and TTD subject cannot be analysed without performance measure. Work measurement is a work study approach that focuses on determining the required time to execute an operation and total work done. The calculations will help in identifying the opportunities for improving the time taken in the TTD subject operations. The number of garments was then calculated using all the possibilities of period variations as the number of periods may differ with schools. The time taken and the planned curriculum time will be used to evaluate the allocated time for the TTD subject and the evaluation of opportunities for improvement.

Calculation of time taken to make a skirt.

Maximum curriculum time for a skirt= **900 minutes**

Average time in observed school operations = Maximum time + minimum time divided by 2

$$= \frac{3099 \text{ minutes} + 929 \text{ minutes}}{2} = 2014 \text{ minutes}$$

Average time for the whole garment method= $\frac{268 \text{ minutes} + 530 \text{ minutes}}{2} = 449 \text{ minutes}$

Average time for the sectionalisation method= $\frac{162 \text{ minutes} + 172 \text{ minutes}}{2} = 167 \text{ minutes}$

=167 minutes for skirts 1

Time taken for 23 skirts using sectionalisation method= $462 \text{ minutes} + 472 \text{ minutes} / 2$

=467 minutes

Time for one skirt = $467 \text{ minutes} / 23$

=20 minutes

Calculations for number of skirts that could to be produced per term

Number of skirts = Total time allocated per term divided by the observed time.

Table 40: Comparison on the Number of Skirts can be produced per term according to curriculum plan, in an improved environment using the whole garment and sectionalisation methods

Number of periods	Time allocation per period	Total Time per term	curriculum Plan Time per garment(/minutes)	Number of garments
4	35	1680	900	1.8
4	40	1920	900	2.1
6	35	2520	900	2.8
6	40	2880	900	3.2
Number of periods	Time allocation per period	Total Time per term	Average observed time in school per garment	Number of garments
4	35	1680	2014	0.82
4	40	1920	2014	0.9
6	35	2520	2014	1.3
6	40	2880	2014	1.4
Number of periods	Time allocation per period	Total Time per term	Observed time using Whole Garment method	Number of garments
4	35	1680	449	3.74
4	40	1920	449	4.27
6	35	2520	449	5.61
6	40	2880	449	6.41
Number of periods	Time allocation per period	Total Time per term	Observed time using Sectionalisation method	Number of garments
4	35	1680	167	10
4	40	1920	167	11
6	35	2520	167	15
6	40	2880	167	17

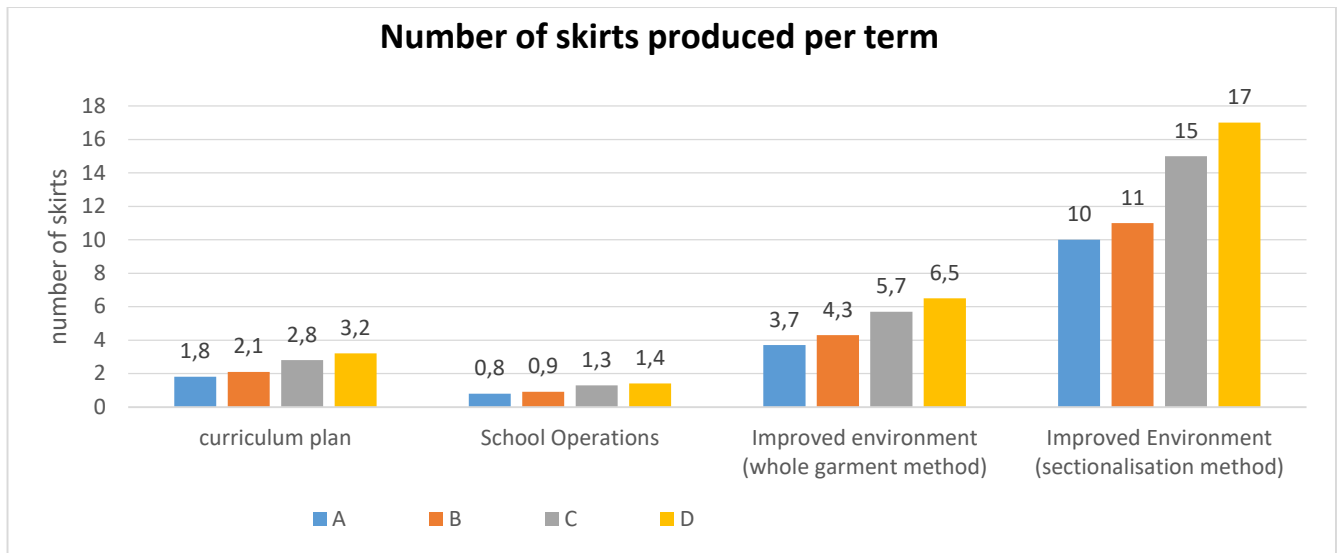


Figure 6: Number of skirts per term

The graph above shows the number of skirts calculated according to curriculum summative assessment objectives. 900 minutes or less should be used to make a skirt and according to the time allocated it comes out that the learner can make between 1 to below 3 skirts per term. Observed time using the whole garment method in an improved environment showed that learners could make between 3 to below 7 skirts and the observed time taken in an improved environment using the sectionalisation method showed that learners could make between 10 and 17 garments per term.

4.6. Discussion of Findings

4.6.1 TTD subject operations through work study for secondary schools in Zimbabwe

The TTD subject syllabus emphasizes empowering the learner to function in the prevailing economy which is production oriented to prepare them for the world of work. The findings revealed that school operations exhibit loopholes that did not match industry requirements and the expected curriculum exit profile. The TTD subject operations were compared to the apparel industry Standard Operating Procedure (SOP) which gives a written step by step guidelines for operating (SOP Manual for Apparel -1128, 2020). The expected standard operations include design development, pattern making, marker planning, fabric spreading, cutting, marking and notching, fusing, sewing (*equipment, processes and methods*) and finishing (*inspection and quality control, pressing and packaging*).

Observations revealed that most operations were done with no sequence or process chart to follow as is done in industry. The operations were clustered and there was no order of operation among schools, each

student and teacher had their own way. In some schools, learners of different levels had practical lessons in the same room and they shared equipment. It came out that most schools used commercial patterns and directly laid on fabric without developing their own patterns. Similarly, Chirapa and Mberengwa, (2021) had similar findings were teachers revealed that they taught using commercial patterns because they lacked pattern making skills. The use of ready-made patterns was standard practice with the old syllabus, where patterns were provided to schools. It therefore follows that teacher are stuck in the old way of doing things and lack some critical skills.

These are crucial processes in the TTD subject summative assessment and in the clothing industry. Design development and pattern making are critical in garment production and the skills help learners to be competent in grading, marker planning, and fabric utilization. It is important to note that the TTD subject operations should serve as an introductory or simplified version of the overall apparel industry production process (Ashan & Shamsa, 2024). It was also found that finishing processes were not done in most schools. Observations showed that learners rarely finished garment and therefore could not account for the finishing and packing processes and only a few who finished indicated familiarity with the processes. The failure of students to finish garments concurs with the findings of Shoko, Dapira, and Mpala, (2022), who noted that learners in schools took a long time to finish garments.

The focus of the TTD subject operations is likely to provide learners with a foundational understanding of garment construction techniques rather than covering the full spectrum of industrial production processes as some operations are not fully embedded in the learning process. The cost of machinery is beyond the reach of most schools, for that matter. Muzira and Bondai, (2020) and UNESCO (2020) are of the opinion that sustainable relationships between training institutions and schools should be nurtured. Mupfumbati, Chuma and Chimbindi (2021), found out that students can use simple affordable instructional applications or software like CorelDraw to expose student to CAD pattern making and shift from the use of tradition demonstration lectures to more constructivist learning practices in practically based topics found in the TTD subject. The adoption of TOC and work study could allow interval checking of the operational processes so that omission may be realised and attended to in time (Panizzolo,2015).

4.6.2 Methods used in the TTD subject operations

The findings revealed that methods used in the TTD subject operations were dominated by traditional methods more than technological methods, the results showed that execution was 24.8% industrialisation compared with 75.2% domestic or traditional. The findings indicate that a significant proportion of

learners and teachers have never used the CAD (Computer-Aided Design) software for designing and pattern making. The results showed a high reliance on manual traditional designing and pattern design methods. These findings align with those of Chirapa and Mberengwa (2021), who found that none of the teachers used CAD since most schools could not afford the software. The limited integration of technology in pattern making can hinder students' ability to adapt to industry practices, as CAD software offers numerous advantages (Ashan & Shamsal, 2024). The use of advanced designing and pattern making technology enables precise and efficient pattern creation, digital manipulation of designs, and the ability to store and modify patterns electronically. This speeds up the pattern making process, improves accuracy, and facilitates collaboration between and among the learners in schools. Whilst there is limited use of CAD software in TTD subject in Zimbabwe, studies conducted in developed countries showed that the use of CAD software in pattern making has become increasingly common, with fashion schools and industry professionals emphasizing its importance in preparing students for modern industry practices (Milinic Bogdanovic & Bogojevic, 2021). Another study conducted by Brink, Kilbrink and Gericke (2023), among Swedish lower secondary schools discovered that CAD software can be used in education even from the lower classes starting with simple shapes design to 3D designs. This means the slow and limited technology adoption among modest secondary schools in Zimbabwe pose a great challenge for student in TTD in their quest to acquire relevant skills required in the millennium. By embracing new technologies and adapting to the changing landscape of the designing and pattern making software, students can gain a competitive edge and prepare themselves for a rapidly evolving industry to satisfy the needs of modern consumers.

The research findings revealed that manual marker making of single fabric layering was the most used while computerised marker making is never used in schools. Marker planning is replaced by the term laying out (which entails fabric spreading) as used in the summative assessment of ZIMSEC papers. There was not much time and effort given to this laying out operation as pattern pieces and a lot of fabric waste was observed. Some learners made mistakes and had to redo the operation again and again. Basically the trial and error method was prevalent in schools. Each learner made a layout that suits them, while in industry once a marker is done more layers of fabric are cut. The manual traditional method that was commonly used in schools cannot be kept for future use as it is not economical and efficient. It is only used once and the efficiency is lower than computerised marker making causing a large amount of fabric waste (ElShishtawy, Sinha, & Bennell, 2022). The results for marking methods show that manual traditional techniques like use of thread markings, tracing wheel and pins were used for transferring markings. In contrast, notchers were the least used method of transferring marking in most schools. This indicates a potential gap in knowledge and accessibility to tools that can enhance precision and efficiency in transferring markings.

The findings on the cutting methods reveal that there was a preference for traditional methods of cutting. The majority of respondents used the cutting shears, trimming scissors and hand scissors, which are hand held cutting tools. Conversely, the usage of hand-operated cutting machines, which can enhance accuracy and speed in cutting fabric was reported to be low. Furthermore, less than half of the respondents have experience with automatic cutting machines, which offer advanced features and automation in the cutting process. The findings suggest a need for greater exposure to modern cutting technologies to improve efficiency and productivity in TTD subjects. De León, de la Torre-Cantero, Meier and Marrero, (2019), explain the preference of traditional cutting tools education, because they are simple to operate and do not require complex installation and are easy to transport. The study recommended that school should use low-cost cutting plotter which cuts at a higher speed than the hand cutters and is much safer to use in school environments. The cutting plotter is digital and more precise and faster.

Although use of technological equipment has a great advantage on speed and accuracy, they usually present problems during electricity power cuts mostly experienced in developing countries like Zimbabwe. The manually operated equipment tends to be ideal in areas that are totally remote with no electricity. While trimming scissors were widely used by respondents, the low usage of hand-operated cutting machines and limited experience with automatic cutting machines indicated a lack of integration of technology in the cutting process (Chirapa and Mberengwa, 2021). Technology plays a significant role in enhancing accuracy, speed, and overall efficiency in the cutting process. Hand-operated cutting machines and automatic cutting machines offer advanced features such as programmable cutting paths, improved precision, and reduced cutting time (Jayasekara, Lai, Wong, & Zhu, 2022).

The survey findings indicate that there is low usage of automatic fusing methods to interface or interline garments in schools. The processes that need interfacing and interlining were done manually using irons which is time-consuming and monotonous work if bulk garments could be produced. It is essential to consider the context in which the survey was conducted and the characteristics of the survey participants, as these factors can influence the usage patterns and familiarity with certain equipment. The relatively small percentage of respondents who indicated that they used the automatic fusing machine could have seen the fusing machine during excursions to industry. Their responses could provide valuable insights into the benefits, challenges, and applications of the automatic fusing machine. The automatic fusing machines do not get tired like humans do, meaning they can operate all day without burning out. Investing in the automatic fusing machines may be expensive for the schools but in the long term, it brings benefits like reduced manpower, increased number of items fused at a time and reduces the time taken for

completing garments, thus they are cost effective (Shen, Li, Zhou, Jiang, & Bao, 2023).

The findings regarding the methods used for sewing revealed that the preference was for the whole garment system. The more modernized production systems such as sectionalisation were not common among schools. This finding corroborates those of Amankwa et al. (2015) and Cassidy (2018) who found out that methods used in the sewing operation in schools were far from the systems used in the clothing fashion industry. Although, the whole garment system is simple and enables the learner to co-ordinate operation by operation till she produces the complete garment, it may not be the most efficient or productive approaches if a number of garments are to be produced. A similar pattern was noted by many researchers including Sithole (2018), Mupfumira (2019), Gudyanga (2019), Chirapa and Mberengwa (2021). They observe that learners did not acquire adequate and essential sewing skills that are compatible with the clothing industry in Zimbabwe. This means that schools have to apply the sectionalisation method to enable learners to perform different operation with different techniques. Embracing other methods like sectionalisation production methods could result in an increase in production process among TTD learners.

The sectionalisation method may limit the learners' exposure to various construction methods and techniques on different garments, a study by Sawitri (2019), in Indonesia found that the achievement of the students in Fashion subject through the factory learning method was 83.41%. Thus through the implementation of the factory learning method, students gained practical and business skills needed for employment in the industries. This informs us that there is need for support for TTD subject from curriculum development unit and other stakeholders if such strategy is to be adopted and implemented in Zimbabwe, this is important because TTD as an academic discipline focuses on the comprehensive study of textile materials, manufacturing processes, and design principles within the Zimbabwean context. It encompasses various aspects of the textile industry, including the exploration of fabric properties, the understanding of manufacturing techniques, and the application of design principles to create innovative textile products (Ministry of Primary and Secondary Education, 2015). However, an assessment of the operations in TTD subject reveals that the field is grappling with the use of outdated tools and methods. This observation points to a gap between the existing practices in TTD education and the advancements in technology and industry standards. Efforts are needed to update the tools, equipment, and methodologies employed in TTD subjects to ensure that students receive a contemporary education aligned with the demands of the textile industry.

When it comes to finishing methods which includes checking/quality control, pressing and packaging, the results revealed that most industrial methods were not used for the finishing section. Garments are

checked for quality of sewing and manipulation by teachers and all defects are returned for correction. The findings indicate a prevalent use of steam irons and charcoal irons for pressing, which are traditional pressing tools. On the other hand, the adoption of more advanced equipment, such as industrial steamers were minimal. The findings are consistent with that of Chirapa and Mberengwa (2021), who found that A-Level TTD learners did not acquire adequate critical concepts in most operations and had no exposure to industrial equipment. The limited use of these advanced pressing methods suggests an opportunity for improvement in achieving higher quality finishing in textile products. It came from the findings that bales, plastic packets and boxes were used as storage materials. This finding could reflect the fact that not much bulk production was done in the TTD subject during learning and therefore no reason for packaging. It was revealed that packaging was done when the schools were submitting for summative assessment at the end of the year.

The findings for supervision in the TTD subject revealed that there is no clear method used in schools. Neither online method of supervision nor right to left hand chart/ flow charts were commonly used in the TTD subject for supervising operations. It came out that the teachers feared their supervisors because they did not know what they were supposed to do. Ngwenya, (2017), in a study on Supervising the Performance of Teachers in Bulawayo Metropolitan Province had similar finding that showed that teachers feared supervision. This shows that the supervision is not done frequently and properly. Ngwenya (2017), opposes the fearsome relationship of supervisors and teachers by explaining that supervision should enable both the teachers and learners to identify weaknesses and strengths for operations improvement. Online supervision was not common among schools while Ngwenya advocates online supervision as it is needed in the 21st century to be involved in the daily operations thus may need fast feedback through online platforms.

The use of both face to face supervision together with online-supervision which uses email, video, and other online resources to report occurrences in the teaching field is supported by Amora, Benabente, Luisen, Villacampa, and Yee, (2023). The online supervision technology comes with expenses while it has benefits like decreased travel time and expenses, and flexible scheduling; in the long run, it becomes cost effective. There is also need for technology training prior to implementation especially on the side of the teacher supervisor.

4.6.3 Time taken to complete operations in the TTD subject before the time study experiment

The findings for the time taken to execute operations in garment construction section in the TTD subject in schools in their natural setting showed that the average domain for making a skirt was 2014 minutes.

Although teachers and students complained of not having enough time to execute the operations on time, it was noted that some learners appeared half-asleep during observations; others were waiting for equipment while others were hanging around holding their work aimlessly and with no hurry in their operations. This showed that TTD operations were relaxed, and characterized by fumbling movements. These findings were also revealed in a study by Sithole, (2018) in Ndabazinduna on the perceptions of teachers on the revised curriculum, who attested that learners were not able to finish most of the targets for sewing. The results were consistent with the findings of Shoko, Dapira, and Mpala, (2022) in a study among secondary schools in Zimbabwe who found that some learners took more than a year to complete a garment, while others managed to finish it in 4 months and only 12% finished within a term. Quarcoo and Akomaning (2022) found out that a few learners could produce a complete and correct garment after completing high school. These findings mean there is need to calculate the subset data on time taken against time specifications in the planned curriculum to find if there was need for time improvement. According to the summative assessment, a garment is supposed to be completed in 900 minutes. Learners therefore used more time, there was an increase of 123.8% in the time taken to make a skirt and it therefore is a cause for concern. As the demands of the world change, time study surfaces as a requisite tool for evaluating operations and finding possibilities that could be employed in the TTD subject. Implementing time study in garment construction delivering lead to high-quality learner output.

4.6.4 Challenges faced in TTD subject operation in secondary schools?

The findings reveal that the TTD subject faces various challenges. Based on the results, the challenges faced by the TTD subject were lack of technological tools recommended in the syllabus such as CAD software, Automatic cutting, fusing machines, industrial irons. The results confirm the findings by Makuvire, Mufanechiya, and Dube, (2023), Chirapa and Mberengwa, (2021) and Mupfumira, (2020) who found out that the TTD subject in Zimbabwe faces many challenges including equipment and resources, teacher competency and inadequate infrastructure. When comparing the findings of the TTD subject operations in secondary schools in Zimbabwe with research conducted in developed countries, challenges regarding the availability of tools and equipment were identified also, however, their challenges have moved from the need of basic industrial tools to the need of advanced technological equipment and resources (Amal, 2022). TTD subjects in Zimbabwe have challenges that emanate from the scarcity of basic tools and equipment as well as the advanced technological equipment required for execution of various TTD operations. This limitation significantly hampers the delivery of comprehensive TTD education and restricts students' practical learning experiences. Students' ability to gain hands-on experience and develop practical skills in TTD operations is hindered. Without access to

the necessary tools and equipment, learners may not fully understand the techniques and processes involved in textile technology and design and this may limit their readiness for the industry and their ability to apply theoretical knowledge in practical settings. The quality of TTD education in Zimbabwe may be compromised. The lack of tools and equipment can limit the scope and depth of instruction, preventing students from fully exploring and experiencing the various aspects of TTD operations.

The survey revealed that teachers were highly skilled in the use of manual equipment and methods but lacked confidence in using technological tools and methods. Teachers demonstrated high competence in constructing samples of garments made from use of commercial patterns to showcase to learners. Teachers perceive themselves as less competent or even incompetent in the utilisation of CAD/CAM software for designing and grading patterns. The findings echo similar findings by Chirapa and Mberengwa, (2021), who observe that teachers were not proficient with new technological skills that are needed in the updated syllabus. The lack of technological confidence among teachers was also confirmed by Mupfumira and Nyaruwata, (2021), who found that the teachers were not sure of how to use the basic technologies in their teaching. Another study in Malawi by Chirwa, Banda and Mwakapenda (2022) explained that the incompetence of teachers was caused by ineffective training for curriculum implementers. This highlights the need for targeted training and professional development opportunities for teachers to enhance their skills so that they keep up with the evolving technology and industry practices. The rapid advancements in technology and industry practices might have outpaced the training and professional development opportunities available to teachers. Limited exposure and access to up-to-date resources and training programmes may hinder teachers' ability to acquire and develop the necessary skills in these areas. The gaps in teacher competencies may hinder the overall quality of TTD education. Teachers who lack proficiency in these areas may struggle to effectively teach and guide students, thereby limiting their learning outcomes and preparedness for future careers in the industry.

According to K12 Academic Report, (2004-2024), China faced a dilemma in the mid-decade of the 21st Century, where academics and policy-makers began to question the policy that pours funds into vocational schools that did not bring the intended outcome on the students. Learning from the Chinese observation, Zimbabwe teachers need to be trained so that they are able to produce learners who will take the clothing industry higher.

Financial constraints also pose a significant challenge in the TTD subject operations. The survey findings indicate that most activities are not highly funded in TTD subjects as they relied on the schools' budget for funding. Some teachers complained of not getting enough funds to execute the practical lessons on

time and ended up hurrying only for examination projects. There was a lack of financial support from other organizations such as churches and NGOs. This limited funding negatively impacts the availability and timely procurement of materials essential for TTD practical exercises. The findings affirm similar findings from Marishane and Mutigwa, (2023), who found that secondary schools lack funding in Zimbabwe given the huge number of learners who need financial assistance owing to the country's poor economic performance. Studies such as Kaala (2022) also highlighted the adverse effects of financial constraints on the availability of materials and resources in textile technology and design education. Mupfumira and Nyaruwata (2021) concluded that effective teaching and learning of Textiles depended on provision of funds for resources and equipment. The lack of awareness or prioritization of TTD education by external organizations and stakeholders resulted in limited financial contributions and support.

Shoko, Dapira, and Mpala (2022), also found that schools did not have adequate infrastructure and teaching facilities leading to less motivation. The TTD syllabus listed the ideal workshop which needs to be a purpose designed workshop (Ministry of Primary and Secondary Education, 2015-2022). Quality improvements in the TTD learning area facilitate learning and quality control. Laboratories should be easily made available for the teaching and learning (Ogbonnaya, Chukwuone, & Ezeaku, 2022). The TTD subject operations and the learning environment should be organised as the industrial manufacturing sequences. All stages of production should be done such as laying, marking, cutting, stitching, checking, finishing, pressing and packaging (Textile School, 2019). Therefore, good practical learning environment with good layout will save time and increase efficiency in operations. TTD subjects should be provided with learning environments that suit the activities and operations done.

4.6.5 How operations in TTD subjects can be improved for secondary schools.

The findings of the study reveal a significant difference between the time taken to execute operations in schools when they were observed in their natural settings and the expected time standard according to the TTD curriculum specifications as well as the time taken in an improved environment using the whole garment method and the use of the sectionalisation method. The findings showed that the number of garments in the observed time in schools ranged from less than 1 skirt to below 2 skirts per term. Observed time using the whole garment method in an improved environment showed that learners could make between three and seven skirts. This finding shows that more garments were made in an improved environment as opposed to the findings by Shoko, Dapira, and Mpala, (2020), who found that some 12% of learners were able to make a garment in 4 months while others used 6-18 months to complete a garment. Under the improved environment learners performed exceptionally better than in school

situations. The observed time taken in an improved environment using the sectionalisation method showed that learners could make between 10 and 17 garments per term. Though the sectionalisation method shows more production than the whole garment method, it is not practical in the learning situation. Varum, (2021), clearly states the disadvantages of the sectionalisation method which includes close supervision, high planning and balancing which could be difficult due to fluctuating enrolment and machine balancing in schools. The whole garment system with improved environment could be the best for the TTD subject.

The data therefore suggest that the improvements have had a positive impact on reducing operational times and increasing consistency across tasks. The findings indicate that the sectionalisation method has had a better positive impact than the whole garment method on reducing operational times and increasing consistency across operations. Observations during the sectionalisation and whole garment experiments showed that learners were business-like and time conscious in their approach.

This substantial difference in time suggests that the observed operations were characterized by slowness, inefficiency, and a lack of enthusiasm among learners. It can be inferred that these findings align with the findings by Chirapa and Mberengwa, (2021) who also identified inefficiencies and lack of enthusiasm in practical operations within the textile and design field. However, the finding of this study further attributes the problem of slower and less productive operations in TTD subject operation to inadequate equipment, lack of teacher competence, limited funding, and a sub-optimal learning environment as noted by Shoko, Dapira, and Mpala (2022). It can be inferred that insufficient and outdated equipment can impede the efficiency of operations, leading to time-consuming processes and delays in completing tasks. When teachers lack competence in utilizing modern tools and techniques, it can further hinder the smooth execution of operations and results in less effective teaching and learning experiences.

Moreover, the limited availability of funds restricted schools' ability to invest in the required equipment, materials, and technology that would streamline operations and enhance productivity. An unfavourable learning environment lacking motivation and inspiration can contribute to a lack of enthusiasm among learners, resulting in reduced productivity and engagement in practical. These consistent findings across research studies highlight the urgent need to address these issues and improve the efficiency of TTD subject operations. Efforts should be directed towards providing schools with adequate resources and modern equipment, ensuring teachers receive training and professional development opportunities to enhance their competencies, and securing sufficient funding to support the procurement of materials and technology. Creating a stimulating and conducive learning environment that encourages enthusiasm and

creativity among learners is also crucial. By addressing these factors, it is possible to optimize the efficiency and productivity of TTD subject operations, leading to enhanced teaching and learning experiences and better outcomes for both students and teachers in the textile and design field as a whole.

Findings indicate that there is a considerable variation in the time taken to perform each individual operation within the TTD subject. The wide range of time for each operation suggests that there may be inconsistencies and inefficiencies in the execution of these tasks. Such variations can be attributed to several factors, including the skill level of the learners, the complexity of the designs, the availability and condition of the equipment, and the level of teacher guidance and supervision. The production approaches utilized also contribute to the variance in execution of tasks in the TTD subject area. Shoko, Dapira, and Mpala (2022), elaborated that the TTD subject policy has afforded learners ample time to work on and complete their coursework garments, they recommended more garments to be made in school. However, when considering the standard time for operations (assuming improved resources, teacher competency, funding, and working environment), the calculation reveals that there was a potential to produce more skirts in the TTD subject. This significant increase highlights the impact of enhancing various factors on operational performance. The improvement in the number of skirts indicates the importance of addressing key areas for development such as providing adequate resources, enhancing teacher competency through training and professional development, increasing funding to acquire necessary materials, and creating a conducive working environment. These findings align with previous research such as Islam (2022) that emphasizes the need for comprehensive improvements in the field of textile and design education to enhance productivity, efficiency, and the ability to meet industry standards. However, this study extends to the need for optimising tenets of time study revealing the need to engage a time study based production approach in TTD subject operations.

To improve the time taken for each operation, several measures can be considered. Firstly, providing comprehensive training and guidance to students in each operation could enhance their skills and efficiency. This can include teaching them time-saving techniques, proper handling of tools and equipment, and effective workflow management. Ensuring the availability of modern and well-maintained equipment can contribute to faster and more precise execution of tasks (Textile School, 2019). Upgrading to advanced cutting machines, sewing machines, and other relevant tools could significantly reduce the time required for cutting, sewing, and attaching various components of the garment. Utilisation of latest production improvement approaches such as use of the TOT theory and work study that emphasises on a constant identification of limiting factors and improving where there were bottlenecks, could also lead to improved TTD operational trends.

Furthermore, optimizing the layout and organization of the workspace could streamline the workflow and minimize time wastage. Proper arrangement of materials, tools, and workstations could facilitate smooth transitions between operations and eliminate unnecessary movements. Regular assessments and feedback from teachers could also help identify areas where students were struggling or where improvements could be made. By addressing these challenges and providing targeted support, students could become more proficient and efficient in performing the operations. Akomaning, (2020), concluded that efficiency in learners' operations is affected by poor workplace organization characterized by narrow space, improper placement of equipment and materials. A combination of improved training, upgraded equipment, optimized workflow, and ongoing monitoring can contribute to reducing the time taken for each individual operation in the TTD subject. This, in turn, could enhance productivity, improve the learning experience, and better prepare students for the textile and design industry.

4.6.6 Chapter summary

The chapter summarised the presentation, analysis and the discussion of findings of the research. Operations were executed with no standard sequence, design development and other finishing processes were not done in some school in the TTD subject. The methods used in the TTD subject were dominated by traditional methods than technological methods. The findings revealed that the average time taken to complete a skirt was 2014 minutes which was an increase of 123.8% from the curriculum expected time for learners to complete a garment. This is a major cause for concern. The challenges faced by the TTD subject were lack of basic technological tools recommended in the syllabus. The working environment was unsatisfactory, supervision in the TTD subject was predominantly face to face than online supervision. The time taken in an improved environment using the whole garment method was 449 minutes which was a decrease of 50.1% from the curriculum plan and 77.7% decrease from the observed school operation. In the improved environment using the sectionalisation method an average of 167 minutes was used for the first skirt which was a decrease of 91.7% from the observed time taken in schools and 74.1% decrease from the curriculum plan time. In the sectionalisation method continued production of 5 hours revealed that learners would make an average of 23 skirts in 20 minutes. It was established that the number of garments produced in schools ranged from less than 1 skirt to below 2 skirts per term, between 3 to 7 skirts for whole garment method in an improved environment and between 10 and 17 garments per term for sectionalisation in an improved environment. Sectionalisation falls as a method to be proposed for the TTD subject, and the whole garment method under improved environment becomes the most suitable for learners.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the researcher presents a comprehensive summary of the study. It reflects on the key insights and observations gathered throughout the research process and draws conclusions based on the data analysis. Practical recommendations aimed at addressing the identified challenges and improving the overall effectiveness and efficiency of TTD subject operations are provided. This chapter serves as a culmination of the study, offering valuable insights into the state of TTD subject operations, highlighting the challenges faced by educators and students, and proposing actionable recommendations for future improvements. By synthesizing the information collected and analysed, the study has contributed to the existing knowledge in the field of textile education and provided a road-map for enhancing the delivery of TTD subjects in secondary schools.

5.2 Summary of the study

Chapter one examined the background of the study highlighting the need for operational improvement in the Textile Technology and Design (TTD) education sector in Zimbabwe. The clothing industry is undergoing rapid changes, and leaders are calling for improvements in teaching and learning of the TTD subject. The TTD curriculum covers various aspects of textile technology and design, but its performance is unsatisfactory. The work study technique is proposed as a solution for improving TTD subject operations. The statement of the problem, objectives, the guiding research questions, significance of the study and the scope of the study were discussed in this chapter.

Chapter two shows previous research and examines the operational performance of secondary schools from various perspectives, however, the evaluation of operational performance using work study has been rarely addressed in the existing literature. In Zimbabwe, the use of work study in the TTD subject learning area has not been explored. Introducing work study techniques in TTD can improve operations by identifying overlooked weaknesses, and standardizing teaching methods, materials, and equipment. Moktadir et al. (2017) emphasized the significance of operations improvement in industry, stating that productivity enhancement through work study is crucial. However, there is limited literature available on the application of work study specifically in the TTD learning area in Zimbabwe.

Chapter three on research methodology provided a detailed description of how the research was conducted. It discusses the research paradigm, approach, design, population, sample, and data collection and analysis techniques. The research adopted a post-positivism paradigm and used a mixed methods design approach combining quantitative and qualitative methods. The study focused on the TTD subject in secondary schools in Zimbabwe. Data were collected through questionnaire, interviews and observation. The collected data were analysed using descriptive statistics using mean and standard deviation, coding techniques. T- test analysis was used to get the difference in the time taken to make a garment in schools and in an improved environment using whole garment and sectionalisation method. The research instruments were validated, and reliability was established at a coefficient of Alpha Cronbach reliability of 0.871 and deemed the questionnaire reliable. The sequential design was done where the data were collected over the period of time in two consecutive phases. The research sample consisted of 26 schools, 26 teachers and 52 learners. The research findings were used to identify current operations, challenges, and intervention strategies for improving operations in the TTD learning area.

Chapter four presents, analyses and discusses the findings of the study on TTD subject operations in secondary schools in Zimbabwe and reveal several important points. The work study approach was used to analyse operations in schools and standard operations were compared to those of the industrial standard operations. The findings showed that operations were not fully representing what is done in industrial production. This result does not align with the aim of the TTD syllabus which stipulates that A-level learners should be production oriented (Curriculum Development and Technical Services, 2015). The findings highlight that the methods commonly used in the TTD operation were traditional and there were specific areas where advancements were lacking, such as pattern making, cutting methods, transferring marking operations, production systems, pressing methods and operational time supervision methods. The reliance on manual techniques and traditional tools limited efficiency, accuracy, productivity and creativity in textile production. The preponderant use of traditional methods and the limited use of advanced equipment indicate a need for updating and incorporating modern technologies in TTD education. The finding on time taken in observed school operations showed that learners took 2014 minutes to make one garment which was more than the 900minutes allocated in the curriculum. The findings revealed that the major challenges in TTD subject operations included lack of technological resources and equipment, unfinished and untimed garments construction operations and inadequate teacher competency in terms of technology methods and use of technological tools. Experimental time study results in an improved environment using the whole garment method showed that learners took 449 minutes to make a skirt which was a decrease from the observed school operation, and sectionalisation method had an average of 167 minutes was a further decrease from the whole garment and curriculum

plan time. Garments produced in schools ranged from less than 1 skirt to below 2 skirts per term, between 3 to below 7 skirts for whole garment method in an improved environment and between 10 and 17 garments per term for sectionalisation in an improved environment. Despite the greater production in the sectionalisation method it does not work in the learning situation. The whole garment method under improved environment becomes the most suitable for the TTD subject in secondary schools in Zimbabwe. To improve TTD subject operations, the study suggests standard operation in the TTD subject, updating methods and equipment to align with technological advancements in industry.

5.3 Conclusions

Based on the findings of the study. It was concluded that:

- The operations in the Textile Technology and Design (TTD) subjects in Zimbabwe's secondary schools primarily did not fully represent the operational expectations of industry and the curriculum plan. There was no standard of the operation process followed by schools.
- The TTD operations were executed dominantly through domestic methods more than industrial methods. This indicated that some schools have not successfully implemented the production vision of the TTD subject as the revised curriculum of 2015-2022 stipulated that A-level learners should use industrial equipment so that they get operational experience which is required in the world of work and business.
- Most schools used out-dated tools and production methods in TTD education which suggests a gap between the existing practices and the technological advancements today as there was limited usage of computer-aided design (CAD) software for pattern making, cutting machines, notchers for transferring markings, fusing machines for fabric bonding.
- The observed time for Textile Technology and Design (TTD) subject in school operations for secondary schools reveals significant inefficiencies and shortcomings as the operations were characterized by slow progress, clumsiness, and lack of enthusiasm among learners. This conclusion has implication for the Curriculum Development and Technical services in Zimbabwe on the impact that extensive improvements in the learning environment and provision of modern equipment could have on productivity in garment design and construction component in TTD subject so as to expose learners to a variety of functional tasks which might in-turn enhance their acquisition of skills that are critical for entrepreneurship and employment in the fashion and textiles industry.
- The challenges faced in Textile Technology and Design (TTD) subject operations in secondary schools in Zimbabwe primarily revolved around the limited availability of technological tools and equipment necessary for TTD operations. This includes a scarcity of resources in various categories, such as technological marking tools, cutting tools, construction equipment and pressing equipment. The absence of these tools hampered students' practical learning experiences and restricted their ability to complete tasks on time. In terms of teacher competencies in TTD, teachers demonstrated high competence in manual methods and they perceived themselves as less competent in areas of technology integration. Targeted training and professional development opportunities are necessary to bridge these competency gaps and ensure that teachers keep pace with evolving technology and industry practices in the field of TTD.
- The time taken to execute operations could be reduced by improving the standards in the working environment. Garment production in schools has a potential of improving from below 2 skirts per

term to between 3 and 7 skirts using the whole garment method and to between 10 and 17 garments per term using sectionalisation method in an improved environment. Sectionalisation method was deemed not suitable in the learning environment because of the enrolment in the A Level TTD subject which is not constant among schools and the low number with others having a maximum of two students in a class. The whole garment method under improved environment was recommended as suitable for the TTD subject in secondary schools in Zimbabwe justify.

5.4 Recommendations

5.4.1 Recommendations based on the findings of the study.

Based on the findings and conclusions from the study, the following recommendations were made:

- As the industry advances in technology the TTD subject needs to upgrade methods and equipment to technological levels so that learners have a high value exit profile. Collaboration between schools within a region or district to share their available tools and equipment. By pooling resources together, schools could optimize their utilization and ensure that all students have access to the required tools, even if each individual school does not possess a complete set. This collaborative approach promotes efficiency.
- To bridge the gap between technology advancements and teacher knowledge, the Curriculum Development unit could develop a yearly teacher development program in line with clothing industry and technology advancements. Garment construction operations are not done properly according to the standard operation in industry. External and internal supervisors in the TTD subject could use a standard process check to assess operations done in the TTD subject.
- Learners were able to complete a garment in an average of 449 minute using the whole garment method under improved environment. It is therefore recommended that the time for completing a garment range between 499 and 900 minutes.
- Online supervision methods could be used in conjunction with manual recording and reporting of work done by learners in schools. An online report and feedback system could be implemented at different levels of supervision in the TTD subject.
- The study recommends that the whole garment method under improved environment can be used to improve the number of garment produced by learners from 3 to a maximum of 7 garments per term.
- The TTD subject planning panel could harness the benefits of the time-study that include improved productivity, accurate planning, and continuous improvement.
- There is need for development campaign programs by the Ministry of Education to improve

conditions in the TTD subject learning environment.

- Work Study personnel could be employed among stakeholders of the TTD subject who will work with curriculum development subject representative, subject managers, subject inspectors to modify and implement continuous time study improvement in the TTD subject using the framework proposed in the next section.

5.4.2 Recommendations based on the findings of the study.

- As this study was conducted with only one stream of learners, it may serve as a basis for other preceding or cycle of studies that can be done to find standardized time for each operation in the garment design and construction in TTD subject in secondary schools in Zimbabwe.

5.5 Proposed Operational framework

Work study approach and the theory of constraints (TOC) were used as the base of the TTD subject operational framework that could be used to revitalise the subject operations so that the exit profile of the learners is viable in the dynamic clothing industry. A continuous model was developed with an objective to improve the operations by analysing the methods used, challenges and getting standard time for executing operations.

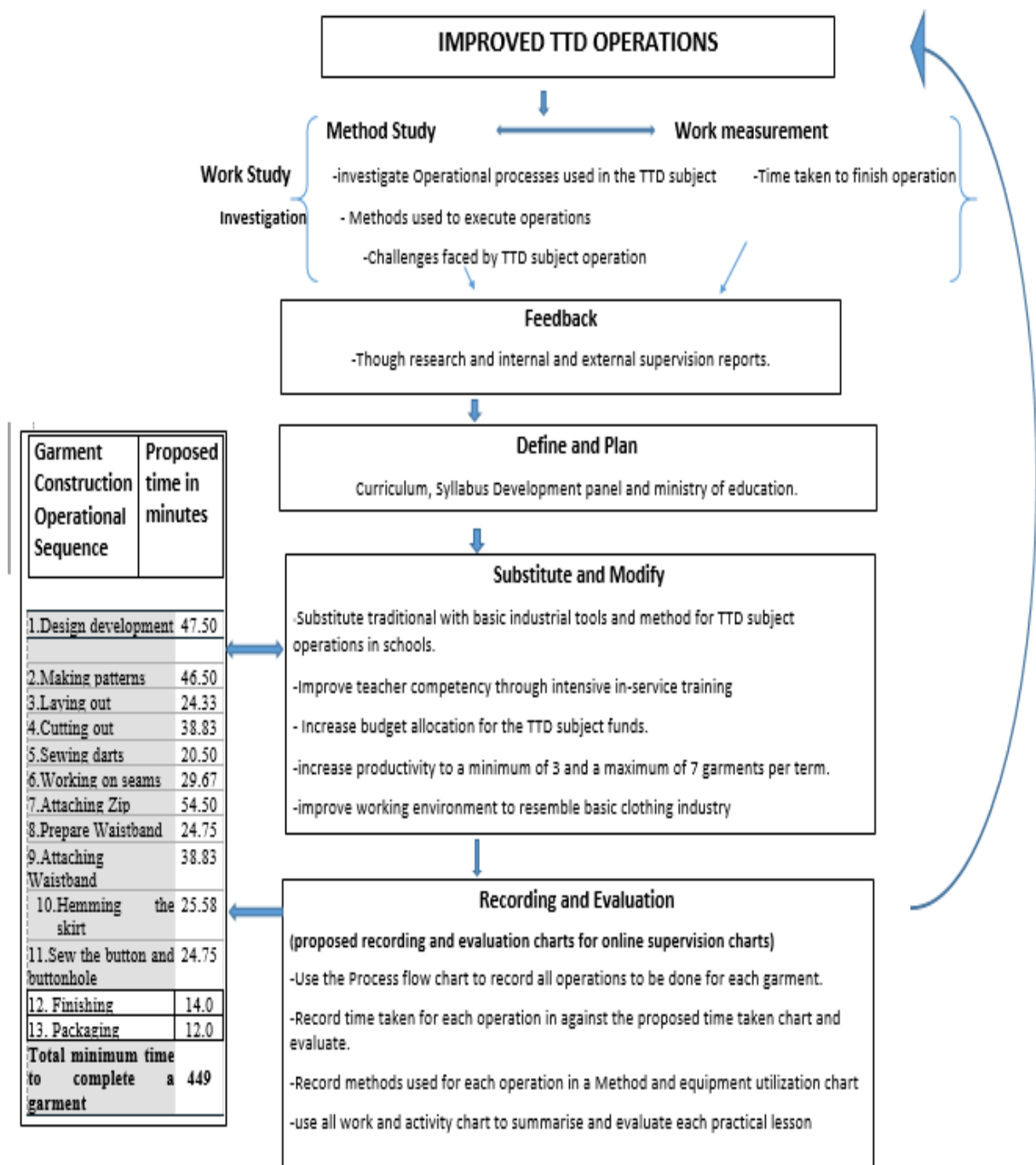


Figure 7:TTD subject Operational Framework

Work Study: To establishing the gaps between the school operations and standard clothing industry operations. This can be done through method study and work measurement.

Method Study: This involves analysing the operational impediments in the TTD subject, considering the curriculum objectives and policies involved in the education circle in Zimbabwe. Method study aims at improvement; to avoid resistance all stakeholders of the TTD subject should be involved including the learner.

Work measurement: This involves time studies to find standard time for finishing garments or tasks.

The Work study intervention:

1. Define – At this stage work to be done in schools is decided and standardized.

2. Identify draw – drawback analysis to narrow down the area of the challenges in the TTD subject operations.

3. Establish New Standards such as: -

- **Standard operational methods:** specifications of methods should state equipment and methods to be used. Alternate the production approaches for the learner to get the best experience while at school. Industrial attachment will give learners an opportunity to experience different production approaches.
- **Improved Resources and Equipment:** Upgrade and provide modern tools, machinery, and equipment for TTD subject practical exercises. This may include dress forms, full-length mirrors, tape measures, dress rails, storage spaces, and other necessary resources to enhance students' learning experiences and improve operational efficiency
- **Advanced time study methods:** specified time taken to make a garment and the number of garments per term.
- **Improved Teacher Competency:** planned teacher training schedule in collaboration with industry and offer targeted training and professional development programs for TTD subject teachers to enhance their knowledge, skills, and understanding of modern technology and industry practices. This will enable them to deliver high-quality instruction and guide students effectively in practical operations.
- **Improved Funding:** Secure adequate financial resources to overcome the financial constraints hindering the acquisition of necessary materials for TTD practical exercises. This will ensure that students have access to the required resources and enable them to engage in hands-on learning experiences and experimentation.
- **Improved Working Environment:** Create a conducive working environment for TTD subject operations. This may involve providing well-equipped TTD classrooms or workshops, adequate space, proper lighting, ventilation, and ergonomic workstations. A comfortable and organized environment with supervision can positively impact students' motivation, productivity, and overall operational performance.

4.Record: All work done should be recorded as evidence in schools and specific charts designed as a standard for supervision. The charts could include workflow charts, utilisation charts, time study charts and all activity charts. These can be embedded in the work plan structure. Online feedback can then be sent through the charts and used for examining the existing operations in schools.

5. Determine the Standard garment operational sequence and time: The standard time for each garment to be made in a year can be determined, recorded and published to secondary school for use.

REFERENCES

- Ahmed, M. A.-E. (2018). Finishing procedures action on mechanical characteristics of pressed ceramics. 1-7.
- Akomaning, E. L. (2020). Facilities and Materials for Teaching Sewing in Junior High Schools in Selected Schools in Ghana. *Archives of Business Review–Vol*, 8(9).
- Alase, A. (2017). The interpretative phenomenological analysis (IPA): A guide to a good qualitative research approach. *International journal of education and literacy studies*, 5(2), , 9-19.
- Alcantara, J., & Garcia-Vigonte, F. (2022). Total Quality Management System in the Industry: The Case of Lean Six Sigma.. *Available at SSRN 4021650*.
- Ali, Y., Younus, A., Khan, A. U., & Pervez, H. (2020). Impact of Lean, Six Sigma and environmental sustainability on the performance of SMEs. *International Journal of Productivity and Performance Management*, 70(8),, 2294-2318.
- Amaechina, U. O., Obioha, J. O., & Obioha, K. C. (2020). Alternative Sources of Funding Secondary Education in Enugu Education Zone. *African Journal of Educational Management, Teaching and Entrepreneurship Studies*, 1(1), 89-98.
- Amal.A. (2022). Time Study Procedure. <https://www.scribd.com/document/293236202/Time-Study-Procedure>.
- Amankwa, J. G., & Agra, F. E. (2015). ving the skill component of clothing and textiles among students in second cycle institutions in Ghana and its effect on the polytechnic fashion student: : A case study of OLA Girls, Mawuko Girls and Mawuli Senior High School in Ho, Ghana. *Journal of Education and Practice*, 6(27),, 20-28.
- Amora, A. J., Benabente, C. R., Luisen, J. M., Villacampa, E. J., & Yee, N. E. (2023). Challenges of Administrative Supervision on the Full Implementation of Face-To-Face Classes. *Journal of Namibian Studies: History Politics Culture*, 34, , 928-957.
- Amos, E., Essel, H., Fobiri, G., & Ibrahim, M. (2023). Analysis on Students' Performance to Promote Gender Equality in Creative Fashion Design. . *Journal of Education and Innovation Pendidikan* (2),, 260-271.

- Appleford, K. (2020). Classifying fashion, fashioning class: making sense of women's practices, perceptions and tastes. . *Routledge*.
- Ashan, H., & Shamsal, A. (2024). A comparative Study of 3d Vurtual Pattern and Traditional Pattern Making. *Journal of Textile science and Technology* (10)(1).
- Babu, R. (2023). Importance of Operation Breakdown in Garment industry. *Apparel industrial Engineering.V* .
- Bahja, M., Kuhail, M. A., & Hammad, R. (2021). Embracing technological change in higher education. *Digitalization, and Globalization in the Age of Covid*.
- Beloor, V., Shekar, J. S., & Hegde, P. P. (2020). Reduction of Process Time in Sewing Section of Garment Industry. . *IUP Journal of Operations Management*, 19(2), , 51-67.
- Bousdekis, A., Lepenioti, K., Apostolou, D., & Mentzas, G. (2021). A review of data-driven decision-making methods for industry 4.0 maintenance applications. . *Electronics*, 10(7),, 828.
- Brink, H., Kilbrink, N., & Gericke, N. (. (2023). Teach to use CAD or through using CAD: An interview study with technology teachers. *International Journal of Technology and Design Education*, 33(3),,, 957-979.
- Brink, H., Kilbrink, N., & Gericke, N. (2023). Teach to use CAD or through using CAD: An interview study with technology teachers. *International Journal of Technology and Design Education*, 33(3),, 957-979.
- Brown, P., & Keep, E. (2018). Rethinking the race between education & technology. *Issues in Science and technology*, 35(1), ., 31-39.
- Busetto, L., Wick, W., & Gumbinger, C. (2020). How to use and assess qualitative research methods. . *Neurological Research and practice*, 2(1), 14.
- Castro, C. A. (2022). Application of Work-Study in Andrei Garments Company. Available at SSRN 4030401.
- Chan, L. L., & Idris, N. (2017). Validity and reliability of the instrument using exploratory factor analysis and Cronbach's alpha. *International Journal of Academic Research in Business and Social Sciences*, 7(10), , 400-410.
- Chaudhari, C. V., Dohale, V., Khanzode, V., & Iqbal, R. (2023). Manifesting Competitiveness Through Theory of Constraints: A Case of Global Carpet Manufacturer. . *International Journal of Global Business and Competitiveness*, , 1-11.
- Chaudhary, S., Kumar, P., & Johri, P. (2020). Maximizing performance of apparel manufacturing industry through CAD adoption. . *International Journal of Engineering Business Management*, 12,, 1847979020975528.
- Chimbindi, F. &. (2022). Content adaptation procedures to cater for students with diverse academic

- backgrounds in delivering Textile, Clothing and Design programmes in Zimbabwe. A case study of two universities of technology. *International Journal of Scientific Research and management(IJSRM)*, 2321-3418.
- Chirapa, A., & Mberengwa, L. R. (2021). A- Level Textile Technology and Design Curriculum Compatibility with Industry Requirements in Harare, Zimbabwe. *East Africa Journal of Education and Social Science*.10.46606/eajess2021v02i02.0096., 243-251.
- Chireshe, R., & Shumba, A. ((2011)). Teaching as a Profession in Zimbabwe: Are Teachers Facing a Motivation Crisis? . *Journal of Social Sciences*, 28(2), , 113–118. <https://doi.org/10.1080/09718923.2011.11892935>.
- Chirwa, G. W., Banda, E., & Mwakapenda, .. (2022). Challenges Facing the Implementation of the New Secondary School Curriculum in Malawi. *A Case Study of Lilongwe District. Afrika Focus*, 35(2), 343-374.
- Chisosa, D. F., & Chipambwa, W. (2018). An exploration of how work study techniques can optimize production in Zimbabwe’s clothing industry. . *Journal of Textile and Apparel, Technology and Management*, 10(3).
- Chituc, C. ((2021).). A Framework for Education 4.0 in Digital Education Ecosystems. In: Camarinha-Matos, L.M., Boucher, X., Afsarmanesh, H. (eds) Smart and Sustainable Collaborative Networks 4.0. . *PRO-VE 2021. IFIP Advances in Information and Communication Technology*, vol 629. Springer,Cham .
- Christiansen. (2023.). Why Time Study Analysis is the Key and how to conduct one. *Limbe CMMS*.
- Chuma. (2022, 05 29). Retrieved from Curriculum Review and Education 5.0 in Higher Education in Zimbabwe: A Review of Textiles and Clothing-related Programs. : URI: <https://ir.cut.ac.zw:8080/xmlui/handle/123456789/328>
- Cooper, M. M. (1997). Distinguishing critical and post-positivist research. . *College Composition and Communication*, 48(4),, 556-561.
- Coulter, J. (2023). E-Textiles as a medium to challenge students’ gender perceptions around STEM and Design subjects in the secondary education curriculum and their aspirations for future career choices. . *Journal of Textile Design Research and Practice*, 1-.
- Coulter, J. (2023). Using E-Textiles to Challenge Gender Perceptions in STEM, Design and Career Aspirations of Secondary School Students. *Journal of Textile Design Research and Practice*, 11(1-2), , 168-193.
- Curriculum Development Unit. (2015-2022). Textile Technology and Design Syllabus. Harare.CDTS. Form 5-6.
- Datta. DB., & Seal., .. (2018). Various approaches in pattern making for garment sector. *J Textile Eng*

- Fashion Technol.* 2018;4(1), 29-34. DOI: 10.15406/jteft.2018.04.00118.
- Dawadi, S., Shrestha, S., & Giri, R. A. (2021). Mixed-methods research: A discussion on its types, challenges, and criticisms. . *Journal of Practical Studies in Education*, 2(2), , 25-36.
- DB., D., & P., S. (2018). Various approaches in pattern making for garment sector. . *J Textile Eng Fashion Technology*, 29-3. DOI: 10.15406/jteft.2018.04.00118.
- de León, A. B., de la Torre-Cantero, J., Meier, C., & Marrero, E. G. (2019). The Classroom as a Makerspace: Use of Tablets and Cutting Plotter to Create Pop-Up Cards in Educational Environments. . *International Journal of Emerging Technologie*.
- De Silva, P. I., & Seneviratne, S. C. (2022). Lean Manufacturing and Operational Performance: An Empirical Study on an Apparel Manufacturing Company. . *Journal of Accounting Research, Organization and Economics*, 5(1), 1-15.
- Di Cataldo, S., Vinco, S., Urgese, G., Calignano, F., Ficarra, E., Macii, A., & Macii, E. (2021). Optimizing quality inspection and control in powder bed metal additive manufacturing: Challenges and research directions. . *Proceedings of the IEEE*, 109(4), 32.
- Díez, F., Villa, A., López, A. L., & Iraurgi, I. (2020). Impact of quality management systems in the performance of educational centers: educational policies and management processes.). *Heliyon*, 6(4).
- Education, M. o. ((2015-2022).). Textile Technology and Design Syllabus (Form 5-6). *Textile Technology and Design Syllabus (Form 5-6)*.
- Education. (2023). *Heliyon article*. doi: 10.1016/j.heliyon.e16342BOOK.
- ElShishtawy, N., Sinha, P., & Bennell, J. A. (2022). A comparative review of zero-waste fashion design thinking and operational research on cutting and packing optimisation. *International Journal of Fashion design, technology and education*, 15(2), , 187-199.
- Ewnetu, M., & Gzate, Y. (2023). Assembly operation productivity improvement for garment production industry through the integration of lean and work-study, a case study on Bahir Dar textile share company in garment, Bahir Dar, Ethiopia. . *Heliyon*, 9(7).
- Franklin.A.F. (2021). Sample Size calculator. <https://www.calculator.net/sample-size-calculator.html>.
- Freichel, S. L., Wollenburg, J., & Wörtge, J. K. (2020). The role of packaging in omni-channel fashion retail supply chains—How can packaging contribute to logistics efficiency?. *Logistics Research*, 13(1).
- Fromhold-Eisebith, M., Marschall, P., Peters, R., & Thomes, P. (2021). Torn between digitized future and context dependent past—How implementing ‘Industry 4.0’production technologies could transform the German textile industry. .
- Gallo, T., Cagnetti, C., Silvestri, C., & Ruggieri, A. (2021). Industry 4.0 tools in lean production: . A

- systematic literature review. *Procedia Computer Science*, 180,, 394-403.
- Genta, G., Galetto, M., & Franceschini, F. (2020). Inspection procedures in manufacturing processes: recent studies and research perspectives. *International Journal of Production Research*, 58(15), , 4767-4788.
- Geršak, J. (. (2022). Design of Clothing Manufacturing Processes: A Systematic Approach to Developing, Planning, and Control. . *Woodhead Publishing*.
- Gill, S. L. (2020). Qualitative sampling methods. . *Journal of Human Lactation*, 36(4), , 579-581.
- Gómez-Bombarelli, R. W.-L., Sánchez-Lengeling, B., & Sheberla, D. &.-G. (2018). Automatic chemical design using a data-driven continuous representation of molecules. *ACS central science*, 4(2),, 2.
- Graham, L. J., White, S. L., Cologon, K., & Pianta, R. C. (2020). Do teachers' years of experience make a difference in the quality of teaching? . *Teaching and teacher education*, 96, 103190.
- Grundmeier, A. M., & Höfer, D. (. (2023). Sustainable Fashion Curriculum at Textile Universities in Europe—Development, Implementation and Evaluation of a Teaching Module for Educators.
- Gudyanga, A., Gora, J., & Moyo, L. (2019). Factors affecting the participation of rural male students in two vocational subjects in Zimbabwe. *Cogent Education*, 6(1),, 1633126.
- Gulhane.S. (2017). Improving the Skills Component of Clothing and Textile with Time study. *International journal on textile Engineering and Process*, , 16-35.
- Gupta, M., Digalwar, A., Gupta, A., & Goyal, A. (2024). Integrating Theory of Constraints, Lean and Six Sigma: a framework development and its application. *Production Planning & Control*, 35(3),, 238-261.
- Halili, S. H. (2019). Technological advancements in education 4.0. . *The Online Journal of Distance Education and e-Learning*, 7(1), , 63-69.
- Hardcopf, R., Liu, G. J., & Shah, R. (2021). Lean production and operational performance: The influence of organizational culture. . *International Journal of Production Economics*, 235, ,, 108060.
- Hashan.W. (2017). Impact Analysis of Sewing Faults. . *International Journal of Clothing Science*, , 1-11.
- Hoque, I., & Maalouf, M. M. (2022). Quality intervention, supplier performance and buyer–supplier relationships: evidence from the garment industry. *Benchmarking: An International Journal*, 29(8),, 2337-2358.
- Hora, S., Gruescu, C. M., Bungau, C., & Bodea, R. (2022). Optimization of Marker Design in Garment Industry on the Criterion of Utility Coefficient. . In *IFTToMM International Symposium on Science of Mechanisms and Machines (SYROM)* , (pp. 417-424). .
- Islam, M. (2022). Productivity of Garment Industry: Various Ways to Improve it. Bangalore,India: . *Textile Learner* .

- Islam, I. (2021). Techniques and Application of Work Measurement in Apparel Industry. *Journal of Textile Engineering*.
- Jafar, D. S., Hamid, M. Z., Suhairom, N., Hisham, M. H., & Zaid, Y. H. (2020). TVET teacher professional competency framework in industry 4.0 era. *Universal Journal of Educational Research*, 8(5), 1969-1979.
- Jain, N. (2021). Survey versus interviews: Comparing data collection tools for exploratory research. *The Qualitative Report*, 26(2), 541-554.
- Jankoska, M., & Stojanovska, R. S. (2023). Comparison of a Computer-Aided Design and Manual Pattern-Making. In *International Conference on Textile Conference & Conference on Engineering and Entrepreneurship*, (pp. 461-467).
- Jayasekara, D., Lai, N. Y., Wong, K. H., & Zhu, Y. (2022). Level of automation (LOA) in aerospace composite manufacturing: Present status and future directions towards industry 4.0. *Journal of Manufacturing Systems*, 62, 44-61.
- K12 Academic report. (2004-2024). *Education Worldwide*. <https://www.k12academics.com/>.
- Kaala, H. (2022). "Management of entrepreneurship education in selected secondary schools of Nakonde district, Muchinga province." *PhD diss., The University of Zambia*.
- Kassah, J. K. (2019). Influence of textile teachers' pedagogical content knowledge on senior high school graduates participation in the modernization of indigenous Ghanaian textile industry [Kenyatta University].
- Kember, D., & Leung, D. Y. (2008). Establishing the validity and reliability of course evaluation questionnaires. *Assessment & Evaluation in Higher Education*, 33(4), 341-353.
- Khan, M. H., Siddiquee, M. A., Moula, A. G., & Islam, M. A. (2020). Effect of standard operating procedure on the Whisker and Hand Brush process of denim garments. *World Scientific News*, (144), 338-357.
- Khan, N. (2014). Impediments Implementation in Textile Industry. *Proceedings of Economics Development and Research*, 83-86.
- Khatri, K. K. (2020). Research paradigm: A philosophy of educational research. *International Journal of English Literature and Social Sciences*, 5(5), 1435-1440.
- Krishan, R. S. (2018). Creation of 'Standard Operating Procedure Manual' for TJX Playwear. *Triburg India Pvt. Ltd. NIFT*.
- Kulsum, U. (2020). Grading women's clothing patterns with the CAD pattern system to improve student learning outcomes and competencies. *Journal of Education Technology*, 4(2), 187-194.
- Lave, J. (2021). *In Situated cognition* (, pp. 17-35). Routledge.
- Lemon, L. L., & Hayes, J. (2020). Enhancing trustworthiness of qualitative findings: Using Leximancer

- for qualitative data analysis triangulation. *The Qualitative Report*, 25(3), 604-614.
- Lin, X. &. (2024). Embracing the Transformative Shift of 3D Technology: Collaborative Pathways Between Sustainable Digital Innovation and Fashion Design Education. In *INTED2024 Proceedings*, (pp. 943-950). IATED.
- Linnet, M., Chipso, C., & Felisia, C. (2021). Online instructional material for computer aided garment pattern making training in colleges: A case study of Zimbabwe. *International Journal of Costume and Fashion*, 21(1), 54-66.
- Liyanage, I. K. (2014). Education system of Sri Lanka: strengths and weaknesses. . *Educ Syst Sri Lanka*, ., 116-40.
- Lutonsky, R. R. (2009). Pre-service and in-service training, gender, and years of teaching experience: Influences on teachers' basic technology competencies. *The University of Alabama*.
- Maciejewski, M. L. (2020). Quasi-experimental design. . *Biostatistics & Epidemiology*, 4(1), ., 38-47.
- MAHAMUD, A. (2021). INDUSTRIAL TRAINING . (*Doctoral dissertation, SU*).
- Maisiri, W., Darwish, H., & Van Dyk, L. (2019). An investigation of industry 4.0 skills requirements. *South African Journal of Industrial Engineering*, 30(3), 90-105.
- Mäkelä, M. (. (2021). *Soft Skills in Construction Management Education*.
- Makuvire, C., Mufanechiya, A., & Dube, B. (2023). Unpacking Continuous Assessment: Teacher Knowledge and Attitudes in Zimbabwe Rural Secondary Schools. *Research in Educational Policy and Management*, 5(2), ., 207-225.
- Manwa, L. (2018). Inclusion of Home Economics Industrial Subjects in the Curriculum of Masvingo High Schools, Zimbabwe. . *Journal of Studies in Social Sciences*, 17(2).
- Mapako, F. P., & Mareva, F. (. (2013). The concept of free primary school education in Zimbabwe: Myth or reality. . *basic education*, 1(1), 135-145.
- Marishane, R. N., & Mutigwa, A. (2023). Addressing Funding Inequalities in the Zimbabwean Secondary Education Sector: Moving Towards Sustainable Development. *Journal of Educational Studies*, 22(2), 56-74.
- Marshall, D. A., Zelinsky, S., & Bryan, S. (2023). Exploring the outcomes of research engagement using the observation method in an online setting. . *BMJ open*, 13(11), 073953.
- Maryanti, N., Rohana, R., & Kristiawan, M. (2020). The principal's strategy in preparing students ready to face the industrial revolution 4.0. . *International Journal of Educational Review*, 2(1), 54-69.
- Masniar., Marasabessy2., U. R., Astrides3., E., Asih Ahistasari4, Mohammad, Arief Nur Wahyudien5, & Rachmadhani, M. M. (2023). Analysis of Work Measurement Using the Stopwatch Time Study Method at PTEA. *Journal of Industrial System Engine*.
- Masniar., Umar Rusli Marasabessy, Astrides., E., Ahistasari., A., Mohammad., Wahyudien., A. N., . . .

- Rachmadhani. (2023). Analysis of Work Measurement Using the Stopwatch Time Study Method at PTEA. . *Journal of Industrial System Engine*.
- Matthews-Fairbanks, J. L. (2018). Pattern Design: Fundamentals: Construction and Pattern Drafting for Fashion Design. . *Fairbanks Publishing LLC*.
- Mauwa, C. T., & Felisia, C. (2021). Exploration of Production methods Beign used in Manufacturing Companies in Zimbabwe Towards a Competitive Strategy. *International Journal of Fashion and Design*, 1(2),, 10-32.
- Mawere, D. (2013). An Evaluation of the Nziramasanga Report of Inquiry into Education in Zimbabwe, 1999: The case of gender equity in Education. . *International Journal of Asian Social Science* 2013 Vol/3 No. 5, pp 1077 – 1088.
- Mazharul I.K. (2022). Production Systems Used in Apparel Industry. <https://textilelearner.net/author/textile-learner/>.
- Mbawankar. (2023). Time study Methods in Operations Mangement. <https://pmicorp.in/blog/time-study-methods-in-operations-management/>.
- McKinney, E., Cho, S. Z., Eike, R., & Sanders, E. (. (2020). Analysis of zero waste patternmaking approaches for application to apparel. Sustainability in the textile and apparel industries: Sustainable textiles, clothing design and repurposing,. 31-5.
- McQuillan, H. (2020). Digital 3D design as a tool for augmenting zero-waste fashion design practice. *International Journal of Fashion Design, Technology and Education*, 13(1), , 89-100.
- Meenakshi, S., & Balasankar, S. K. (2023). Analysis of Work-Flow Design Related to Aspects of Productivity and Ergonomics. . In *International Conference on Human-Computer Interaction* , (pp. 429-443). Cham: Springer Nature Switzerland.
- Mekala, N., Sanju, S. D., Thamaraiselvan, V., & Kavya, M. ((2021, February)). Implementation of Industrial Engineering concepts in Apparel Industry to improving Productivity and it's cost reduction. In *IOP Conference Series: Materials Science and EngineerinEngineering* (Vol. 1059, No. 1,. IOP Publishing., p. 012027).
- Merriam.Webster. (2024). Take time. In Merriam-Webster.com dictionary. <https://www.merriam-webster.com/dictionary/take%20time>.
- Meyer, M. W., & Norman, D. (2020). Changing Design Education for the 21st Century. She Ji:. *The Journal of Design, Economics, and Innovation*, 6 (1), , 13-49.
- Mhlanga, E., Mushoriwa, T., & Mavuso, P. M. (2021). Examining Gender Disparity of Male Undergraduates in Textile Technology and Design at University Level: The Case of Two Universities in Zimbabwe. *e-BANGI Journal*, 18(9).
- Milinic Bogdanovic, M., & Bogojevic, N. (2021). Advantages of using new technology in textile and

- fashion design. In *Experimental and Computational Investigations in Engineering: Proceedings of the International Conference of Experimental and Numerical: Proceedings of the International Conference of Experimental and Numerical Investigations and New Technologies*, (pp. (pp. 294-309).). CNNTech 2020 Springer International Publishing.
- Minhus, S. M., Wang, Z., & Hui, T. (2023, November 16). Sustainable Education Empower Large-Scale Revolution for Fashion Industry. *Submitted: 03 June 2023 Reviewed: , p.* DOI: 10.5772/intechopen.112170.
- Mitchella, K. M., McMillanb, D. E., Lobchukb, M. M., & Nickelb, N. C. (2021). Editing questionnaire items using the Delphi method: Integrating qualitative and quantitative methods. *INTERNATIONAL JOURNAL*, 13(2), ., 1-18.
- Moktadir, M. A., Ahmed, S. O., Zohra, F. T., & Sultana, R. A. (2017). Productivity improvement by work study technique: a case on leather products industry of Bangladesh. *International Journal of Engineering and Management*, 6(1),, 1000207.
- Moyo, B., & Özgüt, H. (2022). Tourism graduate students' employability skills: Results and implications of a Zimbabwean study. . *Journal of Psychology in Africa*, 32(3), , 268-274.
- Muhammad, S., Dawood, I. M., Arsalan, A., Abdul, S., Muhammad, R., & Atif, J. (2022). Reduction of non-conforming through statistical process control charts in textile industry. *Industria Textila*, 73(5), , 537-543.
- Mulang, H. (2021). The effect of competences, work motivation, learning environment on human resource performance. . *Golden Ratio of Human Resource Management*, 1(2), ., 84-93.
- Mulugeta, L. (2021). Productivity improvement through lean manufacturing tools in Ethiopian garment manufacturing company. . *Materials Today: Proceedings*, 37,, 1432-1436.
- Mupfumbati, L., Chuma, C., & Chimbindi, F. (2021). Online instructional material for computer aided garment pattern making training in colleges: A case study of Zimbabwe.
- Mupfumbati, L., Chuma, C., & Chimbindi, F. (2021). Online instructional material for computer aided garment pattern making training in colleges: A case study of Zimbabwe. <https://ir.cut.ac.zw:8080/xmlui/handle/123456789/330> .
- Mupfumira, I. M., & Nyaruwata. (2021). Challenges in the Teaching and Learning of Textiles in the Primary School Curriculum in Masvingo District Zimbabwe. *Asian Journal of Contemporary Education*, 5(1), ., 12-22.
- Mutekwe, E., & Mutekwe, C. (2012). Manifestations of the gender ideology in the Zimbabwean school curriculum. . *Journal of educational and instructional studies in the world*, 2(3),, 193-209.
- Muzira, D. R., & Bondai, B. M. ((2020).). Perception of educators towards the adoption of education 5.0: A case of a state university in Zimbabwe. *East African Journal of education and social sciences*,

1(2), 43-53.

- Nabi, F., Mahmud, R., & Islam, M. M. (2015). Improving sewing section efficiency through utilization of worker capacity by time study technique. *International Journal of Textile Science*, 4(1), 1-8.
- Nayak, S., & Pani, P. (2021). Teacher Competence and 21st Century Challenges: A Critical Analysis of Existing Teacher Competency Frameworks. *Turkish Online Journal of Qualitative Inquiry*, 12(6).
- Neisyfitri, R. J., Ongkunaruk, P., & Ongcunaruk, W. (2023). Productivity Improvement Based on the Theory of Constraint and`Eliminate, Combine, Rearrange, Simplify for Chilled Beef Production. *Management and Production Engineering Review*.
- Ngwenya, V. (2020). School-based supervision enhances the professional development of teachers . *South African Journal of Education*.10.15700/saje.v40n3a1744.
- Ngwenya, V., & Ngwenya.O, .. (2017). Supervising the Performance of Teachers in Bulawayo Metropolitan Province. *Journal of Research in Marketing Volume 8 No.1*.
- Nikolopoulou, K. 2. (2022). “What Is Snowball Sampling? | Definition & Examples.”. *Scribbr*. August 17, 2022. <https://www.scribbr.com/methodology/snowball-sampling/>.
- Nkwodimmah, E. C., & Okoh, P. A. (2019). Clothing and textile Education in Secondary Schools for Job Creation and Sustainable National development. *Journal of Teacher Perspective*.
- Nyathi, W., & Shonhiwa, C. (2020). An Evaluation of the Leadership Role Played by the Head of School in the Delivery of Quality Education in Zimbabwean Day Secondary Schools: A Case Study of Zvishavane in Zimbabwe. *International Journal of Humanities Social Sciences and Education (IJHSSE)*.
- Nyathi, W., & Shonhiwa, C. (2020). Resistance of Vocationalism as Education for Entrepreneurship in the Secondary School System in Zimbabwe.
- Nziramasanga, C. T. (2005). *Report on Technical and Vocational Education and Training*. Harare: Ministry of Higher and Tertiary Education.
- OA, O. A. (2022). Availability and Utilisation of E-Supervision of Instruction Facilities in the Post-COVID-19 Era.
- Ogbonnaya, E. K., Chukwuone, C. A., & Ezeaku, N. (. (2022). Utilization of Home Economics Laboratory in Teaching Senior Secondary School Students in Udenu Local Government Area Schools of Enugu State. . *Journal For Family & Society Research*, 1(2).
- Onyeche, E. D., & Angelina, E. (2022). Management of Clothing and Textiles Facilities in Secondary Schools in Yobe State for National Development. *International Journal of Home Economics, . Hospitality and Allied Research*, 1(2), , 376-383.
- Osman, D. J., & Warner, J. R. (2020). Measuring teacher motivation: The missing link between professional development and teacher competency. *Teaching and Teacher Education*, 92,,

103064.

- Panhwar, A. H., Ansari, S., & Shah, A. A. (2017). Post-positivism: An effective paradigm for social and educational research. *International Research Journal of Arts and Humanities*, 45(45), ., 253-259.
- Park, Y. S. (2020). The positivism paradigm of research. . *Academic medicine*, 95(5), , 690-694.
- Park, Y. S., Konge, L., & Artino Jr, A. R. (2020). The positivism paradigm of research. . *Academic medicine*, 95(5),, 690-694.
- Pease, B. (2020). From evidence-based practice to critical knowledge in post-positivist social work. In Critical social work . *Routledge.*, pp. 45-57).
- Periyasamy, A. P., & Periyasami, S. (2023). Rise of digital fashion and metaverse: influence on sustainability. .*Digital Economy and Sustainable Development*1(1),,16.
- Quarcoo, R., & Akomaning, E. L. (2022). Acquisition of Clothing Production Skills Among Clothing and Textile. *International Journal for Cross-Disciplinary Subjects in Education (IJCDSE)*, Volume 13, Issue 2,.
- Rajesh, M., & Naidu, N. V. (2022). Design and Development of a Trolley for the Finishing Department of Garment Industry to Enhance Feeding Helper Productivity. In Applications of Computational Methods in Manufacturing and Product Design:. *Select Proceedings of IPDIMS 2020 (pp. 317-328)*. Singapore: Springer Nature Singapore.
- Ramdass*, A. e., & Mokgohloa S., K. (2022). An exploration of effective supervisory engagement in the clothing industry through activity sampling technique. *SouthAfrica Journal of Engineering Afr. J. Ind. Eng. vol.33 n.4 Pretoria*.
- Rao.N. (2021). Work Measurement. India: . *Industrial Knowledge Center*.
- Reddy, G. C. (2020). dy on the Academic Management of Fashion Education in India . A Student(Doctoral dissertation, Maharaja Sayajirao University of Baroda (India)).
- Sithole, R. (2018). "Perceptions of teachers and learners on the new ordinary level textile technology and design curriculum in the Ntabazinduna cluster in Umguza district in Matabeleland north province, Zimbabwe." .
- Salmi, A., & Kaipia, R. (2022). Implementing circular business models in the textile and clothing industry. *Journal of Cleaner Production*, 378, , 134492.
- Samsul, A., Manuarul, H., Md Hasibur, R., Faysal, A., & Ranjan Kumar, D. (2022). Industrial Attachment At Pacific Jeans Limited . (Doctoral dissertation, Sonargaon University (SU)).
- Sari, R. P., Nuswantara, D. A., & Iriani, S. S. (2022). VOCATIONAL SCHOOL READINESS TO SUPPORT CREATIVE INDUSTRY DEVELOPMENT. *Journal of Innovation Research and Knowledge*, 1(12), , 1645-1652.
- Sawitri, S. (2019). Implementing Teaching Factory Learning to Increase Students' Achievement in

- Fashion Business Management. *Atlantis Press. In 1st Vocational Education International Conference* , pp. 300-305).
- servives, C. D. (2015-2022)). Textile Technology and Design Syllabus Form 5-6.
- Shahriar, F. (2019). Performing time study in workplace. . *10.13140/RG.2.2.25339.77604*.
- Shankar, S., Gowtham, N., & Surekha, T. P. (2020). Faculty competency framework: Towards a better learning profession. . *Procedia computer science*, 172, , 357-363.
- Shen, X., Li, X., Zhou, B., Jiang, Y., & Bao, J. (2023). Dynamic knowledge modeling and fusion method for custom apparel production process based on knowledge graph. . *Advanced Engineering Informatics*, 55, , 101880.
- Shoko, B., Dapira, N. P., & Mpala, S. (2022). The Impact of Change in Fashion and Fabrics Coursework Requirements at Ordinary Level: A Case Study of Lower Gweru Schools in Zimbabwe.). *Zimbabwe Journal of Science and Technology*, 6(1.
- Sibanda, L., & Young, J. (2020). Towards a postcolonial curriculum in Zimbabwe: A critical review of the literature. . *Africa Education Review*, 17(2), ., 50-72.
- Sigh.MP. (2016). Improvement in Process Industry by Work study Method. *Case Study*, , 426-436.
- Sindhvani, R., & Singh, R. K. (2020). Dutta, G., Kumar, R., Digital transformation priorities of India's discrete manufacturing SMEs—a conceptual study in perspective of Industry 4.0. . *An International Business Journal*, 30(3),, 289-3.
- Sithole, S. (2020). Potential effect of teacher quality on learner achievement: A case of secondary school technical subjects in Mwenezi District of Zimbabwe. *Journal of New Vision in Education Research (JoNVER)*. 1(2).
- Sizwe, M. M., & Charles, M. (2017). Quality control in the clothing production process of an under-resourced sewing co-operative: case study. *In Proceedings of the 2017 International Symposium on Industrial Engineering and Operations Management (IEO)*.
- Slemp, G. R., Field, J. G., & Cho, A. S. (2020). A meta-analysis of autonomous and controlled forms of teacher motivation. *Journal of Vocational Behavior*, 121, ., 103459.
- Sonye, C. U., & Adeniji, O. O. (2017). CLOTHING AND TEXTILES PROCESS SKILL ASSESSMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN EDUCATION DISTRICT IV, LAGOS STATE. *Nigeria Journal of Home Economics (Nig. JHEC)* Vol. 6, No. 1, .
- Sookdeo, B. (2021). Using method analysis to improve productivity: case of a tap manufacturer. *International Journal of Productivity and Performance Management*, 70(6), ., 1470-1486.
- Sookdeo, B. (2021). Using method analysis to improve productivity: case of a tap manufacturer. *International Journal of Productivity and Performance Management*, 70(6),, 1470-1486.

- Stephen, H. O., Chigora, T. B., Hove, B., & Ignatius, S. (2023). Professional Learning Communities (PLCs) for the Zimbabwean Design and Technology High School Contexts: Ensuring Quality Teaching through Effective Professional Development. I. *International Journal of Research and Innovation in Social Science*, 7(6), , 1462-1468.
- Stephen, H. O., Crispen, B., & Silas, S. (2022). An analysis of the Design Technology curriculum implementation at Public Universities in Zimbabwe. . *International Journal of Research and Innovation in Social Science*, 6(11), , 309-315.
- Stratton, S. J. (2021). Population research: convenience sampling strategies. . *Prehospital and disaster Medicine*, 36(4), , 373-374.
- Sudhakar, R., & Renjini, G. (2022). Evaluation and prediction of fused fabric composites properties—A review. . *Journal of Industrial Textiles*, 51(3), 3536S-3574S.
- Sukwadi.R. (2021). TOC, Lean, and Six Sigma:An Integrated Model to Increase the Productivity of the Journal of the Textile Industry. . *Journal of Mechanical Engineering Research and Developments*,, 327-336.
- Taherdoost, H. (2022). Designing a questionnaire for a research paper: a comprehensive guide to design and develop an effective questionnaire. *Asian Journal of Managerial Science*, 11,, 8-16.
- Tettey, A. N. (2020). Challenges in the teaching and learning of clothing and textiles in four selected senior high schools in Ashanti region, Ghana (Doctoral dissertation,. *(Doctoral dissertation, University of Education Winneba)*.
- Tilahun, S. (2020). Optimization of Production process in Sewing Work for Ethiopia Cultural Clothe Apparel Production. *International Journal of Engineering Research and Advanced Technology (IJERAT)*, 6(8), ., 51-62.
- Todeschini, B. V., Cortimiglia, M. N., & de Medeiros, J. F. (2020). Collaboration practices in the fashion industry: Environmentally sustainable innovations in the value chain. *Environmental Science & Policy*, 106, ., 1-11.
- Tsao, Y. C., Delicia, M., & Vu, T. L. (2022). Marker planning problem in the apparel industry: Hybrid PSO-based heuristics. . *Applied Soft Computing*, 123, 108928.
- Ugwu, E. I., Ezeaku, M. N., Attah, B. I., Emeghebo, U. M., & Eze, E. C. (2023). . Application of computer aided design (CAD) and flat techniques in teaching pattern drafting by clothing lecturers in universities in South East, Nigeria. *International Journal of Home Economics, Hospitality and Allied Research*, 2(1), , 29-43.
- UNESCO. (2010). Education Sector Development Program IV (ESDP IV). *Federal Minstry of Education Republic of Ethiopia, Addis Ababa*.
- ur Rehman, A., Ramzan, M. B., Shafiq, M., Rasheed, A., Naeem, M. S., & Savino, M. M. (2019).

- Productivity improvement through time study approach: a case study from an apparel manufacturing industry of Pakistan. *Procedia Manufacturing*, 39, ., (pp. 1447-1454). Pakistine.
- Varum.S. (2021). Types of production systems. *Journal of Industrial Engineering*.
- Vázquez-Cano, E., Sáez-López, J. M., Grimaldo-Santamaría, R. Ó., & del Pilar Quicios-García, M. (2023). Influence of Age, Gender and Years of Experience on Teachers in Promoting Strategies for Digital Sustainability and Data Protection. *Journal of New Approaches in Educational Research*, 12(2), , 307-322.
- Venkatraman, P., & Scott, K. (2018,). Investigation of bark cloth for its surface texture and durability for apparel applications. *In Proceedings of The 91st Textile Institute World Conference (TIWC 2108). The Textile Institute*.
- Vinitha, K., Prabhu, R. A., Bhaskar, R., & Hariharan, R. (2020). Review on industrial mathematics and materials at Industry 1.0 to Industry 4.0. *Materials Today: Proceedings*, 33, , 3956-3960.
- Wijewardhana, H., G. E., Weerabahu, S. K., Nanayakkara, J. L., & Samaranayake, P. (2021). International Journal of Productivity and Performance Management, 70(8), . *New product development process in apparel industry using Industry 4.0 technologies*. , 2352-.
- Yamada, S., & Otchia, C. S. (2021). Perception gaps on employable skills between technical and vocational education and training (TVET) teachers and students: the case of the garment sector in Ethiopia. . *Higher Education, Skills and Work-Based Learning*, 11.
- Yanni, X. U. (2020). Optimization of the cutting-related processes for consumer-centered garment manufacturing. (*Doctoral dissertation, Université de Lille, France*).
- Yoel, S. R., & Dori, Y. J. (2021). FIRST high-school students and FIRST graduates: STEM exposure and career choices. *IEEE Transactions on Education*, 65(2), 167-176. . *IEEE Transactions on Education*, 65(2), , 167-176.
- Zakaria, N. V. (2022). Sustainable apparel technical and vocational education and training (TVET): integrating technology for skills training. . *In Digital Manufacturing Technology for Sustainable Anthropometric Apparel* , pp. 3-21.
- Zhuwau, C., & Shumba, M. (2018). Factors limiting smooth implementation of new curriculum in rural secondary schools of Zimbabwe: Case study of Nyanga north area, Zimbabwe. . *The International Journal of Humanities & Social Studies*, 6(11),, 198-217.
- Zimsec Textile Technology and Design Database, 2. (n.d.).
- Zindi, F. (. (2018). Zimbabwe Teachers Concern Regarding the implementation of the New Curriculum. *Zimbabwe Journal of Education Resources*.

APPENDICES

Appendix A: Research Ethic Letters from Chinhoyi University of Technology

CHINHOYI UNIVERSITY OF TECHNOLOGY RESEARCH PERMISSION LETTER

Student Name SINDISIWE DUBO

Student number C19138196E

Programme Dphil Art and Design

Approved research title
Operations Improvement Through Work Study
for Textile Technology and Design for Secondary
Schools in Zimbabwe

TO WHOM IT MAY CONCERN

I hereby confirm that the above mentioned student is registered at Chinhoyi University of Technology for the programme indicated. The proposed study met all the requirements as stipulated in the university Policies and guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached outlined by the Research Ethics Committee of the University. Permission is hereby granted to carry out the research as described in the approved proposal. May you please assist the student in any way possible.

The main objective of the research is to
Find out the current operations in Textile Technology
and Design subjects and the challenges faced. It is
also to develop a workstudy method for Textile
Technology and Design in Secondary schools

Best Regards


Name
Chairperson of School's/Institute's Higher Degrees Committee
Tel: +263 773 792 034
E-mail: hchikombwe@cut.ac.zw

Date
30/ April /2021

CHINHOYI UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF CLOTHING AND TEXTILE TECHNOLOGY
CHAIRMAN OF THE EXECUTIVE CHAIRMAN
30-APR 2020
P. BAG 7724 CHINHOYI ZIMBABWE
TELEPHONE: 773 792 034
SIGNATURE 

Appendix B: Permission letter from the Ministry of Education and Culture in Zimbabwe.

All communications should be addressed to:
The Secretary for Primary and Secondary Education
Telephone: 794895/794211
Telegraphic address: "EDUCATION"
Fax: 794565



Reference: C/426/3
Ministry of Primary and Secondary Education
P.O. Box CY 121
Causeway
HARARE

7 June 2021

Sindisiwe Dube
Plot Number 11 218
Block 10
Francistown
Botswana

Re: PERMISSION TO CARRY OUT RESEARCH IN SELECTED SECONDARY IN THE PROVINCES

Reference is made to your application to carry a research in the secondary schools on the research title:

"OPERATIONAL IMPROVEMENT THROUGH WORK STUDY FOR TEXTILES AND DESIGN SUBJECT FOR SECONDARY SCHOOLS IN ZIMBABWE"

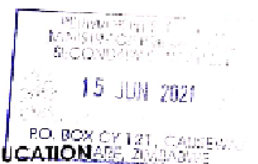
Permission is hereby granted. However, you are required to liaise with the Provincial Education Directors, who are responsible for the schools attached on separate sheet which you want to involve in your research. You should ensure that your research work does not disrupt the normal operations of the school. Where students are involved, parental consent is required.

You are also required to provide a copy of your final report to the Secretary for Primary and Secondary Education.

Handwritten signature of T. Thabela (Mrs) in blue ink.

T. Thabela (Mrs)

SECRETARY FOR PRIMARY AND SECONDARY EDUCATION



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Appendix C: Permission Letters from provincial education offices in Zimbabwe

All communications should be addressed to "The Provincial Education Director Mashonaland Central Province" Telephone: 0271- 6948/6996/7134/6994 Fax: 0271-6997	 Ministry of Primary and Secondary Education Mashonaland Central Province P.O Box 340 Bindura Zimbabwe
16 August 2021	

Sindisiwe Dube
Plot Number 11 218
Block 10
Francistown
Botswana

RE: PERMISSION TO CARRY OUT RESEARCH IN MASHONALAND CENTRAL PROVINCE IN SELECTED SECONDARY SCHOOLS

Reference is hereby made to the Secretary for Primary and Secondary Education's minute dated 09 June 2021 granting you permission to carry out a research at Rujeko Secondary School in Mazowe District and Mt Darwin High School in Mt Darwin District in Mashonaland Central Province on the research title:

"OPERATIONAL IMPROVEMENT THROUGH WORK STUDY FOR TEXTILES AND DESIGN SUBJECT FOR SECONDARY SCHOOLS IN ZIMBABWE"

I am pleased to inform you that the Provincial Education Director Mashonaland Central Province has granted you permission to carry out your research in the selected secondary schools in Mashonaland Central Province. You should, however, liaise with the respective D.S.I.s before you start.

Finally, you are advised to submit a copy of your findings to the Ministry of Primary and Secondary Education.


Kubeta.B
A/Deputy Director Human Resources
FOR PROVINCIAL EDUCATION DIRECTOR
Mashonaland Central Province
/cc
Permission to carry out research doc



i)Mashonaland Central Province

*All communications should be
addressed to
"The Provincial Education Director"
Telephone: 067-23083/4/5
Fax: 067-23320
Email:edumashwest@gmail.com*



Ref: P/Sindisiwe Dube
E C No. 0177946T

Ministry of Primary and Secondary
Education
Mashonaland West Province
P.O Box 328
CHINHOYI

30 July 2021

Ms Sindisiwe Dube
Plot No: 11218
Block 10
Francistown
Botswana

Dear Madam

**APPLICATION TO CARRY OUT RESEARCH: TEXTILES AND DESIGN SUBJECT:
SANYATI GOVERNMENT HIGH AND RIMUKA HIGH SANYATI DISTRICT:
MASHONALAND WEST PROVINCE.**

Reference is made to your letter 28/ 06/2021

In line with the Secretary's minute of 0/06/2021, authority is hereby granted for you to carry out your research at the above mentioned schools.

By copy of this letter the concerned District School's Inspector (DSI) is requested to give you all the assistance you may need.

Please ensure that your research does not disrupt the normal operations of the schools and seek parental consent where learners are involved.

You are also required to send us a copy of your final report.

We wish you the best in your research.


.....
G Mhuma
Provincial Education Director
Mashonaland West Province
Cc/ The D.S.I : SANYATI DISTRICT



Mash-West Province



Masvingo province

Plot Number 11218
Block 10
Francistown
Botswana

RE: PERMISSION TO CARRY OUT RESEARCH IN MASVINGO PROVINCE: CHIVI AND MASVINGO DISTRICT: CHIBI HIGH AND

Reference is made to your application to carry out a research at the above mentioned school in Masvingo and Chivi District on the research title:

"OPERATIONIMPROVEMENT THRIOUGH WORK STUDY FOR TEXTILES AND DESIGN SUBJECT FOR SECONDARY SCHOOLS IN ZIMBABWE"

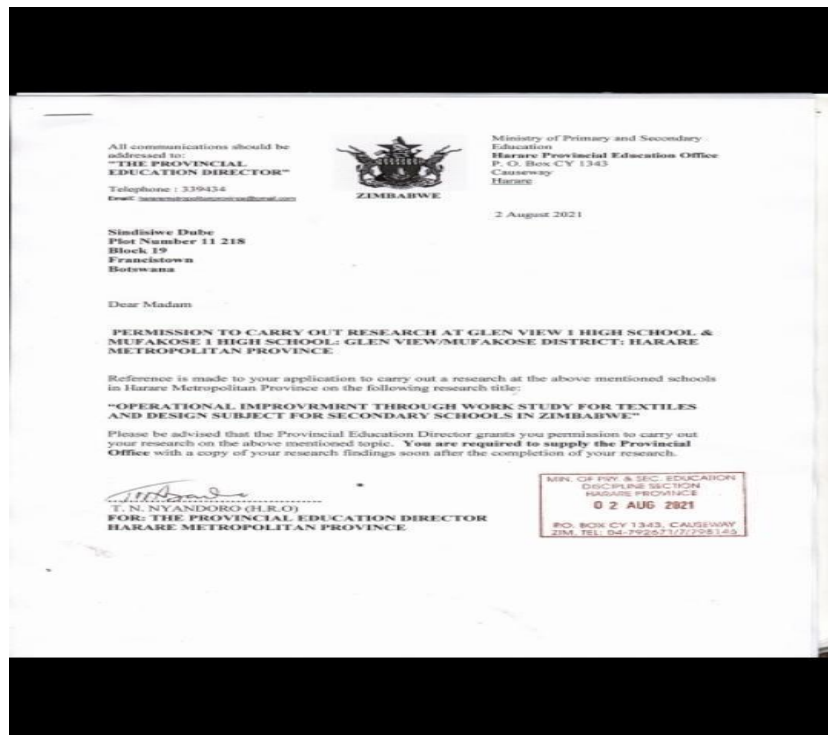
Please be advised that the Secretary for Primary and Secondary Education has granted permission to carry out your research.

You are also advised to liaise with the District Education Officer who is responsible for the schools which are part of the sample for your research.

S. Mhike

Acting Provincial Education Director

Response from Harare province



All communications should be addressed to
"The Provincial Education Director"
Tide-Fax: 67534
E-mail: matnorth12@gmail.com



Ministry of Primary and Secondary Education
Matabeleland North Province
P.O. Box 55
Bulawayo
Zimbabwe

22 July 2022

Chinhoyi University of Technology
P Bag 7724
Chinhoyi
Zimbabwe

Attention: Sindisiwe Dube

Student No. C19138196F

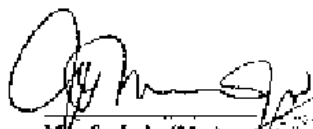
REQUEST FOR PERMISSION TO CARRY OUT A RESEARCH PROJECT:
TSHOLOTSHO DISTRICT: MATABELELAND NORTH PROVINCE

Reference is made to your letter dated 28 June 2022, requesting for permission to carry out a research project entitled "*Operations Improvement Through Work Study for Textile Technology and Design Subject for Secondary Schools*" at John T. Mack Elgin and Tsholotsho High Schools in Umguza and Tsholotsho Districts, Matabeleland North Province, Zimbabwe.

You are hereby granted permission to carry out your research in the above mentioned districts. However, your research should not in any way disturb the smooth running of teaching and learning activities in schools.

You will be required to furnish the Province with a copy of your findings after the research.

NB: Before proceeding to schools, please ensure that you pass through the District Education Office – Umguza and Tsholotsho.


Mphahlele J. A. (Mr.)
Provincial Education Director - Matabeleland North.
CC: District Schools Inspector - Umguza and Tsholotsho



iv) *Matebelaland North province*

All communications should be addressed to "The Provincial Education Director Mashonaland Central Province" Telephone: 0224- 6348/6996/7134/6994 Fax: 0224- 6957	 Ministry of Primary and Secondary Education Mashonaland Central Province P.O. Box 340 Bindura Zimbabwe
16 August 2021	

Sindiwe Dube
Plot Number 11 218
Block 10
Francistown
Botswana

RE: PERMISSION TO CARRY OUT RESEARCH IN MASHONALAND CENTRAL PROVINCE IN SELECTED SECONDARY SCHOOLS

Reference is hereby made to the Secretary for Primary and Secondary Education's minute dated 09 June 2021 granting you permission to carry out a research at Rujeke Secondary School in Mazowe District and Mt Darwin High School in Mt Darwin District in Mashonaland Central Province on the research title:

"OPERATIONAL IMPROVEMENT THROUGH WORK STUDY FOR TEXTILES AND DESIGN SUBJECT FOR SECONDARY SCHOOLS IN ZIMBABWE"

I am pleased to inform you that the Provincial Education Director Mashonaland Central Province has granted you permission to carry out your research in the selected secondary schools in Mashonaland Central Province. You should, however, liaise with the respective D.S.I.s before you start.

Finally, you are advised to submit a copy of your findings to the Ministry of Primary and Secondary Education.



Kibeta B
A/Deputy Director Human Resources
FOR PROVINCIAL EDUCATION DIRECTOR
Mashonaland Central Province

DEPUTY PROVINCIAL EDUCATION
MIN. OF PRY. & SEC. EDUCATION
16 AUG 2021
MASH. CENTRAL
P.O. BOX 340, BINDURA

/s/ Permission to carry out research doc

All communications should be addressed to:
The Secretary for Primary and Secondary Education
Telephone: 794005/7940211
Telegraphic address: "EDUCATION"
Fax: 794005



Reference: C/425/1
Ministry of Primary and Secondary Education
P.O. Box CY 121
Causeway
HARARE

9 June 2021

Sindisiwe Dube
Plot Number 11 218
Block 10
Francistown
Botswana

Re: PERMISSION TO CARRY OUT RESEARCH IN SELECTED SECONDARY IN THE PROVINCES

Reference is made to your application to carry a research in the secondary schools on the research title:

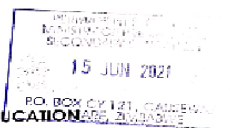
"OPERATIONAL IMPROVEMENT THROUGH WORK STUDY FOR TEXTILES AND DESIGN SUBJECT FOR SECONDARY SCHOOLS IN ZIMBABWE"

Permission is hereby granted. However, you are required to liaise with the Provincial Education Directors, who are responsible for the schools attached on separate sheet which you want to involve in your research. You should ensure that your research work does not disrupt the normal operations of the school. Where students are involved, parental consent is required.

You are also required to provide a copy of your final report to the Secretary for Primary and Secondary Education.

T. Thabela (Mrs)

SECRETARY FOR PRIMARY AND SECONDARY EDUCATION

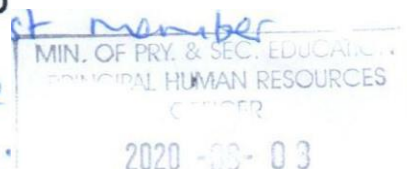


Scanned with CamScanner

T. Thabela (Mrs)

SECRETARY FOR PRIMARY AND

*D.S.I. Mutare please
accordingly 3/8/21 ML*



"The Provincial Education Director, Ministry of
Primary and Secondary Education."
Telephone: 0284/23009/7 7
Fax: 0284/23383



SINDISIWE DUBE

CHINHOYI UNIVERSITY

The Provincial Education Director Ministry of Primary and Secondary
Education
P. Bag 5824
Gwanda, Zimbabwe

21 June 2021

**RE: PERMISSION TO CONDUCT A RESEARCH ON "OPERATIONS IMPROVEMENT
THROUGH WORK STUDY FOR TEXTILE TECHNOLOGY AND DESIGN SUBJECT FOR SECONDARY SCHOOLS IN
ZIMBABWE"**

The above matter refers:

You have been granted authority to conduct a research on the title, "OPERATIONS IMPROVEMENT THROUGH WORK STUDY FOR TEXTILE TECHNOLOGY AND DESIGN SUBJECT FOR SECONDARY SCHOOLS IN ZIMBABWE".

At the end of your research you will be requested to submit a copy of your findings to the Ministry of Primary and Secondary Education (Matabeleland South Provincial Office) so that it can be of use and of benefit to the Ministry.

Appendix D: Teachers' Questionnaire

Dear Respondents:

My name is Sindisiwe Dube and I am a student at Chinhoyi University studying Dphil in the school of Art and Design. I hereby carry a supervised research study on **OPERATIONS IMPROVEMENT THROUGH WORK STUDY IN TEXTILE TECHNOLOGY AND DESIGN FOR SECONDARY SCHOOLS IN ZIMBABWE**. It would be my greatest appreciation if you could answer the questions below.

INFORMED CONSENT FORM

1. Project Title: An Analysis of Textile Technology and Design Subject Operations for Secondary Schools Through Work Study Approach: A Case Study of Zimbabwe.

2. Researcher: Sindisiwe Dube

3. Co-Investigators: Supervisors DR C. Chuma and DR F. Chimbindi

4. PURPOSE OF STUDY: The aim of this study was to analyse operations in the TTD subject through work study for secondary schools in Zimbabwe.

5. PROCEDURES AND DURATION: online questionnaires, observation check sheet and interviews will be used. Interviews will be done face to face in form of probe question. The data will be collected between 2020 and 2021.

6. RISKS AND DISCOMFORTS: Injuries during the workshop will be the responsibility of the researcher.

7. BENEFITS OF THE STUDY: This study attempts to find the gap between school operations and the standard operations in industry in the TTD subject in secondary schools. This study highlights the real challenges and identifies better methods to be used in the TTD subject operations and in secondary schools. It intends to find ways of cementing the relationship between work study and TTD subject operations improvement. The study will help in finding an appropriate model for the work study in TTD curriculum in secondary school education. The study will help TTD Associations and Curriculum developers in developing and presenting strategic visions and give them a strong voice when communicating to national policy makers, other government agencies and partners by revealing the operation in TTD subject in secondary schools. This research will be relevant to academics, scholars and students by adding to the board of knowledge as well as the adoption of innovative practices in the education system as it will bring an appropriate work study model

for industrialising and improving the TTD subject operations. It will also give guidance to the responsible statutory bodies and policy makers in monitoring and ensuring useful and viable operations in TTD by revealing the work study method appropriate for industrialising the operation. The observed time taken intricate on the vision for a possible reduction in the time taken and improvements that could be made in secondary schools for the TTD subject operations.

8. CONFIDENTIALITY: Participants are not supposed to write their names or provide any information that will lead to their identification. The questionnaires will be kept in a secure place which only the researcher has access to.

9. VOLUNTARY PARTICIPATION: The participants are advised to freely withdraw at any stage of data collection and anytime, when they feel that they are no longer comfortable or interested.

10. OFFER TO ANSWER QUESTIONS

Before you sign this form, take your time to go over the questions and ask for clarity in case your do not understand something.

11. AUTHORIZATION

YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE IN THIS STUDY. YOUR SIGNATURE INDICATES THAT YOU HAVE READ AND UNDERSTOOD THE INFORMATION PROVIDED ABOVE, HAVE HAD ALL YOUR QUESTIONS ANSWERED, AND HAVE DECIDED TO PARTICIPATE.

1.	I have read and understood the information about the project, as provided in the Information Sheet.	
2.	I have been given the opportunity to ask questions about the project and my participation.	
3.	I voluntarily agree to participate in the project.	
4.	I understand I can withdraw at any time without giving reasons and that I will not be penalized for withdrawing nor will I be questioned on why I have withdrawn.	
5.	The procedures regarding confidentiality have been clearly explained (e.g. use of names, etc.) to me.	
6.	The use of the data in research, publications, sharing and archiving has been explained to me.	
8.	I understand that other researchers will have access to this data only if they agree to preserve the confidentiality of the data and if they agree to the terms I have specified in this form.	

Participant:

.....
Name of Participant

.....
Signature

.....
Date

Researcher:

Sindisiwe Dube



Name of Researcher

Signature

Date

SECTION A: Demographic profiles of the respondents.

Instruction: Mark the appropriate box with a tick.

1. Gender

Males	
Females	

2. Age

Below 30years	
Between 40 and 50	
Above 50 years	

3. Experience in teaching TTD.

3 years	
4-6years	
7-10years	
Above 10 years	

4. Qualification

Diploma	
Degree	
Above degree	

SECTION B: What are the Current Operations in TTD subject for secondary schools in Zimbabwe.

Instruction: Please indicate your response by ticking in the appropriate box.

	Operations in TTD subject: We do the following operations:	Always 1	Sometimes 2	Never 3
1.	<i>Design Development Operation</i>			
2.	Design Development			
3.	Pattern making			
4.	Marker making/ laying out			

5.	Cutting			
6.	Notching/ transferring markings			
7.	Fusing/Ironing			
8.	Sewing operation			
9.	Finishing-Checking			
	-Pressing			
	-Packaging			

SECTION C: What are the methods used in the TTD subject operations for secondary schools in Zimbabwe.

Instruction: Please indicate your response by ticking in the appropriate box.

	Operations in TTD subject: We use the following methods in teaching practical lessons:	Always 1	Sometimes 2	Never 3
	Designing and pattern making methods			
1.	Commercial patterns			
2.	manually design and draft patterns on paper			
3.	Pirated CAD/CAM software			
4	Original CAD/CAM software			
5	Flexible and French curves			
6	Square rulers			
7	Dress forms for pattern making			
	Marking methods			
10	Notchers to transfer makings			
11	Tailors chalk to transfer makings			
12	Thread markings/ tailors tacks to transfer makings			
	Cutting methods			
13	Cutting tables			
14	Straight knife cutting machine			
15	Band knife cutting machine			
16	Hand Operated cutting machines			
17	Round knife cutting machine			
18	Trimming scissors			
18	Automatic cutting machine			
	Construction methods			
19	Whole garment system: <i>one person does all the processes of a garment</i>			
20	Departmental whole garment: <i>learners specialise in sections e.g. cutting, sewing, pressing and packaging sections.</i>			
21	Line production: <i>one person specialises on a specific operation e.g. pockets, collar, sleeve</i>			
	Pressing methods: we use the following methods			
15	Steam irons			
16	Charcoal irons			
17	Seam presser			
18	Adjustable ironing boards			
19	Sleeve boards			

20	Industrial steamers			
21	Fusing machine			
	<i>Finishing: we use the following</i>			
22	Dress forms			
23	Full length mirrors			
24	Tape measures			
25	Dress rails for putting garments			
26	Storage cupboards			
27	Square rulers			
28	Curving rulers			
	<i>Packaging methods: we package in</i>			
29	Packets			
30	Boxes			
31	Bales			
	<i>Methods study monitoring used</i>			

32	Online supervision			
33	Just on time supervision			
34	Right to left hand chart			
35	Flow diagram chart			
	<i>Time study monitoring method</i>			
36	Analytical estimation: <i>time for completing a task is estimated by the teacher</i>			
37	Comparative estimation: <i>time to complete a task depends on other learners speed.</i>			
38	We follow set performance standards of time to complete sewing tasks and projects			
39	We have no time limit measurement for completing our tasks.			

SECTION D: Challenges faced in TTD subject operation in secondary schools.

Instruction: Please indicate your response by ticking in the appropriate box.

	Equipment and Resources: the following tools are available:	Adequate 1	Inadequate 2	None at all 3
	<i>Designing and pattern making tools</i>			
1.	Commercial patterns			
2.	manually design and draft patterns on paper			
3.	Pirated CAD/CAM software			
4	Original CAD/CAM software			
5	Flexible and French curves			
6	Square rulers			
7	Dress forms for pattern making			
	<i>Marking tools</i>			
8	Notchers to transfer makings			
9	Tailors chalk to transfer makings			
10	Thread markings/ tailors tacks to transfer makings			
	<i>Cutting tools</i>			
11	Cutting tables			

12	Straight knife cutting machine			
13	Band knife cutting machine			
14	Hand Operated cutting machines			
15	Round knife cutting machine			
16	Trimming scissors			
17	Automatic cutting machine			
	Construction tools			
18	Domestic electric sewing machines			
19	Manual sewing machines			
20	Industrial straight sewing machines			
21	Domestic over locking sewing machines			
22	Buttonholing machine			
23	Hemmer			
24	Safety over locking machine			
25	Industrial over locking machine			
26	Computerised sewing machines			
	Pressing tools			
27	Steam irons			
28	Charcoal irons			
29	Seam presser			
30	Adjustable ironing boards			
31	Sleeve boards			
32	Industrial steamers			
34	Fusing machine			
	Finishing tools			
35	Dress forms			
36	Full length mirrors			
37	Tape measures			

	Teacher Competency and Skills	Disagree	Slightly Disagree	Agree	Slightly Agree	Strongly Agree
1	I can use CAD/CAM software for designing					
2	I can make patterns from commercial patterns					
3	I can draft and design patterns					
4	I have been trained to use CAD/CAM software					
5	I have designed samples of garments as demonstration to learners.					
6	I have been trained for industrialising TTD learning.					
7	I want to upgrade my TTD knowledge.					
	Funding for TTD learning area					
1	The budget allocated to TTD is					

	satisfactory					
2	Material for TTD is purchased in time					
3	TTD departments get money by producing and selling					
	Working Environment					
1	Machines have permanent positions					
2	There is enough sanitary equipment					
3	There is enough sewing space					
4	working rooms are well ventilated					
5	There is a first aid kit in the sewing room					
6	There is enough supervision during sewing					
7	There is enough cutting space					
8	Learners are aware of the safety precautions					
9	Learners talk to each other during sewing lessons					
10	Learners are given relaxation time during sewing					

SECTION E: How can operation improvement through work study in TTD for secondary schools?

Instruction: Please indicate your response by filling in the appropriate information.

	Operation	Time taken in min/hrs/days/months
	Construction-Skirt	
1.	Sketching the pattern	
2.	Designing the patterns	
3.	Laying out	
4.	Cutting out	
5.	Sewing darts	
6.	Working on seams	
7.	Attaching Zip	
8.	Prepare Waistband	
9.	Attaching Waistband	
10.	Sew the button and buttonhole	
11.	Hemming the skirt	
12.	Finishing	
13.	Packaging	

Appendix E: Learners' Questionnaire

Dear Respondents:

My name is Sindisiwe Dube and a student at Chinhoyi University studying DPhil in the school of Art and Design. I hereby carry a supervised research study on **OPERATIONS IMPROVEMENT THROUGH WORK STUDY IN TEXTILE TECHNOLOGY AND DESIGN FOR SECONDARY SCHOOLS IN ZIMBABWE**. It would be my greatest appreciation if you could answer the questions below. All answers will be treated with confidentiality and anyone is free to withdraw.

Do not write your name and the information will be used for educational purpose.

INFORMED CONSENT FORM

1. Project Title: AN ANALYSIS OF TEXTILE TECHNOLOGY AND DESIGN SUBJECT OPERATIONS FOR SECONDARY SCHOOLS THROUGH WORK STUDY APPROACH: A CASE STUDY OF ZIMBABWE.

2. Researcher: Sindisiwe Dube

3. Co-Investigators: Supervisors DR C. Chuma and DR F. Chimbindi

4. PURPOSE OF STUDY: The aim of this study was to analyse operations in the TTD subject through work study for secondary schools in Zimbabwe.

5. PROCEDURES AND DURATION: online questionnaires, observation check sheet and interviews will be used. Interviews will be done face to face in form of probe question. The data will be collected between 2020 and 2021.

6. RISKS AND DISCOMFORTS: Injuries during the workshop will be the responsibility of the researcher.

7. BENEFITS OF THE STUDY: This study attempts to find the gap between school operations and the standard operations in industry in the TTD subject in secondary schools. This study highlights the real challenges and identifies better methods to be used in the TTD subject operations and in secondary schools. It intends to find ways of cementing the relationship between work study and TTD subject operations improvement. The study will help in finding an appropriate model for the work study in TTD curriculum in secondary school education. The study will help TTD Associations and Curriculum developers in developing and presenting strategic visions and give them a strong voice when communicating to national policy makers, other government agencies and partners by revealing the operation in TTD subject in secondary schools. This research will be relevant to academics, scholars and students by adding to the board of knowledge as well as the adoption of innovative practices in the education system as it will bring an appropriate work study model for industrialising and improving the TTD subject operations. It will also give guidance to the responsible statutory bodies and policy makers in monitoring and ensuring useful and viable operations in TTD by revealing the work study method appropriate for industrialising the operation. The observed time taken

intricate on the vision for a possible reduction in the time taken and improvements that could be made in secondary schools for the TTD subject operations.

8. CONFIDENTIALITY: Participants are not supposed to write their names or provide any information that will lead to their identification. The questionnaires will be kept in a secure place which only the researcher have access to.

9. VOLUNTARY PARTICIPATION: The participants are advised to freely withdraw at any stage of data collection and anytime, when they feel that they are no longer comfortable or interested.

10. OFFER TO ANSWER QUESTIONS

Before you sign this form, take your time to go over the questions and ask for clarity in case your do not understand something.

11. AUTHORIZATION

YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE IN THIS STUDY. YOUR SIGNATURE INDICATES THAT YOU HAVE READ AND UNDERSTOOD THE INFORMATION PROVIDED ABOVE, HAVE HAD ALL YOUR QUESTIONS ANSWERED, AND HAVE DECIDED TO PARTICIPATE.

1.	I have read and understood the information about the project, as provided in the Information Sheet.	
2.	I have been given the opportunity to ask questions about the project and my participation.	
3.	I voluntarily agree to participate in the project.	
4.	I understand I can withdraw at any time without giving reasons and that I will not be penalized for withdrawing nor will I be questioned on why I have withdrawn.	
5.	The procedures regarding confidentiality have been clearly explained (e.g. use of names, etc.) to me.	
6.	The use of the data in research, publications, sharing and archiving has been explained to me.	
8.	I understand that other researchers will have access to this data only if they agree to preserve the confidentiality of the data and if they agree to the terms I have specified in this form.	

Participant:

.....
Name of Participant

.....
Signature

.....
Date

Researcher:

Sindisiwe Dube



Name of Researcher

Signature

Date

Demographic profiles of the respondents.

Instruction: Mark the appropriate box with a tick.

1. Gender

male ☐ female ☐

2. Level?

A 'Level	
----------	--

Question 1 and 2: Present operations and methods used in TTD subject for secondary schools in Zimbabwe. Instruction: Please indicate your response by ticking in the appropriate box.

	Operations in TTD subject: We use the following in our practical lessons:	Always 1	Sometimes 2	Never 3
	<i>Designing and pattern making</i>			
1.	Commercial patterns			
2.	manually design a nd draft patterns on paper			
3.	Pirated CAD/CAM software			
4	Original CAD/CAM software			
5	Flexible and French curves			
6	Square rulers			
7	Dress forms for pattern making			
	Marking Operation			
10	Notchers to transfer makings			
11	Tailors chalk to transfer makings			
12	Thread markings/ tailors tacks to transfer makings			
	Cutting Operation			
13	Cutting tables			
14	Straight knife cutting machine			
15	Band knife cutting machine			
16	Hand Operated cutting machines			
17	Round knife cutting machine			
18	Trimming scissors			
18	Automatic cutting machine			
	Construction Operation			
19	Whole garment system: <i>one person does all the processes of a garment</i>			
20	Departmental whole garment: <i>learners specialise in sections e.g. cutting, sewing, pressing and packaging sections.</i>			
21	Line production: <i>one person specialises on a specific operation e.g. pockets, collar, sleeve</i>			
	Pressing methods: we use the following			

15	Steam irons			
16	Charcoal irons			
17	Seam presser			
18	Adjustable ironing boards			
19	Sleeve boards			
20	Industrial steamers			
21	Fusing machine			
	<i>Finishing: we use the following</i>			
22	Dress forms			
23	Full length mirrors			
24	Tape measures			
25	Dress rails for putting garments			
26	Storage cupboards			
27	Square rulers			
28	Curving rulers			
	<i>Packaging methods: we package in</i>			
29	Packets			
30	Boxes			
31	Bales			

Question 3: Time taken to execute operations the TTD subject for secondary schools?

Instruction: Please indicate your response by filling in the appropriate information.

Operation	Time taken
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	
Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	
Packaging	

Question 4: Challenges faced in TTD subject operation in secondary schools.

Instruction: Please indicate your response by ticking in the appropriate box.

	Equipment and Resources: the following tools are available:	Adequate 1	Inadequate 2	None at all 3
	<i>Designing and pattern making tools</i>			
1.	Commercial patterns			
2.	manually design and draft patterns on paper			
3.	Pirated CAD/CAM software			
4	Original CAD/CAM software			
5	Flexible and French curves			
6	Square rulers			
7	Dress forms for pattern making			
	<i>Marking tools</i>			
10	Notchers to transfer makings			
11	Tailors chalk to transfer makings			
12	Thread markings/ tailors tacks to transfer makings			
	<i>Cutting tools</i>			
13	Cutting tables			
14	Straight knife cutting machine			
15	Band knife cutting machine			
16	Hand Operated cutting machines			
17	Round knife cutting machine			
18	Trimming scissors			
18	Automatic cutting machine			
	<i>Construction tools</i>			
19	Domestic electric sewing machines			
20	Manual sewing machines			
21	Industrial straight sewing machines			
22	Domestic over locking sewing machines			
23	Buttonholing machine			
24	Hemmer			
25	Safety over locking machine			
26	Industrial over locking machine			
27	Computerised sewing machines			
	<i>Pressing tools</i>			
15	Steam irons			
16	Charcoal irons			
17	Seam presser			
18	Adjustable ironing boards			
19	Sleeve boards			

20	Industrial steamers			
21	Fusing machine			
	Finishing tools			
22	Dress forms			
23	Full length mirrors			
24	Tape measures			
25	Dress rails for putting garments			
26	Storage cupboards			
27	Square rulers			
28	Curving rulers			
	Packaging tools			
29	Packets			
30	Boxes			
31	Bales			

	Teacher Competency and Skills: Our teacher is :	Disagree	Slightly Disagree	Agree	Slightly Agree	Strongly Agree
	Confident and knows her teaching content.					
2.	Uses technological tools for teaching					
3.	Demonstrates the use of tools					
4.	Produces professionally made garments samples					
	Funding for TTD learning area					
1	The budget allocated to TTD is satisfactory					
2	Material for TTD is purchased in time					
3	TTD departments get money by producing and selling					
	Working Environment					
1.	Machines have permanent positions					
2.	There is enough sanitary equipment					
3.	There is enough sewing space					
4.	working rooms are well ventilated					
5.	There is a first aid kit in the sewing room					
6.	There is enough supervision during sewing					
7.	There is enough cutting space for sewing					

8.	We are aware of the safety precautions					
9.	We talk to each other during sewing lessons					
10.	We are given relaxation time during sewing					

Research Question 4: How can operations be improvement through work study in the TTD subject for secondary schools?

Instruction: Record the time taken to execute operations in an improved environment by filling in the time taken record guide form with the assistance of your teacher.

Operation	Time taken using the Whole garment method
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	
Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	
Packaging	

Operation	Time taken using the sectionalisation method
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	
Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	
Packaging	

Appendix F: Interview Guide for Teachers and Learners.

Section 1: Demographical Data

Tell me about yourself

- a. Age
- b. Gender
- c. Experience in teaching/level
- d. Qualifications

Section 2: Do you do the following operations in garment construction?

Operation	Comment
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	
Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	
Packaging	

Section 3: What methods do you use for the following processes in garment construction?

Operation	Method used
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	
Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	
Packaging	

Section 4: How long do you take to complete the following processes

Operation	Time taken
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	

Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	
Packaging	

Section 5: Challenges in TTD subject operation in secondary schools.

1. What challenges do you have in TTD subject area in your operations?

- a) Resources and equipment
- b) teacher competency
- c) funding
- d) teaching and learning environment

2. How long do you take to make a skirt?

3. How many garments do you do per term?

Appendix G: Observation Checklist

Section 1: Are the following operations done in garment construction?

Operation	Comment
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	
Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	
Packaging	

Section 2: What methods are used in garment construction?

Operation	Method used
Design development	
Making patterns	
Laying out	
Cutting out	
Sewing darts	
Working on seams	
Attaching Zip	
Prepare Waistband	
Attaching Waistband	
Sew the button and buttonhole	
Hemming the skirt	
Finishing	

Section 3: *How do learners execute operations in terms of speed?*

Section 4: Challenges in TTD subject operation in secondary schools.

- What challenges do they have in TTD subject operations?
 - a) Resources and equipment
 - b) teacher competency
 - c) funding
 - d) teaching and learning environment
- Any evidence of finished garments?

APPENDIX H - Raw Data for Time Study Observation

Research Question 1: Descriptives

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GET DATA /TYPE=XLSX
  /FILE='C:\Users\NTANDO\Downloads\Dube data.xlsx'
  /SHEET=name 'Sheet1'
  /CELLRANGE=full
  /READNAMES=on
  /ASSUMEDSTRWIDTH=32767.
EXECUTE.
DATASET NAME DataSet1 WINDOW=FRONT.

SAVE OUTFILE='C:\Users\NTANDO\Downloads\Dube data.sav'
  /COMPRESSED.
RECODE p1 p2 p3 p4 p5 p6 p7 p8 p9 p10 p11 p12 p13 p14 p15 p16 p17 p18 p19 p20 p21 p22
p23 p24 p25
      p26 p27 p28 p29 p30 p31 p32 p33 p34 p35 p36 p37 p38 p39 p40 p41 p42 p43 p44 p45 p46
p47 p48 p49 p50 p51 p52 (3=1)
      (1=3) .
EXECUTE.
```

Question 1 and 2: Descriptives

Notes	
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Comments	
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	C:\Users\NTANDO\Downloads\Dube data.sav

	Active Dataset	DataSet1
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	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=p1.....p52 Designingave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,13

[DataSet1] C:\Users\NTANDO\Downloads\Dube data.sav

Descriptive Statistics

	N	Mean	Std. Deviation
Pirated CAD/CAM software	52	1.00	.000
Original CAD/CAM software	52	1.42	.793
manually designing patterns	52	2.80	.422
Commercial patterns	52	1.83	.389
Flat pattern making method	52	1.73	.905
Draping pattern making method	52	1.38	.744
Designingave	52	1.6736	.18956
Valid N (listwise)	52		

FREQUENCIES VARIABLES=p1...p52
/ORDER=ANALYSIS.

Frequencies

Notes

Output Created		06-NOV-2021 20:54:12
Comments		
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Missing Value Handling	Split File	<none>
	N of Rows in Working Data File	52
	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=p1....p52 /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,05

Demographics

Variable	Specific variable	Frequency	Percentage
Gender	Male	5	19.2
	Females	21	80.8
Age	Below 30	3	11.5
	Between 40 and 50	18	69.3
	Above 50	5	19.2
Experience	3 years	2	7.7
	4-6 years	4	15.4
	7-10 years	5	19.2
	Above 10 years	15	57.7
Qualification	Diploma	18	69.2
	Degree	6	23.1
	Above Degree	2	7.7
	Total Frequency	26	

Statistics

		Pirated CAD/CAM software	Original CAD/CAM software	manually designing patterns	Commercial patterns	Flat pattern making method	Draping pattern making method
N	Valid	52	52	52	52	52	
	Missing	0	0	0	0	0	
Variable	Specific variable	Frequency		Percentage			
Gender	Male	7		19.2			
	Females	45		80.8			

Age	Below 15	5	11.5
	Between 16 and 18	40	69.3
	Above 16	7	19.2

Present operation	Teachers			Learners		
	Never	Sometimes	Always	Never	Sometimes	Always
Design Development	16.7%	66.7%	6.6%	16.7%	66.7%	6.6%
Pattern making	16.7%	66.7%	6.6%	16.7%	66.7%	6.6%
Marker making/laying out	5%	6.3%	88.7%	5%	7%	88%
Cutting	0	0	100%	16.7%	66.7%	16.7%
Notching/transferring markings	5.7%	5.5%	85%	5.7%	5.5%	85%
Fusing/Ironing	8.3%	16.7%	75%	8.3%	16.7%	75%
Sewing operation	0	0	100%	0	0	100%
Quality control	6.7%	8.3%	85%	0	0	100%
Finishing	75%	10.3%	14.7%	75%	10.3%	14.7%
Packaging	75%	10.3%	14.7%	79%	19.3%	1.7%

Frequency Table

Pirated CAD/CAM software

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Never	52	100.0	100.0	100.0

Original CAD/CAM software

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Never	39	75.0	75.0	75.0
Always	4	8.3	8.3	83.3
Sometime	9	16.7	16.7	100.0
Total	52	100.0	100.0	

manually designing patterns

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sometimes	8	16.7	20.0	20.0
	Always	34	66.7	80.0	100.0
	Never	3	6.6	100.0	
Missing	System	7	16.7		
Total		52	100.0		

Commercial patterns

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	9	16.7	16.7	16.7
	Sometimes	43	83.3	83.3	100.0
Total		52	100.0	100.0	

Flat pattern making method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	26	50.0	54.5	54.5
	Sometimes	9	16.7	18.2	72.7
	Always	13	25.0	27.3	100.0
Missing	System	4	8.3		
Total		52	100.0		

Draping pattern making method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	44	83.40	75.0	75.0
	Sometimes	4	8.3	12.5	87.5
	Always	4	8.3	12.5	100.0
Total		52	100.0		

```

COMPUTE Cuttingave=MEAN(p1...p52)
EXECUTE.
DESCRIPTIVES VARIABLES=p1...p52 Cuttingave
/STATISTICS=MEAN STDDEV.

```

Descriptives

Notes

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	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=p1..p52Cuttingave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Descriptive Statistics

	N	Mean	Std. Deviation
Cutting tables	52	2.50	.905
Straight knife cutting machine	52	1.00	.000
Band knife cutting machine	52	1.00	.000
Hand Operated cutting machines	52	1.33	.778
Round knife cutting machine	52	1.00	.000
Trimming scissors	52	2.75	.452
Automatic cutting machine	52	1.00	.000
Cuttingave	52	1.5119	.21501
Valid N (listwise)	52		

```
FREQUENCIES VARIABLES=p1...p52
/ORDER=ANALYSIS.
```

Frequencies

Notes

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	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=p1...p52 /ORDER=ANALYSIS.	
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Statistics

		Cutting tables	Straight knife cutting machine	Band knife cutting machine	Hand Operated cutting machines	Round knife cutting machine	Trimming
N	Valid	52	52	52	52	52	
	Missing	0	0	0	0	0	

Frequency Table

Cutting tables

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	25.0	25.0	25.0
	Always	9	75.0	75.0	100.0
	Total	12	100.0	100.0	

Straight knife cutting machine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	52	100.0	100.0	100.0

Band knife cutting machine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	52	100.0	100.0	100.0

Hand Operated cutting machine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	52	100.0	100.0	100.0

Round knife cutting machine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	52	100.0	100.0	100.0

Trimming scissors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sometimes	13	25.0	25.0	25.0
	Always	39	75.0	75.0	100.0
	Total	52	100.0	100.0	

Automatic cutting machine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	52	100.0	100.0	100.0

```

COMPUTE Markingave=MEAN(p1.....p52) .
EXECUTE.
DESCRIPTIVES VARIABLES=p1..p52) Markingave
  
```

/STATISTICS=MEAN STDDEV.

Descriptives

Notes		
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Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=q14 q15 q16 q17 q18 Markingave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Variable	Descriptive Statistics			
	Never	Sometimes	Always	Total
Tailor's chalk	8.3	0	91.7	100
Use of notchers	91.7	8.3	0	100
Pins	0	33.3	66.7	100
Thread marking	0	25.0	75.0	100
Tracing wheel				

Descriptive Statistics			
	N	Mean	Std. Deviation
Tracing wheel	52	3.00	.000
Tailors chalk	52	2.92	.289
Notchers to transfer makings	52	1.92	.996
Using pins	52	2.67	.492
Thread markings	52	2.75	.452
Markingave	52	2.6500	.24309
Valid N (listwise)	52		

```
FREQUENCIES VARIABLES=p1..p52)
/ORDER=ANALYSIS.
```

Frequencies

Notes		
Output Created		06-NOV-2021 20:58:52
Comments		
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=q14 q15 q16 q17 q18 /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Statistics						
		Tracing wheel	Tailors chalk	Notchers to transfer makings	Using pins	Thread markings
N	Valid	52	52	52	52	52
	Missing	0	0	0	0	0

Frequency Table

Tracing wheel

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	52	100.0	100.0	100.0

Tailors chalk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sometimes	4	8.3	8.3	8.3
	Always	48	91.7	91.7	100.0
	Total	52	100.0	100.0	

Notchers to transfer makings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	26	50.0	50.0	50.0
	Sometimes	4	8.3	8.3	58.3
	Always	22	41.7	41.7	100.0
	Total	52	100.0	100.0	

Using pins

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sometimes	17	33.3	33.3	33.3
	Always	35	66.7	66.7	100.0
	Total	52	100.0	100.0	

Thread markings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sometimes	13	25.0	25.0	25.0
	Always	39	75.0	75.0	100.0
	Total	52	100.0	100.0	

COMPUTE Constructionave=MEAN (p1...p52) .

```
EXECUTE.
DESCRIPTIVES VARIABLES=p1...p52) Constructionave
/STATISTICS=MEAN STDDEV.
```

Automatic Fusing machine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	43	83.3	83.3	33.3
	Sometimes	9	16.7	16.7	100.0
	Total	52	100.0	100.0	

Hand Irons Fusing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	43	16.7	16.7	16.7
	Sometimes	17	83.3	83.3	100.0
	Total	52	100.0	100.0	

Fusing machine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	43	83.3	100.0	100.0
Missing	System	9	16.7		
Total		52	100.0		

Descriptives

Notes

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	Split File	<none>
	N of Rows in Working Data File	52
	Cases Used	All non-missing data are used.
Resources	Processor Time	00:00:00,02

Descriptive Statistics

	N	Mean	Std. Deviation
Whole garment system: one person does all the processes of a garment	52	2.58	.669
Departmental whole garment: learners specialise in sections e.g. cutting, sewing, pressing and packaging sections.	52	2.17	.937
Line production: one person specialises on a specific operation e.g. pockets, collar, sleeve	52	1.67	.985
Constructionave	52	2.1389	.61065
Valid N (listwise)	52		

```
FREQUENCIES VARIABLES=p1...p52)
/ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created	06-NOV-2021 21:02:24	
Comments		
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	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.

Syntax		FREQUENCIES VARIABLES=p1...52) /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,01

Statistics

		Whole garment system: one person does all the processes of a garment	Departmental whole garment: learners specialise in sections e.g. cutting, sewing, pressing and packaging sections.	Line production: one person specialises on a specific operation e.g. pockets, collar, sleeve
N	Valid	52	52	52
	Missing	0	0	0

Frequency Table

Whole garment system: one person does all the processes of a garment

	Frequency	Percent	Valid Percent	Cumulative Percent
Always	52	100	100	100.0
Total	52	100.0	100.0	

Departmental whole garment: learners specialise in sections e.g. cutting, sewing, pressing and packaging sections.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Never	35	66.7	66.7	66.7

Sometimes	17	33.3	16.7	50.0
Total	52	100.0	100.0	

Line production/Sectionalisation: one person specialises on a specific operation e.g.

pockets, collar, sleeve

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Never	8	66.7	66.7	66.7
Always	4	33.3	33.3	100.0
Total	2	100.0	100.0	

```
COMPUTE Pressingave=MEAN(q22,q23,q24,q25,q26,q27,q28) .
EXECUTE.
DESCRIPTIVES VARIABLES=q22 q23 q24 q25 q26 q27 q28 Pressingave
/STATISTICS=MEAN STDDEV.
```

Descriptives

Notes

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Comments		
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	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=q22 q23 q24 q25 q26 q27 q28 Pressingave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Descriptive Statistics

	N	Mean	Std. Deviation
Steam irons	52	2.83	.577
Charcoal irons	52	1.67	.888
Seam presser	52	1.33	.651
Adjustable ironing boards	52	1.75	.965
Sleeve boards	52	1.67	.778
Industrial steamers	52	1.00	.000
Fusing machine	50	1.00	.000
Pressingave	52	1.6151	.39813
Valid N (listwise)	51		

```
FREQUENCIES VARIABLES=q22 q23 q24 q25 q26 q27 q28
/ORDER=ANALYSIS.
```

Frequencies

Notes

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Comments		
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=q22 q23 q24 q25 q26 q27 q28 /ORDER=ANALYSIS.	
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Statistics

		Steam irons	Charcoal irons	Seam presser	Adjustable ironing boards	Sleeve boards	Industrial ste
N	Valid	52	52	52	52	12	
	Missing	0	0	0	0	0	

Frequency Table

Steam irons

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	4	8.3	8.3	8.3
	Always	48	91.7	91.7	100.0
	Total	52	100.0	100.0	

Charcoal irons

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	30	58.3	58.3	58.3
	Sometimes	9	16.7	16.7	75.0
	Always	13	25.0	25.0	100.0
	Total	52	100.0	100.0	

Seam presser

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	39	75.0	75.0	75.0
	Sometimes	9	16.7	16.7	91.7
	Always	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

Adjustable ironing boards

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	30	58.3	58.3	58.3
	Sometimes	4	8.3	8.3	66.7
	Always	18	33.3	33.3	100.0
	Total	52	100.0	100.0	

Sleeve boards

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	26	50.0	50.0	50.0
	Sometimes	17	33.3	33.3	83.3
	Always	9	16.7	16.7	100.0
	Total	52	100.0	100.0	

Industrial steamers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	52	100.0	100.0	100.0

Descriptives

Notes

Output Created		06-NOV-2021 21:09:57
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube
		data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.

Syntax	Cases Used	All non-missing data are used.
		DESCRIPTIVES VARIABLES=q33 q34 q35 q36 q37 Finishingave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Descriptive Statistics

	N	Mean	Std. Deviation
Dress forms	52	1.33	.651
Full length mirrors	52	2.08	.996
Tape measures	52	2.67	.778
Dress rails for hanging garments	52	2.08	.996
Storage cupboards	51	2.27	.467
Finishingave	52	2.1000	.60000
Valid N (listwise)	49		

FREQUENCIES VARIABLES=q33 q34 q35 q36 q37
/ORDER=ANALYSIS.

Frequencies

Notes

Output Created		06-NOV-2021 21:10:17
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.

Syntax	FREQUENCIES VARIABLES=q33 q34 q35 q36 q37 /ORDER=ANALYSIS.			
Resources	Processor Time	00:00:00,00		
	Elapsed Time	00:00:00,00		

Statistics

		Dress forms	Full length mirrors	Tape measures	Dress rails for hanging garments	Storage cupboards
N	Valid	52	52	52	52	49
	Missing	0	0	0	0	1

Frequency Table

Dress forms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	39	75.0	75.0	75.0
	Sometimes	9	16.7	16.7	91.7
	Always	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

Full length mirrors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	22	41.7	41.7	41.7
	Sometimes	4	8.3	8.3	50.0
	Always	26	50.0	50.0	100.0
	Total	52	100.0	100.0	

Tape measures

		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Never	9	16.7	16.7	16.7
	Always	43	83.3	83.3	100.0
	Total	52	100.0	100.0	

Dress rails for hanging garments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	22	41.7	41.7	41.7
	Sometimes	4	8.3	8.3	50.0
	Always	26	50.0	50.0	100.0
	Total	52	100.0	100.0	

Storage cupboards

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sometimes	35	66.7	72.7	72.7
	Always	13	25.0	27.3	100.0
	Total	48	91.7	100.0	
Missing	System	4	8.3		
Total		12	100.0		

```

COMPUTE Packagingave=MEAN(q38,q39,q40) .
EXECUTE.
DESCRIPTIVES VARIABLES=q38 q39 q40 Packagingave
  /STATISTICS=MEAN STDDEV.

```

Descriptives

Notes

Output Created		06-NOV-2021 21:11:35
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=q38 q39 q40 Packagingave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Descriptive Statistics

	N	Mean	Std. Deviation
Plastic packets	48	1.36	.674
Boxes	48	2.27	.647
Bales	48	1.09	.302
Packagingave	48	1.5972	.34420
Valid N (listwise)	48		

FREQUENCIES VARIABLES=q38 q39 q40
/ORDER=ANALYSIS.

Frequencies

Notes

Output Created		06-NOV-2021 21:11:54
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

Cases Used		Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=q38 q39 q40 /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Statistics

		Plastic packets	Boxes	Bales
N	Valid	48	48	48
	Missing	4	4	4

Frequency Table

Plastic packets

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	34	66.7	72.7	72.7
	Sometimes	8	16.7	18.2	90.9
	Always	4	8.3	9.1	100.0
	Total	48	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

Boxes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	4	8.3	9.1	9.1
	Sometimes	26	50.0	54.5	63.6
	Always	18	33.3	36.4	100.0
	Total	48	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

Bales

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	43	83.3	90.9	90.9
	Sometimes	4	8.3	9.1	100.0
	Total	147	91.7	100.0	
Missing	System	5	8.3		
Total		52	100.0		

```
COMPUTE Methodsave=MEAN(q41,q42,q43,q44) .
EXECUTE.
DESCRIPTIVES VARIABLES=q41 q42 q43 q44 Methodsave
  /STATISTICS=MEAN STDDEV.
```

Research Question 3 (Time in Minutes): Descriptives

Descriptives

Notes

Output Created		06-NOV-2021 21:13:57
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube
		data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
Missing Value Handling	Split File	<none>
	N of Rows in Working Data File	52
	Definition of Missing	User defined missing values are treated as missing.
Syntax	Cases Used	All non-missing data are used.
		DESCRIPTIVES VARIABLES=q41 q42 q43 q44 Methodsave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,01

Descriptive Statistics

	N	Mean	Std. Deviation
Online supervision	52	1.33	.492
Just on time supervision	52	1.92	.515
Right to left hand chart	52	1.33	.492
Flow diagram chart	51	1.82	.751
Methodsave	52	1.6111	.40410
Valid N (listwise)	51		

```
FREQUENCIES VARIABLES=q41 q42 q43 q44
/ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created	06-NOV-2021 21:14:15	
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=q41 q42 q43 q44 /ORDER=ANALYSIS.	
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,02

Statistics

		Online supervision	Just on time supervision	Right to left hand chart	Flow diagram chart
N	Valid	52	52	52	51
	Missing	0	0	0	1

Frequency Table

Online supervision

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	34	66.7	66.7	66.7
	Sometimes	18	33.3	33.3	100.0
	Total	52	100.0	100.0	

Face to face supervision

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	9	16.7	16.7	16.7
	Sometimes	39	75.0	75.0	91.7
	Always	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

Right to left hand chart

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	34	66.7	66.7	66.7
	Sometimes	18	33.3	33.3	100.0
	Total	52	100.0	100.0	

Flow diagram chart

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	18	33.3	36.4	36.4

	Sometimes	22	41.7	45.5	81.8
	Always	9	16.7	18.2	100.0
	Total	11	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

```

COMPUTE Tiimeave=MEAN(q45,q46,q47,q48) .
EXECUTE.
DESCRIPTIVES VARIABLES=q45 q46 q47 q48 Tiimeave
  /STATISTICS=MEAN STDDEV.

```

Descriptives

Notes		
Output Created		06-NOV-2021 21:16:05
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube
		data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=q45 q46 q47 q48 Tiimeave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

	Mean	Std. Deviation
Analytical estimation: time for completing a task is estimated by the teacher	2.33	.707

Comparative estimation: time to complete a task depends on other learners speed.	1.83	.718
We follow set performance standards of time to complete sewing tasks and projects	2.75	.452
We have no time limit measurement for completing our tasks.	1.55	.688
Tiimeave	2.1181	.25490
Valid N (listwise)		

FREQUENCIES VARIABLES=q45 q46 q47 q48
/ORDER=ANALYSIS.

Frequencies

Notes

Output Created	06-NOV-2021 21:16:22	
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=q45 q46 q47 q48 /ORDER=ANALYSIS.	
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Statistics

		Analytical estimation: time for completing a task is estimated by the teacher	Comparative estimation: time to complete a task depends on other learners speed.	We follow set performance standards of time to complete sewing tasks and projects	We have no time limit measurement for completing our tasks.
N	Valid	49	52	52	52
	Missing	3	0	0	1

Frequency Table

Analytical estimation: time for completing a task is estimated by the teacher

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	5	8.3	11.1	11.1
	Sometimes	17	33.3	44.4	55.6
	Always	17	33.3	44.4	100.0
	Total	39	75.0	100.0	
Missing	System	13	25.0		
Total		52	100.0		

Comparative estimation: time to complete a task depends on other learners speed.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	4	33.3	33.3	33.3
	Sometimes	6	50.0	50.0	83.3
	Always	2	16.7	16.7	100.0
	Total	12	100.0	100.0	

We follow set performance standards of time to complete sewing tasks and projects

		Frequency	Percent	Valid Percent	Cumulative Percent
--	--	-----------	---------	---------------	-----------------------

Valid	Sometimes	13	25.0	25.0	25.0
	Always	39	75.0	75.0	100.0
	Total	52	100.0	100.0	

We have no time limit measurement for completing our tasks.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	26	50.0	54.5	54.5
	Sometimes	17	33.3	36.4	90.9
	Always	5	8.3	9.1	100.0
	Total	48	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

```

COMPUTE DesigningChaave=MEAN(s1,s2,s3,s4,s5,s6,s7,s8,s9) .
EXECUTE.
RECODE s1 s2 s3 s4 s5 s6 s7 s8 s9 s10 s11 s12 s13 s14 s15 s16 s17 s18 s19 s20 s21 s22
s23 s24 s25
      s26 s27 s28 s29 s30 s31 s32 s33 s34 s35 s36 s37 s38 s39 s40 s41 s42 s43 s44 s45 s46
s47 s48 s49 s50
      s51 s52 s53 s54 s55 s56 (3=1) (1=3) .
EXECUTE.
COMPUTE DesigningChaave=MEAN(s1,s2,s3,s4,s5,s6,s7,s8,s9) .
EXECUTE.
DESCRIPTIVES VARIABLES=s1 s2 s3 s4 s5 s6 s7 s8 s9 DesigningChaave
/STATISTICS=MEAN STDDEV.

```

The table below shows the observed time taken per learner to complete a skirt in schools.

PRV4					Descriptive Statistics for time PRV6								PRV7					PRV8		
					taken in schools.															
16	p17	p18	p19	p20	p21	p22	p23	p24	p25	p26	p27	p28	p29	p30	p31	p32	p33	p34	p35	p37
34	322	180	164	288	175	234	322	180	164	288	183	160	180	165	234	301	287	300	180	165
34	240	138	142	245	142	234	240	138	142	245	179	130	177	135	220	233	248	241	117	120
20	154	50	167	120	167	120	112	50	65	120	45	167	44	167	120	120	120	120	44	167
93	75	30	43	90	44	76	92	30	45	90	30	45	30	45	90	87	90	96	30	45
36	236	35	30	236	33	236	236	35	30	236	35	30	35	30	222	233	224	236	35	30
02	302	125	124	333	132	302	302	125	154	302	125	122	125	122	345	362	323	302	125	122

370	370	121	119	334	119	370	370	121	119	370	121	119	121	119	370	370	370	370	121	120
207	207	170	163	254	145	243	210	170	163	223	170	164	170	164	207	207	207	207	170	164
368	368	121	113	368	113	368	368	121	112	368	121	113	121	113	368	368	368	368	121	113
243	257	76	55	222	54	243	257	76	55	222	65	51	65	56	240	240	246	255	62	56
234	234	30	25	234	25	234	234	30	25	234	23	22	24	25	234	245	233	234	33	15

94	1452	1162	1034	1414	1099	1637	1489	1279	1274	1425	1039	1398	1034	1105	1145	1362	1328	1055	1635	1
----	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	---

1165

The table below shows the observed time taken per school to complete a skirt

Descriptive Statistics for time taken in schools.																										
Prov ince	PRV 1			PRV 2			PRV3			PRV4		PRV 5		PRV 6		PRV 7		PRV8			PRV 9			PRV 10		
Sch ools	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Desi gn deve lop men t	183	160	180	165	234	301	287	300	180	165	300	300	120	175	234	342	180	164	288	175	234	324	320	180	164	288
Mak ing patt erns	179	130	177	135	220	233	248	240	117	120	234	236	112	142	234	240	138	142	245	142	234	240	138	142	234	245
Layi ng out	45	167	44	167	120	120	120	120	44	167	120	120	30	167	120	154	50	167	120	167	120	120	50	65	120	120
Cutt ing out	30	45	30	45	90	90	90	90	30	45	90	90	30	45	93	75	30	43	90	44	76	92	30	45	90	90
Sew ing dart s	35	30	35	30	22	233	224	236	35	30	236	235	30	30	236	236	35	30	236	33	236	236	35	30	236	236
Wor king on sea ms	125	122	125	122	345	362	323	302	125	122	302	302	125	122	302	302	125	124	333	132	302	302	125	125	302	302
Atta chin g Zip	121	119	121	119	370	370	370	370	121	119	370	370	121	119	370	370	121	119	370	119	370	370	121	119	370	370
Prep are Wai stba nd	170	164	170	164	207	207	207	207	170	164	207	207	170	164	207	207	170	164	207	207	207	207	170	164	207	207

Atta chin g Wai stba nd	1 2 1	1 1 3	1 2 1	1 1 3	3 6 8	3 6 8	3 6 8	3 6 8	1 2 1	11 3	3 6 8	36 8	1 2 1	11 3	3 6 8	3 6 8	1 2 1	1 1 3	3 6 8	1 1 3	3 6 8	3 6 8	1 2 1	1 1 2	3 6 8
Sew the butt on and butt onhole	6 5	5 1	6 5	5 6	2 4 0	2 4 0	2 4 6	2 5 5	6 2	56	2 4 3	25 4	3 4	54	2 4 3	2 5 7	7 6	5 5	2 2 2	5 4	2 4 3	2 5 7	7 6	5 5	2 2 2
He mmi ng the skirt	2 3	2 2	2 4	2 5	2 3 4	2 4 5	2 3 3	2 3 4	3 3	15	2 3	23 4	3 0	25	2 3 4	2 3 4	3 0	2 5	2 3 4	2 5	2 3 4	2 3 4	3 0	2 5	2 3 4
Finish ing	1 0	1 8	9	1 9	1 0	1 7	1 1	1 8	9	18	9	20	1 0	17	1 1	1 8	1 0	1 7	1 1	1 8	9	1 8	9	2 0	1 0
Packagi ng	1 0	1 4	1 1	1 3	1 0	1 4	9	1 5	8	16	1 0	14	1 0	14	1 2	1 2	1 0	1 4	9	1 5	8	1 6	1 0	1 4	1 0

Observed time in an improved environment using whole garment method

Notes

Output Created	06-NOV-2021 21:57:03	
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Syntax	DESCRIPTIVES VARIABLES=p1 p2 p3 p4 p5 p6 p7 p8 p9 p10 p11.....p52 TContruictionave /STATISTICS=MEAN STDDEV.	
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,02

DESCRIPTIVES VARIABLES=p1 p2 p3 p4 p5 p6 p7 p8 p9 p10 p11..... p52TContruictionave
/STATISTICS=MEAN STDDEV MIN MAX

Descriptives

Descriptive Statistics whole garment

	N	Minimum	Maximum	Mean	Std. Deviation
Sketching the design.	52.	30	64	47.50	0.894
Making patterns	52.	23	60	46.50	0.683
Laying out	52	15	34	24.33	1.211
Cutting out	52	30	45	38.83	1.366

Sewing darts	52	10	30	20.50	0.730
Working on seams	52	20	37	29.67	1.483
Attaching Zip	52	45	62	54.50	1.366
Prepare Waistband	52	15	33	24.75	0.930
Attaching Waistband	52	30	45	38.83	2.338
Sew the button and buttonhole	52	15	45	25.58	0.930
Hemming the skirt	52	15	33	24.75	0.683
		10	18	14.0	0.683
		10	14	12.0	0.365
Valid N (listwise)	52	268	530	449	

Observed time in an improved environment using sectionalisation method

Notes			
Output Created		06-NOV-2021 21:57:03	
Comments			
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav	
	Active Dataset	DataSet0	
	Filter	<none>	
	Weight	<none>	
	Split File	<none>	
	N of Rows in Working Data File	4	
Syntax		DESCRIPTIVES VARIABLES=L1,L2,L3,L4 TContruictionave /STATISTICS=MEAN STDDEV.	
Resources	Processor Time	00:00:00,02	
	Elapsed Time	00:00:00,02	

DESCRIPTIVES VARIABLES=L1, L2, L3, L4TContruictionave
/STATISTICS=MEAN STDDEV MIN MAX

Descriptives

Observed time in an improved environment using sectionalisation method

Descriptive Statistics sectionalisation

	L1	L 2	L3	L 4	Mean	Std. D
	N=13	N=13	N=13	N=13		
1 Design development	30	32	30	32	30.8	0.251

2. Making patterns			23	25	24	25	24.2		0.373
3. Laying out			15	15	13	17	15.2		1.180
4. Cutting out			32	30	30	32	30.4		1.143
Total time for 26 skirts			100	102	107	106	104		
Time for (Design development, drafting , laying out and cutting out) for 1 skirt.			3.8	3.9	4.1	4.08	4.15		0.341
1.. Sewing darts			10	10	10	12	10.4		0.730
2. Working on seams			22	18	21	22	20.4		1.483
3. Attaching Zip			43	47	45	47	45.6		1.366
4. Prepare Waistband			16	18	15	17	16.6		0.930
5. Attaching Waistband			32	25	30	30	29.8		2.338
6. Sew the button and buttonhole			15	13	14	15	14.2		0.683
7. Hemming the skirt			16	16	14	15	15.6		0.930
8. Finishing			10	10	11	9	9.8		0.683
9. Packaging			5	5	5	5	5.2		0.365
Total Time for 1 skirt			169	162	165	172	167		
			1hrs	2hrs	3hrs	30min	4hrs	5 hrs	total
L 1	Skirt Quantity	N=13	4	9	14	A	19	24	
	Minutes Worked	N=13	229	289	349	L	409	469	469
L2	Skirt Quantity	N=13	6	12	18	L	23	26	
	Minutes Worked	N=13	222	282	342	O	402	462	462
L 3	Skirt Quantity	N=13	5	10	15	W	20	25	
	Minutes Worked	N=13	225	285	345	A	405	465	465
L4	Skirt Quantity	N=13	4	6	10	N	15	20	
	Minutes Worked	N=13	232	292	352	C	412	472	472
	Total	52				E			467

Question4:Teacher Competency

Frequencies

Notes

Output Created	06-NOV-2021 21:48:47	
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=r1 r2 r3 r4 r5 r6 r7 /ORDER=ANALYSIS.	
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Statistics

		I can use CAD/CAM software for designing and grading patterns.	I can make patterns from commercial patterns	I can draft patterns	I have been trained to use CAD/CAM software	I have constru cted sample s of garmen ts as demon stration to learner s.	I have been trained industrialising TTD le
N	Valid	52	52	52	51	52	
	Missing	0	0	0	1	0	

Frequency Table

I can use CAD/CAM software for designing and grading patterns.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	26	50.0	50.0	50.0
	Agree	17	33.3	33.3	83.3
	Slightly Agree	9	16.7	16.7	100.0
	Total	52	100.0	100.0	

I can make patterns from commercial patterns

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	22	41.7	41.7	41.7
	Slightly Agree	4	8.3	8.3	50.0
	Strongly Agree	26	50.0	50.0	100.0
	Total	52	100.0	100.0	

I can draft patterns

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	13	25.0	25.0	25.0
	Slightly Agree	4	8.3	8.3	33.3
	Strongly Agree	35	66.7	66.7	100.0
	Total	52	100.0	100.0	

I have been trained to use CAD/CAM software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	26	50.0	54.5	54.5
	Slightly Disagree	4	8.3	9.1	63.6
	Agree	13	25.0	27.3	90.9
	Slightly Agree	1	8.3	9.1	100.0
	Total	48	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

I have constructed samples of garments as demonstration to learners.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	4	8.3	8.3	8.3
	Agree	22	41.7	41.7	50.0
	Slightly Agree	4	8.3	8.3	58.3
	Strongly Agree	48	41.7	41.7	100.0
	Total	52	100.0	100.0	

I have been trained for industrialising TTD learning.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	9	16.7	25.0	25.0
	Slightly Disagree	4	8.3	12.5	37.5
	Agree	9	16.7	25.0	62.5
	Slightly Agree	9	16.7	25.0	87.5
	Strongly Agree	4	8.3	12.5	100.0
	Total	8	66.7	100.0	
Missing	System	17	33.3		
Total		52	100.0		

I want to upgrade my TTD knowledge.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	5	8.3	8.3	8.3
	Agree	22	41.7	41.7	50.0
	Slightly Agree	5	8.3	8.3	58.3
	Strongly Agree	22	41.7	41.7	100.0
	Total	52	100.0	100.0	

```

COMPUTE WCompetenceave=MEAN(r8,r9) .
EXECUTE.
DESCRIPTIVES VARIABLES=r8 r9 WCompetenceave
/STATISTICS=MEAN STDDEV.

```

Descriptives

Notes

Output Created		06-NOV-2021 21:49:47
Comments		
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Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=r8 r9 WCompetenceave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,02

Descriptive Statistics

	N	Mean	Std. Deviation
Assessment needs are done for teacher.	52	3.75	1.215
Trainings are done to improve teacher competency	52	3.33	1.371
WCompetenceave	52	3.5417	1.21465
Valid N (listwise)	52		

```
FREQUENCIES VARIABLES=r8 r9
/ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created	06-NOV-2021 21:50:04	
Comments		
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	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=r8 r9 /ORDER=ANALYSIS.	
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,01

Statistics

		Assessment needs are done for teacher.	Trainings are done to improve teacher competency
N	Valid	52	52
	Missing	0	0

Frequency Table

Assessment needs are done for teacher.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	43	8.3	8.3	8.3
	Agree	17	33.3	33.3	41.7
	Slightly Agree	26	25.0	25.0	66.7
	Strongly Agree	17	33.3	33.3	100.0
	Total	52	100.0	100.0	

Trainings are done to improve teacher competency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	9	16.7	16.7	16.7
	Agree	22	41.7	41.7	58.3
	Slightly Agree	9	16.7	16.7	75.0
	Strongly Agree	26	25.0	25.0	100.0
	Total	52	100.0	100.0	

```

COMPUTE Fundingave=MEAN(r10,r11,r12,r13,r14,r15) .
EXECUTE.
DESCRIPTIVES VARIABLES=r10 r11 r12 r13 r14 r15 Fundingave
  /STATISTICS=MEAN STDDEV.

```

Descriptives

Notes

Output Created		06-NOV-2021 21:51:01
Comments		
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	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=r10 r11 r12 r13 r14 r15 Fundingave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,02

Descriptive Statistics

	N	Mean	Std. Deviation
--	---	------	----------------

The budget allocated to TTD is satisfactory	52	3.08	1.311
Material for TTD is purchased in time	52	2.58	1.782
We launch Fund raising activities to raise money for buying materials.	52	1.08	.289
Department is funded by NGO	52	1.08	.289
The department is church funded	52	1.08	.289
The department is funded by other organisations.	52	1.08	.289
Fundingave	52	1.6667	.47673
Valid N (listwise)	52		

```
FREQUENCIES VARIABLES=r10 r11 r12 r13 r14 r15
/ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created	06-NOV-2021 21:51:35	
Comments		
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	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=r10 r11 r12 r13 r14 r15 /ORDER=ANALYSIS.	

Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Statistics

		The budget allocated to TTD is satisfactory	Material for TTD is purchased in time	We launch Fund raising activities to raise money for buying materials.	Department is funded by NGO	The department is church funded	The department is funded by other organisations
N	Valid	52	52	52	52	52	
	Missing	0	0	0	0	0	

Frequency Table

The budget allocated to TTD is satisfactory

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	9	16.7	16.7	16.7
	Slightly Disagree	4	8.3	8.3	25.0
	Agree	22	41.7	41.7	66.7
	Slightly Agree	9	16.7	16.7	83.3
	Strongly Agree	9	16.7	16.7	100.0
	Total	52	100.0	100.0	

Material for TTD is purchased in time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	26	50.0	50.0	50.0
	Agree	9	16.7	16.7	66.7
	Slightly Agree	4	8.3	8.3	75.0
	Strongly Agree	13	25.0	25.0	100.0
	Total	52	100.0	100.0	

We launch Fund raising activities to raise money for buying materials.

				Cumulative
	Frequency	Percent	Valid Percent	Percent

Valid	Disagree	48	91.7	91.7	91.7
	Slightly Disagree	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

Department is funded by NGO

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	48	91.7	91.7	91.7
	Slightly Disagree	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

The department is church funded

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	48	91.7	91.7	91.7
	Slightly Disagree	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

The department is funded by other organisations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	48	91.7	91.7	91.7
	Slightly Disagree	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

```

COMPUTE WEnvironmentave=MEAN(r16,r17,r18,r19,r20,r21,r22,r23,r24,r25) .
EXECUTE.
DESCRIPTIVES VARIABLES=r16 r17 r18 r19 r20 r21 r22 r23 r24 r25 WEnvironmentave
/STATISTICS=MEAN STDDEV.

```

Descriptives

Notes

Output Created		06-NOV-2021 21:53:06
Comments		
Input	Data	C:\Users\NTANDO\Downloads\Dube data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=r16 r17 r18 r19 r20 r21 r22 r23 r24 r25 WEnvironmentave /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,02

	Mean	Std. Deviation
Machines have permanent positions	2.18	1.401
There is enough sanitary equipment	2.30	1.767
There is enough sewing space	2.36	1.629
working rooms are well ventilated	2.58	1.975
There is a first aid kit in the sewing room	2.45	2.018
There is enough supervision during sewing	7.33	10.629
There is enough cutting space	3.08	1.443
Learners are aware of the safety precautions	4.17	.835
Learners talk to each other during sewing lessons	3.92	1.084
Learners are given relaxation time during sewing	3.00	1.859
WEnvironmentave	3.3755	1.18661
Valid N (listwise)		

FREQUENCIES VARIABLES=r16 r17 r18 r19 r20 r21 r22 r23 r24 r25
/ORDER=ANALYSIS.

Frequencies

Notes		
Output Created		06-NOV-2021 21:53:24
Comments		
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	Active Dataset	DataSet1
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=r16 r17 r18 r19 r20 r21 r22 r23 r24 r25 /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00,02
	Elapsed Time	00:00:00,02

		Statistics					
		Machines have permanent positions	There is enough sanitary equipment	There is enough sewing space	working rooms are well ventilated	There is a first aid kit in the sewing room	There is a supervisor in the sewing room
N	Valid	51	50	51	52	51	51
	Missing	1	2	1	0	1	1

Frequency Table

Machines have permanent positions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	26	50.0	54.5	54.5
	Agree	9	16.7	18.2	72.7
	Slightly Agree	13	25.0	27.3	100.0
	Total	48	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

There is enough sanitary equipment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	26	50.0	60.0	60.0
	Agree	4	8.3	10.0	70.0
	Slightly Agree	4	8.3	10.0	80.0
	Strongly Agree	9	16.7	20.0	100.0
	Total	43	83.3	100.0	
Missing	System	9	16.7		
Total		52	100.0		

There is enough sewing space

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	26	50.0	54.5	54.5
	Agree	4	8.3	9.1	63.6
	Slightly Agree	13	25.0	27.3	90.9
	Strongly Agree	4	8.3	9.1	100.0
	Total	48	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

working rooms are well ventilated

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	30	58.3	58.3	58.3
	Slightly Agree	5	8.3	8.3	66.7
	Strongly Agree	17	33.3	33.3	100.0
	Total	52	100.0	100.0	

There is a first aid kit in the sewing room

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	30	58.3	63.6	63.6
	Strongly Agree	17	33.3	36.4	100.0
	Total	47	91.7	100.0	
Missing	System	4	8.3		
Total		52	100.0		

There is enough supervision during sewing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	9	16.7	16.7	16.7
	Slightly Agree	17	33.3	33.3	50.0
	Strongly Agree	22	41.7	41.7	91.7
	41	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

There is enough cutting space

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	13	25.0	25.0	25.0
	Slightly Disagree	5	8.3	8.3	33.3
	Agree	5	8.3	8.3	41.7
	Slightly Agree	26	50.0	50.0	91.7
	Strongly Agree	5	8.3	8.3	100.0
	Total	52	100.0	100.0	

Learners are aware of the safety precautions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	3	25.0	25.0	25.0
	Slightly Agree	4	33.3	33.3	58.3
	Strongly Agree	5	41.7	41.7	100.0
	Total	12	100.0	100.0	

Learners talk to each other during sewing lessons

		Frequency	Percent	Valid Percent	Cumulative Percent
--	--	-----------	---------	---------------	--------------------

Valid	Slightly Disagree	1	8.3	8.3	8.3
	Agree	4	33.3	33.3	41.7
	Slightly Agree	2	16.7	16.7	58.3
	Strongly Agree	5	41.7	41.7	100.0
	Total	12	100.0	100.0	

Learners are given relaxation time during sewing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	30	41.7	41.7	41.7
	Agree	5	8.3	8.3	50.0
	Slightly Agree	9	16.7	16.7	66.7
	Strongly Agree	18	33.3	33.3	100.0
	Total	52	100.0	100.0	

```
COMPUTE Monitoringave=MEAN(r26,r27,r28,r29).
EXECUTE.
DESCRIPTIVES VARIABLES=r26 r27 r28 r29 Monitoringave
/STATISTICS=MEAN STDDEV.
```

Descriptives

Notes

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		data.sav
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Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.

Syntax	DESCRIPTIVES VARIABLES=r26 r27 r28 r29 Monitoringave /STATISTICS=MEAN STDDEV.	
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Descriptive Statistics

	N	Mean	Std. Deviation
Right hand to left hand chart	52	1.67	1.073
Student to machine chart	52	1.75	1.138
Multiple activity chart	52	1.75	1.138
Relaxation time chart	52	1.67	1.073
Monitoringave	52	21.4167	.26827
Valid N (listwise)	52		

FREQUENCIES VARIABLES=r26 r27 r28 r29
/ORDER=ANALYSIS.

Frequencies

Notes

Output Created	06-NOV-2021 21:54:43	
Comments		
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	Split File	<none>
	N of Rows in Working Data File	52
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax	FREQUENCIES VARIABLES=r26 r27 r28 r29 /ORDER=ANALYSIS.	
Resources	Processor Time	00:00:00,00

Statistics

		Right hand to left hand chart	Student to machine chart	Multiple activity chart	Relaxation time chart
N	Valid	52	52	52	52
	Missing	0	0	0	0

Frequency Table**Right hand to left hand chart**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	34	66.7	66.7	66.7
	Slightly Disagree	5	8.3	8.3	75.0
	Agree	8	16.7	16.7	91.7
	Slightly Agree	5	8.3	8.3	100.0
	Total	52	100.0	100.0	

Student to machine chart

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	34	66.7	66.7	66.7
	Agree	13	25.0	25.0	91.7
	Slightly Agree	5	8.3	8.3	100.0
	Total	52	100.0	100.0	

Multiple activity chart

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	34	66.7	66.7	66.7
	Agree	26	25.0	25.0	91.7
	Slightly Agree	4	8.3	8.3	100.0
	Total	52	100.0	100.0	

Relaxation time chart

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	34	66.7	66.7	66.7
	Slightly Disagree	5	8.3	8.3	75.0
	Agree	8	16.7	16.7	91.7
	Slightly Agree	5	8.3	8.3	100.0
	Total	52	100.0	100.0	

```

COMPUTE TConctruictionave=MEAN(z1,z2,z3,z4,z5,z6,z7,z8,z9,z10,z11) .
EXECUTE.
DESCRIPTIVES VARIABLES=z1 z2 z3 z4 z5 z6 z7 z8 z9 z10 z11 TConctruictionave
/STATISTICS=MEAN STDDEV.

```

APPENDIX I - Sample Calculations

Measurements	Calculation
Confidence Level	70%
Margin of error	5%
Population proportion	92%
Population Size	121
Sample size	26

Measurements	Calculation
Confidence Level	90%
Margin of error	10%
Population proportion	30%
Population Size	476
Sample size for learners	52

APPENDIX J- List Of Equipment

Time study equipment:

The equipment needed for time stud:

1. Stop watch.
2. Picture camera or Phone camera
3. Computer or Laptop (Optional for storing data)

Sewing equipment:

Purpose designed workshop

Cutting tables (1.80cm by 90cm)

Basic industrial cutting tools

Industrial straight sewer for each learner

Industrial over locker

Designing equipment

4metres cotton blend material, valine and matching thread

Pins, notcher and pattern markers.

Making the Time study:

These eight steps, however, are usually required:

1. Secure all equipment for recording information about the operations.
2. Record a complete description of the method used.
3. Observe and record the time taken by the learner.
4. Rate the learner's performance (slow, relaxed, business like)
5. Determine the allowances (for eating and to the rest room and any other time required for relief and emergency)
8. Determine the time taken to make the skirt).

Request for a Time study:

- teacher should confirm satisfactorily before starting the study.
 - The teacher should ensure that the learners have thoroughly learned how to make the skirt and they are following the prescribed method.
 - The teacher should inform the learners in advance that a time study is to be made, stating the purpose of the research as stipulated in the questionnaire.
 - All results and pictures should be forwarded to the researcher at the end of the time study: Sindisiwe Dube
- Email: Sindisiwemabuza@gmail.com Phone: +26775491317

APPENDIX K– Results and Pictures from Schools

A. Welch t test results

P value and statistical significance:

The two-tailed P value equals 0.0002

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of School Operations minus Improved environment (Whole garment method) equals 111.6208

95% confidence interval of this difference: From 65.4689 to 157.7727

APPENDIX M– English Editing Certificate

CHINHOYI UNIVERSITY OF TECHNOLOGY



INSTITUTE OF LIFELONG LEARNING AND DEVELOPMENT STUDIES

CENTRE FOR LANGUAGE AND COMMUNICATION STUDIES

EDITORIAL CERTIFICATE

DATE 12 June 2024

Author: Sindisiwe Mabuza

Thesis Title: An Analysis of Textile Technology and Design Subject Operations for Secondary Schools through the Work Study Approach: A case for Zimbabwe.

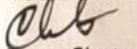
To Whom It May Concern

This letter confirms that the above-mentioned thesis was edited by a professionally qualified English Language specialist. The Editor in question has a Master of Arts Degree in English and a PhD in Media Studies and currently chairs the Centre for Language and Communication Studies at Chinhoyi University of Technology in Zimbabwe.

The proofreading and editing attended to grammatical and syntactical issues only. The editor made no effort to address substantive matters of content covered in the thesis. Similarly, arguments advanced by the researcher in the thesis, whether tenable or untenable, were not altered except in cases where they were not articulated succinctly.

The author of the thesis can accept or reject the syntactical and grammatical alterations done by the editor.

Yours Sincerely


Isaac Choto

(PhD Media Studies, MA English, BA Hons English and Communication)