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Research article

An Analysis of the Textile Technology and Design Subject Operations for Secondary Schools in Zimbabwe

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ABSTRACT

This study evaluates the Textile Technology and Design (TTD) curriculum in Zimbabwean secondary schools, highlighting the need for performance improvement in a competitive work environment. Employing a post-positivism research paradigm with mixed methods, it examines operations procedures, challenges, and enhancement strategies among staff and pupils. indicate prevalent use of standard operations with gaps in pattern development and finishing processes. The study suggests integrating a method study unit for systematic analysis, optimizing production systems for TTD self-sustainability, and establishing network-sharing centres to bridge the gap between traditional methods and technological advancements.

Keywords: Operations, Improvement, Industrialisation.

Background of the study

Leaders worldwide are urging for a transformation in the clothing industry due to dissatisfaction with the current state of operations in teaching and learning (Sukwadi, 2021). The rapid changes in the clothing industry have presented numerous operational challenges in education today (Periyasamy & Periyasami, 2023). Textile Technology and Design (TTD) education has shifted its focus from planning and control to continuous improvement (Islam, 2021). Industrial markets are expanding their manufacturing activities and are motivated to integrate modern manufacturing operations to provide high-quality products and services at reasonable costs (Muhammad, Dawood, Arsalan, Abdul, Muhammad & Atif, 2022). Over the past century and a decade, schools have experimented, discarded, iterated, evolved, and embraced methods of operating the TTD subjects that

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have proved appropriate and effective (Wood &Varran, 2023). As the clothing industry aspires to succeed in its operations, the TTD subject as the base of the industry is no exception.

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). While the operations in schools do not always prepare learners well, the most important elements of the TTD subject and process are seldom taught (Meyer & Norman., 2020. In some secondary schools, learners were not given adequate 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 & Mberengwa, 2021). The learner's exit profile in the TTD subject thriftily matches the needs of industry and university requirements (Chuma, 2022).

There is a need for a work study system that will give a deep analysis of the operations in the TTD subject in Zimbabwe schools. Work study has proved as an effective method for improving production in other industries and can also be used in education, India, Bangladesh and China have embraced the use of work study technique to improve TTD subject operations and it has contributed to their major contributions in textile products and trade. In India the wide gap between the industry and educational institutes is bridged by using the work study method to find the problems in the subjects and proposing solutions (Abbate, Centobelli & Cerchione, 2023). The work study process has been used in the clothing industry and it aims at analyzing and doing work better while exploring the methods used to measure work done (Chisosa & Chipambwa, 2018).

The TTD program in Zimbabwe is a vital component of the education system, particularly in vocational and technical education (Ministry of Higher and Tertiary Education, Science and Technology Curriculum Development, 2013). It equips students with the necessary knowledge and skills to work in the textile industry or pursue further studies in related fields. The TTD curriculum in Zimbabwe covers various topics such as Textile Science, Textile Processes, Fashion and Design, and Entrepreneurship (Ministry of Primary and Secondary Education, 2015). Textile Science involves studying the properties and behavior of textile fibers, yarns, and fabrics, while Textile Processes focuses on manufacturing techniques like weaving, knitting, dyeing, and finishing. Fashion and Design emphasize creative aspects such as design principles, color theory, pattern making, and garment construction. Entrepreneurship skills are also developed to prepare students for starting and managing their own textile-related ventures.

To enhance practical skills and industry relevance, TTD programs in Zimbabwe often incorporate hands-on training and industrial attachments. Students gain experience working with textile machinery, learning different processes, and creating their own textile products. Industrial attachments provide exposure to real-world work environments and allow students to apply their skills in professional settings. Graduates of TTD programs

have various career opportunities in the textile and fashion industry, including roles like textile technologists, fashion designers, textile engineers, quality control inspectors, and more (Costa, Azoia, Silva & Marques, 2020).

Despite efforts to improve the TTD learning area, the operations still need enhancement for Zimbabwe to compete technologically with other countries in the textile industry. The substandard operations are characterized by waste, poor working conditions, low resource utilization, absence of proper work procedures, and poor work standardization. To address these issues, continuous operations improvement is crucial, and techniques like work study could be employed to analyze and improve TTD operations.

Statement of the problem

Zimbabwe faces operational challenges in teaching and learning Textile Technology and Design (TTD) in secondary schools. The current operations in TTD education do not align with the changing needs of the clothing industry, which demands improved efficiency and quality (Chirapa & Mberengwa, 2021). The existing TTD curriculum covers various topics, but the operational methods used to teach and assess students' performance are ineffective and outdated. As a result, the TTD subject is not competitive enough globally, hindering the country's technological advancement in the textile industry. There is a need to analyze and improve the operations in the TTD subject in secondary schools through work study techniques, method study, and work measurement. Linking work study and the TTD subject could help analyse operations for secondary schools in Zimbabwe. Work study has proved as an effective method for improving vocational education in China and India (Khan, 2014). However, to date limited studies have been carried out to improve TTD subject operations in secondary schools through work study in Zimbabwe. However, limited research has been conducted to address the TTD subject operational short comings. It is alongside this background that the study seeks to analyze operations and methods used in the TTD subjects through work study and establish the gap from industry operations for improvement in the TTD subject operations for secondary schools in Zimbabwe.

Research Objective

To analyse the operations of Textile Technology and Design subject at secondary schools in Zimbabwe.

Methodology

In this study, a post-positivism research paradigm was adopted in the foam of mixed methods research approach, which combines both quantitative and qualitative methods. By prioritizing quantitative data and strengthening the findings with qualitative data through triangulation, and synthesis of ideas, this paradigm is well-suited for studying operations in TTD subjects in secondary schools.

The study utilized sequential triangulation survey design, which involves the use of multiple methods or data sources to develop a comprehensive understanding of the research topic. By combining qualitative and quantitative data, the design aims to complement and clarify the findings, identify common themes, and explore the relationship between current operations in the TTD subject and standard operations in the clothing industry.

In this study, the population consisted of A Level secondary schools in Zimbabwe that offer TTD. The target population included 121 A Level secondary schools. Non-probability sampling techniques were used to deliberately select specific schools and participants. Maximum variation sampling was employed to select 26 schools with a range of characteristics. Convenience sampling was used to select TTD teachers in the selected schools. Simple random selection was used to choose 52 learners for participation. The sample size was determined using Andrew Fisher's formula.

Introduction letter and research ethics letter were obtained from the university and permissions were sought from relevant authorities, The Ministry of Primary and Secondary Education and from the Secondary School Heads. Data was collected using a mixed methods approach, including online questionnaire, interview and observation. TTD subject supervisors and researchers participated in data collection through various methods, including observation, interviews, and online questionnaires.

Data collection was done using online questionnaire, interview, and observation. Online questionnaires were distributed to selected respondents, allowing for anonymity and flexibility in completing the survey. Interviews were conducted through online platforms, and observations were made in selected schools. A case study was used to gather additional information about standard time for the TTD subject. The collected data analyzed in various techniques, such as descriptive statistics, ANOVA, coding, and thematic analysis. Quantitative data from questionnaire were analyzed using SPSS to determine mean agreements, while qualitative data were coded and organized into themes.

Reliability, Validation, and Trustworthiness of Research Instruments

The validity and reliability of the research instruments were assessed. Face and content validity were considered, and the questionnaire was reviewed and validated by supervisors. Pilot studies were conducted to test the reliability of the instruments, and necessary changes were made. The Cronbach Alpha analysis was used to assess the reliability of the questionnaire.

Results

Demographic Profile of Respondents

Table 1:Demographic profile of the teachers in the TTD subject.

Variable	Specific variable		Frequency	Percentage
Gender	Male		5	19.2
	Females		21	80.8
Age	30 and below		3	11.5
	31 to 50 years		18	69.3
	51 and above		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 Total Frequency		2 26	7.7

The results show that the TTD subject is female dominated with 80.8% females and 19.2% males. Most teachers were between the ages of 31 and 50 years. This might show that most females prefer teaching the TTD subject than males and that most of the teachers are mature as reflected by the age range.

Table 2: Demographic profile of learners**.**

Variable	Specific variable	Frequency	Percentage
Gender	Male	7	19.2
	Females	45	80.8
Age	Below 15	5	11.5
	15 to18	40	69.3
	Above 18	7	19.2

The results revealed that the TTD subject is female-dominated, with 80.8% female learners and 19.2% male learners. Most learners were between the age of 15 and 18 which implies maturity for engagement in the improved curriculum and the age bracket between 15 and 18 which is the best group to train in technological operations for future development in Zimbabwe. A similar pattern was also noted by (Charamba & Mberengwa, 2021) ;(Coulter, 2023), where the researchers found that the TTD subject is dominated by females.

TTD subject operations for Garment construction in secondary schools in Zimbabwe?

This research question sought to elicit the operations in the TTD subject. Data was collected using questionnaire, interview and observation. The focus of the revised A Level TTD subject syllabus (2015-2022) is 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 of products in the TTD matches what is expected in the clothing and apparel industry standards operating procedures.

Table 3: Operation breakdown in the garment construction section in TTD subject in schools in Zimbabwe.

Present TTD 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 shows 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 performed design development. Marker making/ laying out was always done by some learners 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 respondents at the sampled schools. The data indicated that fusing /ironing was done by 75%, 16.7% of the respondents indicated that they sometimes fused/ironed their products during the construction process and 8.3% indicated that they never did the fusing/ironing operation. Quality control was being done by 85% of learners and 100% teachers who agreed that it was 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% indicating that it was sometimes done 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. The results were confirmed by one of the teachers who was asked how operations were 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 the very few managed

to complete the all the garment construction processes during the time allocated for the TTD subject" (P14)

It was also observed that learners were very free to do patterns the way they wanted; the teachers seemed to have little input on order of operations. 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 most of the first and ending operations were not done in the TTD subject in secondary schools in Zimbabwe.

Methods used in the TTD subject operations in secondary schools.

This research question sought to examine the methods used to execute operations in the TTD subject. Data was collected using a questionnaire, interview and observation. 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 match those methods needed in the clothing apparel and fashion industry. The findings are presented in the sections below

This operation starts with design development which is a crucial phase in the making of apparel, which involves creating initial design concepts, and carefully choosing the fabrics

Table 4: 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%	8.3%	16.7%	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%

Table 5 : 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 table 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 has never been used in their daily operations as one learner said:

"I have never seen or used the CAD software for designing but we have an idea of what CAD is" (p17)

When participants were asked to explain how they did their patterns. It was revealed that the manual methods dominated the pattern marking operations as one of the learners said:

"*I prefer to use manual pattern drafting because that is what I have been taught from form 1" (p23)*

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" (p34)*

Teachers also confirmed their lack of knowledge with 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 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" (P23)

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 pattern drafting method dominated in most of the schools.

Table 6: 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 on the frequency of usage of maker making methods is presented in a table form and 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 the use of computerized 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 used computerized marker-making methods, and a standard deviation of .289 shows that a few learners never used the manual marker-making method. Computerized marker making was not used by the sampled schools, as shown by a response of (100%) and a standard deviation of .000. This shows that manual marker making was mostly used while computerized marker making was never used.

Methods used in the Cutting Operation

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 and cutting tools and their average score based on the study sample.

Table 7: ***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**

The data represents 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 that they sometimes used the tables. 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. Observation 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 suggests 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 schools use domestic cutting tools. In line with the above sentiments the Learners 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" (p40)

It was also observed that each learner cuts his/her own garment pieces, and most learners used 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 indicates that most schools did the cutting operation manually. Observations also revealed that students used the scissors only and cutting was done on single layers of fabric.

Transferring Marking/ Marking Operation

Table 8: ***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 represents 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%) were using it sometimes. The table shows that 8.3% used tailor's chalk. This data, therefore, suggests 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 also represent responses to a survey question about the frequency with which the learners used notchers to transfer markings. Of these responses, 91.7% indicated that they never used notchers to transfer markings, while 8.3% were using notchers sometimes.

Based on this data, it can be concluded that a majority of respondents never used notchers to transfer makings, while a smaller proportion used them, and a few respondents used notchers sometimes.

The data indicates that a majority of participants (66.7%) used pins "Always", while a minority (33.3%) used pins "Sometimes" for transferring markings. Thread markings were sometimes used by (25%) and (75%) indicated that they always used thread markings. The data suggests that the majority of respondents always used thread markings. One of the learners confirmed that:

"We use what we were taught during the topic for pattern marking but we have never used notchers in particular" (p13)

The Mean column shows the average score given to each tool/method, while the Std. The 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. The 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 suggests that tracing wheel and tailor's 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 was some variability in respondents' ratings of the tools, especially for notchers, pins, and thread markings.

Fusing operation

The tables below show the methods used for fusing in the TTD subject.

Table 9: **Use of the automatic fusing machines**

Responses		**Percent**
	Never	83.3
	Sometimes	16.7
Total		100.0

Table 10: **Use of iron for fusing**

Responses		**Percent**
	Always	83.3
	Sometimes	16.7
Total		100.0

The data in Table 9 shows that (83.3%) of the sampled teachers and learners have never used automatic fusing machines in the garment construction operation. The remaining (16.7%) indicated that they sometimes used the automatic fusing machine. The

high percentage of respondents who have never used the fusing machine may imply that they used an iron for the fusing operation due to the high percentage (83.3%) of respondents who showed that they used an iron for fusing. It could be due to limited access to the equipment, lack of training or knowledge on operating 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 of the fusing machines 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 have worked in industries where its use is more prevalent. Their responses could provide valuable insights into the benefits, challenges, and applications of the fusing machine in garment construction.

Sewing Operation

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

*Table 11**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 specialize 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 in a specific operation e.g. pockets, collar, sleeve	**66.7**	**33.3**	**0**	**100**	**1.67**	**0.985**

The table shows that all (100%) the sampled TTD teachers and learners were using the whole garment manufacturing system. Departmental whole garment System use in the TTD subject is shown by the response of 33.3% of the teachers and learners who responded that they sometimes used the specialization method, while 67.7% never used specialization system at all. The data therefore suggests that a majority of the respondents never used the departmental whole garment system, with only a minority of the learners using it sometimes. The responses for the Sectionalisation System use is shown by the response of 66.7% of the learners who responded that they never used the Sectionalisation method, while 33.3% used it sometimes. The data therefore suggests that a majority of the respondents never used the sectionalisation method system, with only a minority of the learners using it sometimes. The interview responses concurred with questionnaire responses as the teachers and learners revealed that:

"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" (P1)

"*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" (P4)*

"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. (P14)

One of the learners explained that:

"We make designs, patterns together, cut together and transfer pattern markings together then we do other processes as individuals" (p34)

It was also observed that most learners made their own garments; with just a few schools where other methods of garment construction like line production was used. Some schools have industrialized their TTD departments.

Basing 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.

Finishing Operations

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

Table 12: ***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 and classes.

The mean value for full length mirrors is 2.08, implying that, on average, there were 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 and classes.

The mean value for tape measures is 2.67, suggesting that, on average, there were 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.

The mean value for the finishing equipment availability 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 variables mentioned above. The standard deviation of 0.60000 suggests some variability in the perceived adequacy of equipment across different schools.

When the learners were asked what they used for checking/fitting they seemed to be familiar with the word "fitting" and one of them complained that:

"we do not have fitting equipment like mirrors, dress forms and even rails to hang our garments" (p25)

However, most respondents (83.3%) reported that they always used tape measures, while a minority (16.7%) reported that they never used them.

Table 13: **Pressing and ironing methods**

Pressing	**Always**	**Sometimes**	**Never**	**Mean**	**Standard. Deviation**
Steam irons	91.7	8.3	0	2.83	.577
Steam 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 that respondents mostly used steam irons, charcoal irons, adjustable irons, sleeve boards and steam pressers when pressing products during construction. Steam iron was mostly by the respondents as indicated by the highest percentage usage of 91.7%. Steam presser was used by the least number of respondents as show by the lowest percentage of 8.3%. The presented data also reflects that industrial steamers were not used by the teachers and learners at the sampled secondary schools.

When the learners were asked to explain how they carried out the pressing operation one learner 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". (P6)

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 mean and standard deviation for steam irons, charcoal irons, steam pressers, adjustable ironing boards, sleeve boards, and industrial steamers. The 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 1.00 and in terms of variability

showing that the responses were homogeneous reflecting that all the learners agreed that they were not using 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.

Packaging

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

Table 14: **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 data presents the frequency and percentage of respondents' usage of plastic packets, boxes, bales, storage space, and dress rails as packaging and storage for products in the TTD schools. Most of the respondents were using dress rails although the percentage usage is just fair (58.3%). The least method of packaging was bales and (8%) plastic packets (25%) The "Missing" row indicates that (8.3% of the total) did not provide a response to the question, showing they were using other means of storing products not provided in the table. When learners were asked about packaging one learner laughed and said:

"Ah you expecting us to pack the things that we make, why?" (p8)

Another learner 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 tuck-shop for sale" (P17)

It was observed that other schools use the TTD subject as a production sector in the school and sell uniforms to parents.

Another learner from one of the schools explained that:

"We just do our work and make sure it is neat and keep it in our work bags"

Another learner said:

"We have to fit, check for any defaults so that we get marks and then hang in the cupboards" (p51)

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 provided includes 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 use of 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 is .647, and for bales is .302. 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 (.674) is larger than the standard deviation for bales (.302), which suggests that there was more variability in the use of plastic packets. The standard deviation for boxes (.647) is between the other two, indicating a moderate amount of variability in the use of boxes. The next section presents supervision methods used by the teachers in the TTD subject operations.

Supervision Methods in the TTD subject operations

Table 15: **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% never used online supervision, while the remaining 33.3% reported that they experience it sometimes. The data, therefore, shows that a majority of the respondents have never experienced online supervision. Face-to-face supervision mode was always used by 16,7%, 75% used it sometimes, while 8.3 % were not using it for supervising students' operations, showing that this supervision method was mostly (91.7%) used by the teachers to supervise learners' work. 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. The data suggests that the flow chart was 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 face to face from the way students explained, it showed that they were supervised more on the examination requirements that needed to be submitted. From observation, most teachers and students did not operate in industry, where supervision is strict and more 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 0.40410 to 0.751. 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.

Operational time

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

Table 16: ***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	0	25.0	75.0	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 presents descriptive statistics for four different approaches to estimating 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 teacher estimated the time needed to complete a task. 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 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 for completing a task, and the remaining 44.4% of the participants always estimated the time required to complete a task.

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

The data also shows the frequency and percentage of responses regarding adherence to set performance standards and time to complete sewing tasks and projects. It was revealed that (75%) always followed the set performance standards, while (25%) sometimes followed 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 also shows the use of an unlimited time system in completing practical tasks, with one response being marked as missing. Of the valid responses, (50%) did not have a time limit for completing their tasks, (33.3%) reported that they sometimes had a time limit, and (8.3%) indicated that they always had 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 had a time limit, and 100% reported that they had some

experience with time limits. This data therefore suggests that a majority of individuals did not have a time limit for completing their tasks, but there were still a significant number who sometimes or always had a time limit.

When teachers were asked about the operational time they had a lot to say:

"*Personally, I use the syllabus and the dates for submitting the project, then we learn, and towards submission, we can complete the garment within a week and submit then train them for the final practical exam. When they are ready if you do it too early they are never serious" (P17).*

"Some students are fast, others are slow, so they encourage each other to finish tasks and they motivate each other to complete tasks and sometimes we do exchange programs so that they are motivated by others from other schools" (P14).

Another teacher 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" (P1).*

The next table, 17, presents workflow supervision methods used by the teachers to monitor learners' work.

Table 17: ***Workflow Supervision Methods***

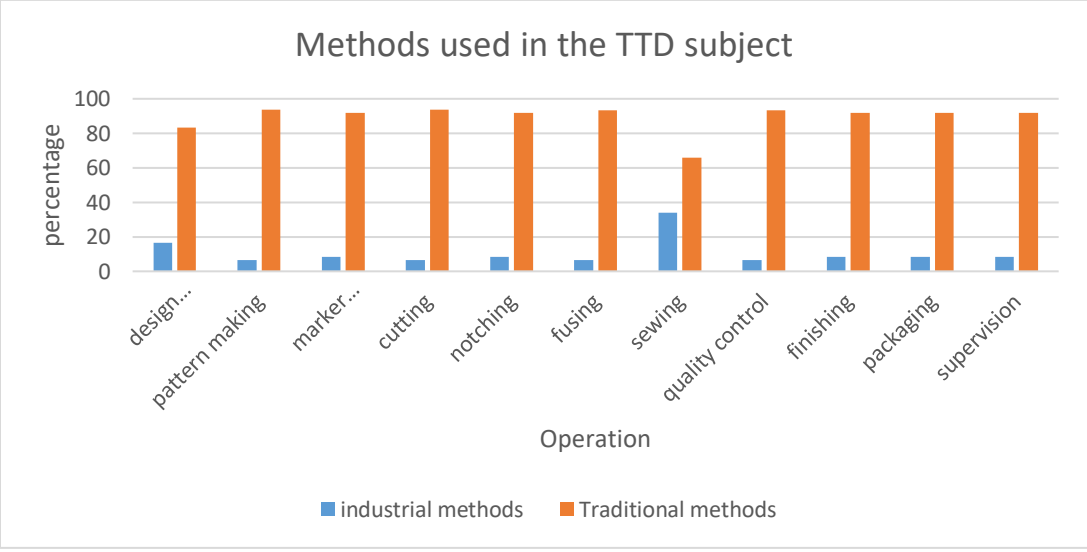
Workflow Methods	**Mean**	**Standard. Deviation**
1.Right hand to left hand chart	1.67	1.073
2.Student to machine chart	1.75	1.138
3.Multiple activity chart	1.75	1.138
4.Relaxation time chart	1.67	1.073
Domain Average	**1.4167**	**2.6827**

Table 18: **Verbal interpretation for workflow supervision methods**

	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 that most learners were relaxed, charting and going out of classes leaving work for a long time with no time study guiding them as reflected by the data in table 17 and 18. The next bar graph summarises and compares the methods used in the TTD subject operations.

Figure 1: Summary of Methods used in the TTD subject Operations



The data above presents the findings of the methods used in the execution of operations 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.

Discussion of Findings

A work study technique was used to find the gap between the operations and methods used in the TTD subject in secondary schools and standard operations expected by the curriculum and clothing industry to produce useful learners for the world of work. The analysis will help identify opportunities for improving TTD subject operations.

Demographic profile of respondents in the TTD subject in secondary schools in Zimbabwe

Gender

The TTD subject was female dominated with 80.8% females and 19.2% males, which points to the fact that more females are interested in Clothing and Textiles than males. Coulter (2023) supports the finding by stating that secondary school curriculums are largely the domain of female students, also affecting higher institutions and even leading to a gender imbalance in the industry. The female domination in TTD subject is also confirmed by Chirapa and Mberengwa (2021) in their study on A Level curriculum compatibility with industry requirements in Zimbabwe, who found out that 83% of the learners in Advanced Level were female and only 17% were males. For a long time, gender-based stereotypes have been labelled to the TTD subject as a female subject training girls to be good mothers and wives in the feature (Mpofu et al., 2022). The stereotype continues even when the subject has changed from Home Economics to Fashion and Fabrics and to date with TTD. The objectives of TTD are inclusive, while the problem still stems from the assessment content; in the previous levels of the subject, continuous and summative assessment questions are almost 90% feminine. Most examination practical questions and textbooks are feminine.

Age

Most teachers were between the ages of 40 and 50, and this finding supports those of Fossen & Sorgner's (2019) study of teacher competency, which found that most teachers were between the ages of 40 and 50. This age group of teachers might have been trained well before the revised TTD subject when it was termed Fashion and Fabrics. This age group faces problems of aligning content learnt during the Fashion and Fabrics phase and the new TTD curriculum. The problem has created anxiety and uncertainty in the expected outcomes of the TTD curriculum. This finding corroborates with those of Chirapa and Mberengwa (2021), who stated the consequences of having implementers who were not sure of their role in the operations of the TTD subject. This implies that there was a need for extensive in-service training of teachers to acquire updated knowledge in the implementation of the TTD subject.

The result also points out that the majority of the learners were in the age bracket of 15 to 20 years which is a youthful category. The youths are the core group that needs to be

well-equipped with skills to enable them to engage in youthful employment (Kassah, 2019).

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

The findings of the study reveal that although the TTD subject syllabus emphasizes empowering the learner to function in the prevailing economy which is production oriented. Although, the subject is aimed at preparing learners for the world of work, the observed 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 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).* Most operations were done in the TTD subject, but notable pattern development, finishing, and packaging processes were sparingly done in some schools. It was confirmed by one of the teachers that learners did what was best for them to make a garment. Therefore, some used commercial patterns and directly lay on fabric without developing the pattern. The use of readymade patterns was common with the old syllabus, where learners were provided with patterns. It, therefore, follows that teachers were stuck in the old ways of doing things. The finishing processes were mostly omitted, but from observations, it surfaced that most learners rarely finished constructing garments and, therefore, could not account for doing the finishing and packing processes, and only a few who finished indicated that they had done the processes. These are crucial processes in the TTD subject summative assessment and in the clothing industry. Design development and pattern making are the keys to garment production and help learners be exposed to 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 &Shamsal, 2024). The TTD subject operations 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. Chirapa and Mberengwa (2021) also established that learners did not acquire adequate essential concepts in designing, pattern making, computer-aided designing, use of industrial sewing equipment and business enterprise, which are critical for business and employment in the clothing industry. It emerged that the cost of industrial machinery is beyond the reach of most schools. For that matter, Muzira and Bondai (2020) and UNESCO (2010) are of the opinion that sustainable relationships between training institutions and schools should be nurtured.

Methods used in the TTD subject operations

The operations were then further investigated to establish the methods used to execute in each operation in the TTD subject in schools. The findings revealed that methods used in the TTD subject operations were dominated by traditional methods than technological methods.

Design Development and Pattern making

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) study on A Level Textile Technology and Design curriculum compatibility with industry requirements in Zimbabwe found that none of the teachers used CAD since most schools could not afford the software. The manual or traditional methods approach is slow and time intensive (Ashan & Shamsal, 2024). 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, speeds up the pattern making process, improve accuracy, and facilitate collaboration between designers, pattern makers, and manufacturers (Roberts & Turner, 2018).

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 (Clark & Evans, 2017; Milinic & Bogojevic, 2021)). Another study conducted by Brink, Kilbrink and Gericke (2022), 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. By embracing new technologies and adapting to the changing landscape of 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.

Marker making, fabric spreading and marking methods

The research 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 Zimsec papers. There was not much time and effort given to this laying out the fabric and pattern pieces during teaching and learning, a lot of fabric waste was observed and some learners made mistakes and restarted cutting. Basically, the trial-and-

era method was prevalent in schools. Each learner made a layout that suits them, while in industry, after a marker is done, more layers of fabric are cut. The manual traditional method, such as laying out plans that were commonly used in schools, may not be kept for feature use. It is only used once, and the efficiency is lower than computerised marker making causing a large amount of fabric waste (Elshishtawy et al., 2021)

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 of tools that can enhance precision and efficiency in transferring markings.

Cutting Out Methods

The findings on the cutting methods reveal that there was a preference for traditional methods of cutting. The majority of respondents used 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. The findings regarding the preference for traditional cutting tools and limited utilization of advanced cutting technologies in the surveyed population align with research conducted in developed countries.

Although the use of technological equipment has a great advantage in speed and accuracy, they usually present problems during electricity power cuts, mostly experienced in most developing countries. Manually operated equipment tends to be ideal in areas that are totally remote and have 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 & 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 (Evans & Jenkins, 2017; Smith & Nichols, 2015). These technologies can streamline the cutting process, reduce fabric waste, and increase productivity in textile production.

Fusing Methods

The survey findings indicate that a significant majority of respondents have never used automatic fusing methods to interface or interline garments. The processes that need interfacing and interlining were processed manually using irons which are time-consuming

and monotonous work if large quantities of garments are to 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.

There was relatively small percentage of respondents who indicated that they used the automatic fusing machine. These respondents might have been trained in the use of the fusing machine or worked in industries where its use is more prevalent. 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, 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 man power, increased number of items fused at a time and reduces the time taken for completing garments, thus they are cost effective. The fusing machine is listed in the equipment needed for the running of TTD subject according to the syllabus giving a justification for schools not to rely on traditional fusing methods. Muntasir (2023) lists the equipment and methods used for fusing such as the flat bed fusing press, continuous fusing press and the high frequency fusing and in addition the hand iron and the steam press are part of the fusing machines. The next section presents sewing methods used in garment construction by most of the sampled schools.

Sewing Methods

The findings regarding the methods used for sewing revealed that the preference was for the whole garment system and limited use of more modernized production systems, such as sectionalisation were not common among schools. The whole garment system, where one person is responsible for producing a complete garment, is a traditional method that offers simplicity and ease of coordination. However, it may not be the most efficient or productive approach for large-scale production (Harrison & Wilson, 2017; Thompson, Peppler & Keune, 2020). On the other hand, sectionalisation, which involves dividing the production process into sequential tasks performed by different individuals or workstations, offers advantages in terms of specialization, efficiency, and productivity (Khosravi, Sadeghi & Jolai, 2011; Vázquez-Cano, Sáez-López, Grimaldo-Santamaría, & del Pilar, (2023)) although, this may limit the learners' exposure to various construction methods and techniques on different garments.

The findings are similar to those done by Cassidy (2018) in the UK in a study for revitalizing and enhancing sewing skills and expertise where methods used in the sewing operation were far from the systems used in the fashion industry. Amankwa et al. (2015) in their study on improving skills among clothing and textile learners in Ghana, also found that the whole garment method was commonly used due to insufficient teaching and learning hours

allocated for teaching practical courses in TTD and lack of adequate teaching and learning materials at the second cycle institutions. Researchers have tried to explore the situation in Zimbabwe and a common conclusion was made by Sithole, Sithole & Chirimuta (2018), Mupfumira & Nyaruwata (2019), Gudyanga & Jita (2019), and Chirapa and Mberengwa (2021) that learners did not acquire adequate and essential sewing skills that are compatible with the clothing industry in Zimbabwe.

Embracing other methods like sectionalisation production methods could result in an increase in production process among TTD learners. This is consistent with findings from Sawitri (2019) in Indonesia who found that the achievement of the students in Fashion Business Management subject was 83.41% and recommended the teaching factory learning to be applied in another subject like the TTD subject. Sawitri (2019) also explained that the implementation of teaching factory learning needs a special environment for students to manage the business and needs support from the TTD department and Engineering department (CDU). This also applies to the situation in Zimbabwe basing on the study finding which unpacked that most industrial production processes were not used by most schools due to inadequate time, space and equipment.

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.

Finishing Methods

Checking and Quality control

The results revealed that the tape measure was the most used tool for checking. Dress forms and full length mirrors are rarely used for quality control in schools. Garments are checked for quality of sewing and manipulation by teachers and all defects are returned for correction.

Pressing

The findings indicate a prevalent use of steam irons and charcoal irons for pressing, which are traditional pressing tools. The adoption of more advanced equipment, such as industrial steamers was very 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 such as Industrial steamers. The limited use of these advanced pressing methods suggests an opportunity for improvement in achieving higher quality finishing in textile products.

Packaging

The findings for packaging showed that bales, plastic packets and boxes were used by 50% of the respondents. This finding could allude to the fact that not much bulk production was done in the TTD subject during learning and therefore no reason for packaging. It was revealed during the interview that packaging is done when the schools were submitting for summative assessment at the end of the year and the products were usually packaged in boxes.

Supervision Methods in the TTD subject operations

The findings for supervision in the TTD subject revealed that the online supervision was not experienced in most schools in the TTD subject while face to face supervision was sometimes experienced. The right to left hand chart and the flow charts were not commonly used in the TTD subject for supervising operations. Observations revealed that students were relaxed, charting and going out of classes leaving work for a long time with no time study guiding them. According to Ngwenya (2020), supervision should enable both the teachers and learners to identify weaknesses and strengths which would help in operations improvement. School based supervision by teachers, heads of departments and school administrators would minimise the external inspectorate supervision if fully enforced in the Zimbabwean schools. The data from school supervision can then be sent online for further supervision up to the curriculum developers who will then make informed decisions to drive efficiency and optimization of operations in the TTD subject.

The use of the traditional (face to face supervision) is discouraged over online-supervision which uses email, video, and other online resources to report occurrences in the teaching field (Zhang & Zhao, 2022). Moreover, online supervision comes with expenses that include training and technological equipment while it has benefit like decreased travel time and expenses, and flexible scheduling in the long run it becomes cost effective and communication covers a number of schools at once.

Conclusion

The operations in the Textile Technology and Design (TTD) subjects in Zimbabwe's secondary schools primarily did not represent the operational expectations of industry and the curriculum plan recommendations. The TTD operations were mostly based on domestic methods rather than industrial methods. This indicated that most 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 (Curriculum Development and Technical Services, 2015).The use of outdated tools and

production methods in TTD education suggests a gap between the existing practices and the technological advancements. The survey findings reveal limited usage of computer-aided design (CAD) software for pattern making, hand-operated cutting machines, notchers for transferring markings, fusing machines for fabric bonding and limited monitoring of workshop operations from internal and external supervisors in schools. This lack of adoption hindered students' ability to adapt to industry practices and limited the efficiency and quality of textile production. Incorporating these advanced technologies could significantly enhance precision, efficiency, and productivity in TTD education and the textile industry in Zimbabwe.

Recommendations

Operations and methods used to execute operations

- Method study could be implemented in the education supervision system. Method study units could be positioned in the system to be responsible for analysis and laying out the most effective methods in garment construction that resemble mini industry procedures. A standard operational chart could be specified at curriculum development stage for the TTD subject so that all necessary garment construction processes are specified in line with the clothing industry operations standard.
- The operations in the TTD subjects in secondary schools in Zimbabwe reflect the utilization of outdated tools and methods across various aspects of textile and garment construction. Machine attachments, equipment and methodologies to align TTD education with technological advancements and industry standards.
- Collaborating with textile industry stakeholders, such as textile manufacturers, suppliers, and retailers, can create opportunities for partnerships that support TTD subject operations like attachment and staff development programs. These stakeholders may be willing to provide financial support or donate tools and equipment to schools, recognizing the importance of nurturing future talent in the textile industry. By establishing partnerships and leveraging these networks, schools can access the resources needed to acquire essential tools and equipment for their TTD programs through attaching learners and teachers so that they gain the industrial experiences.
- Establish resource-sharing networks among schools to optimize the utilization of available technological tools and equipment: Schools facing limitations in acquiring all the necessary tools and equipment can benefit from establishing resource-sharing networks. This involves collaboration between schools within a region or district to share their available tools and equipment. By pooling resources together, schools can 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 and maximizes the use of available

resources, benefiting the TTD subject in multiple schools. The study recommended provision of adequate resources for effective teaching and learning of Textiles.

- TTD departments could optimise on production and fundraise for themselves so that they could upgrade their resources and equipment.

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