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Costs Comparison of Teaching and Learning Strategies in a South African University Fashion Design Programme

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ABSTRACT

The use of manual teaching and learning (T&L) strategies for creative design, as well as technical drawing modules, continues in South African university fashion design programmes with few computer-aided design (CAD) T&L strategies being employed. Given the global developments in technological T&L strategies using CAD approach, this comparative study assessed the cost-effectiveness of manual T&L strategies against CAD T&L strategies for Creative Design and Technical drawing modules in a South African fashion design programme. A case study design was used to collect data (documents) on manual and CAD T&L strategies from procurement, budget documents and the in-house university printing department. The results showed that manual T&L strategies expenditure was over 70% to 318% compared to the budget, while CAD T&L strategies were below 60% compared to the budget for creative design ii, creative design iii, technical drawing ii, and technical drawing iii. The findings indicated that CAD T&L strategies are sustainable for the implicated university and the South African government as they fund free higher education with decreasing budgets. The paper concluded that technologically driven T&L strategies like CAD can reduce tuition fees for the programme, improve the sustainability of the university, widen access to government funding for free higher education, as well as improve the contribution of fashion design education programmes towards Sustainable Development Goals 8, 9, and 12. This paper contributes to the ongoing research on developing and implementing sustainable strategies to support the constitutional mandate and the #FeesMustFall campaign and the funding sustainability of South African higher education. This paper's contribution is a comparison of the cost-effectiveness of manual and CAD T&L strategies.

Keywords: *Computer-aided Design, clothing industry, fashion design education programme, technology in universities.*

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INTRODUCTION

The South African celebrated constitution advocates that education is a basic human right.[1] For over two decades, the South African government has been battling to implement this constitutional right resulting in the #FeesMustFall campaign of 2009.[2] Budget allocation towards funding free higher

[1] *Constitution of the Republic of South Africa* (Government Gazette, 1996).
[2] News24, "Free Higher Education? Why It's Not Possible in SA. Brilliant Analysis!," 2016, https://www.news24.com/fin24/free-higher-education-why-its-not-possible-in-sa-brilliant-analysis-20160928.

education remains unsustainable.[3] Research is ongoing to explore strategies to fulfil the constitutional mandate.[4] Two factors are crucial to the problem statement of this paper. Firstly, from 2015/2016 the South African government has been striving to implement free higher education for students from families with a combined income of not more than ZAR350 000.[5] Given that learners who complete Grade 12 are more in number than the available university spaces, the government is struggling to fund free higher education sustainably, let alone make free higher education available to all, regardless of family income.[6] A need arises for universities to explore cost-effective measures to discharge T&L for students with available government funding, among other factors.

Secondly, fashion design education programmes generally charge T&L materials associated with manual T&L strategies into student tuition fees. This is done for equality reasons so that student performances may not be influenced by the student's ability to spend more money on their projects while others may have less given their socioeconomic circumstances. Most of these T&L materials are imported, thus costing more and resulting in excessive fashion design education tuition fees for average South African families. Furthermore, these manual T&L materials strain government efforts to fund more students through its free higher education policy.[7] There is a need to explore reducing the T&L material costs to ensure that families can afford fees if they do not qualify to have their children funded by the government through the free higher education policy.

There is, therefore, a need to drive down fees in South African higher education institutions. Hence, this paper contributes to this call through fashion design education programmes. There is a need to increase the use of technology in the apparel manufacturing industry of South Africa by ensuring that graduates have these technical skills as they enter the job market. There is a need to deepen sustainability efforts in South African higher education institutions to strengthen SDGs and African Union Agenda 2063 contributions by the fashion design educational programmes.

This paper is motivated by the following. There is an international call for academia to look for costs cutting ways of discharging T&L. There is an increasing use of technology in the clothing industries and university fashion design programmes around the world that has not been fully embraced by South African university fashion design education programmes.[8] Technological skills gaps found in the clothing industry and from South African university fashion design education programmes have been identified as one of the factors limiting the development of competitive advantage.[9] Exploring measures to reduce the costs of higher education in South Africa in order to ensure that government

[3] George Hull, "Free University Education Is Not the Route to Social Justice," Mail&Guardian, October 28, 2015, https://mg.co.za/article/2015-10-28-free-university-education-is-not-the-route-to-social-justice/; Totsie Memela, "Investing in Education a Good Strategy," 2015, https://www.iol.co.za/news/opinion/investing-in-education-a-good-strategy-1948015; Peter Ayuk and Sam Koma, "Funding, Access and Quality Conundrum in South African Higher Education," April 30, 2019.

[4] E. De Jager and R. Baard, "Does 'Free' Higher Education in South Africa Make Economic Sense? Views of Commerce Students," *South African Journal of Higher Education*, December 2019, https://doi.org/10.20853/33-6-3084.

[5] Norma Nel and Helene Muller, "The Impact of Teachers' Limited English Proficiency on English Second Language Learners in South African Schools," *South African Journal of Education* 30, no. 4 (2010): 635–50.

[6] Dawid-Willem Pienaar, "Higher education: Getting our priorities right" (2016). Accessed April 1 2023. http://www.dnaeconomics.com/pages/public_finance/?zDispID=NewsArtHigher_education_Getting_our_priorities_right.

[7] Ayuk and Koma, "Funding, Access and Quality Conundrum in South African Higher Education."

[8] Barbara J Frazier and Wanda K Cheek, "An Industry View of Competencies for Entry-Level Merchandising Jobs: Application of the ITAA Meta-Goals," *Clothing and Textiles Research Journal* 34, no. 2 (2016): 79–93.

[9] Ogutu Miruka, "No Need to Throw in the Towel Yet: The Case for the Revival of South African Textile and Clothing Industries," *Mediterranean Journal of Social Sciences*, May 1, 2014, https://doi.org/10.5901/mjss.2014.v5n7p11; Nicole Barnes, Helenrose Fives, and Charity M Dacey, "US Teachers' Conceptions of the Purposes of Assessment," *Teaching and Teacher Education* 65 (2017): 107–16; Sipho Mbatha and Anne Mastamet-Mason, "Competitive Advantage Challenges Affecting the Apparel Manufacturing Industry of South Africa (AMISA): Application of Porter's Factor Conditions," *International Journal of Industrial and Manufacturing Engineering* 9, no. 8 (2015): 2836–42.

funding accommodates more students.[10] The contribution of fashion design education programmes towards the SDGs, as well as the African Union Agenda 2063 should be interlaced.[11]

Given the discussed research problem statement, this paper compares manual T&L strategies against CAD T&L strategies for creative design (CRD) and technical drawing (TD) modules in a South African university fashion design programme. The following are the research questions guiding this paper:

a) What are the manual T&L costs of CRD and TD modules?

b) What are the CAD T&L costs of CRD and TD modules?

c) What is the cost-effective T&L strategy for CRD and TD modules?

d) What are the implications of the results for sustainability?

The above factors are central to sustainability improvements within the fashion design educational programmes of South Africa. This paper contributes to sustainability endeavours advanced through the sustainable development goals (SDGs) and African Union Agenda 2063. The paper also seeks to aid the sustainable development of the competitive advantage for the apparel manufacturing industry of South Africa. The paper further promises to be of importance to South African higher education practitioners and policymakers, given the sustainability proposals or impact arising out of the findings of the paper.

LITERATURE REVIEW

Technology in Institutions of Higher Learning

Radical technological improvements in the global apparel manufacturing industry's creative and technical departments have resulted in adopting new technology in higher education institutions' apparel-related programmes.[12] Such radical technological shifts require curriculum upgrading of apparel-related programmes. Information Technology has been introduced to various industries and universities to catch up with industry technological developments.[13] Technology has positively impacted T&L in higher education.[14] Technology improves the accuracy of information resulting in better comprehension by students.[15] CAD is defined as follows:

> *"The term 'CAD' generally refers to a broad variety of computer-based tools used by architects, engineers, and other construction and design professionals. CAD applications*

[10] Hull, "Free University Education Is Not the Route to Social Justice"; De Jager and Baard, "Does 'Free' Higher Education in South Africa Make Economic Sense? Views of Commerce Students"; Ayuk and Koma, "Funding, Access and Quality Conundrum in South African Higher Education."

[11] Sinqobile Sihlobo and Sipho Mbatha, "University-Industry-Government Research and Development Collaborations in Public Higher Education Institutions in South Africa," *African Journal of Science, Technology, Innovation and Development* 15, no. 1 (January 2, 2023): 69–78, https://doi.org/10.1080/20421338.2021.2016559; Sipho Mbatha, "Roles of Practitioners in Industry-Government Research Collaborations of South African Clothing, Textiles, Leather, and Footwear Industry: Implications for SDGs and Agenda 2063," *Academic Journal of Interdisciplinary Studies* 11, no. 4 (July 5, 2022): 123, https://doi.org/10.36941/ajis-2022-0103.

[12] Frazier and Cheek, "An Industry View of Competencies for Entry-Level Merchandising Jobs: Application of the ITAA Meta-Goals."

[13] Jianxia Su, Zhao Li, and Xiaodong Sun, "The Computer Aided Methods for Tie Dyeing Pattern," in *2015 International Industrial Informatics and Computer Engineering Conference* (Atlantis Press, 2015), 620–22; Claire Loh et al., "Re-Examining Students' Perception of e-Learning: An Australian Perspective," *International Journal of Educational Management*, 2016; Daphney Kobe, "Computer-Aided Design: A Study of Fashion Lectures Acceptance" (Tshwane University of Technology, 2016).

[14] Meong Jin Shin and Tracy Diane Cassidy, "Designing a Fashion Driving Forces Website as an Educational Resource," *International Journal of Fashion Design, Technology and Education* 8, no. 2 (2015): 173–83.

[15] Lynn M Boorady and Jana M Hawley, "The Wonders of Technology: Teaching Becomes Virtual," *Clothing and Textiles Research Journal* 26, no. 2 (2008): 131–42.

> *may be used to construct computer models representing virtually any real-world constructs."*[16]

CAD and computer-aided manufacturing (CAM) are the two main channels that are used for technology adoption within the clothing manufacturing industry and university fashion design departments. Computer-aided instruction (CAI) is among the other channels through which technology is adopted in higher education institutions.[17] They found that CAI is cost-effective, efficient, and improves the quality of work. The most recent form of technology introduced in most fashion design education programmes is the 3D body scan, which is also efficient and improves fit.[18] Digital textile printing, 3D body scanning, 3D garment design, and pattern drafting are among other technological innovations introduced in the apparel manufacturing industry. While South African university fashion design education programmes apply CAD and CAM less, it can be argued that they are yet to introduce 3D body scanning, 3D garment design, and pattern drafting. This underscores that South African higher education programmes are technologically behind.

CAD in the Clothing and Textiles Programmes

Zooming into the apparel manufacturing industry, CAD and CAM's application, benefits, challenges, and development have been visible. A study focused on CAM systems for spiral-fashion embroidery and found that CAM systems for spiral-fashion embroidery save time during production.[19] It can be argued that this time reduction may also result in cost reductions. A study explored computer-aided methods for tie-dyeing patterns in the textiles industry and found that tie-dyeing through CAD leads to innovation, shorter production time, and better quality output.[20] It can be argued that such innovation and shorter production also resulted in cost reductions for tie-dyeing patterns in the textile industry.

In their study of a web-based design support system, it is argued argue that traditional CAD systems for the CRD and TD are not user-friendly for apparel manufacturing industry professionals and students.[21] As a result, CAD systems produce inaccurate proportions. CAD is not user-friendly, stating students have difficulty recalling the steps needed to produce the required designs.[22] Furthermore, this also makes it harder to implement such skills in a work environment.

In order to offer an alternative to traditional CAD systems stated above, a web-based system was developed for CRD and TD that was trial ran by industry professionals and students between Hong Kong and the United States.[23] Their results found that their web-based design system was more user-friendly and accurate in sketching designs than traditional CAD systems. This literature highlights that while South African university fashion design education programmes apply less CAD, some parts of the world have moved towards developing alternative CAD for CRD and TD software.

Challenges of CAD for Stakeholders

Technological systems have transformed industries and T&L, students raised concerns about decreasing face-to-face interactions with lecturers.[24] Challenges with CAD technologies also require further studies to understand the context of South African fashion design education programmes.

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[16] Andrew Wood, "Method for Semi-Automatic Quantity Takeoff from Computer Aided Design Drawings" (Google Patents, December 8, 2015).
[17] Ann C Slocum and Carol A Beard, "Development of a CAI Module and Comparison of Its Effectiveness with Traditional Classroom Instruction," *Clothing and Textiles Research Journal* 23, no. 4 (2005): 298–306.
[18] Hwa Kyung Song and Susan P Ashdown, "An Exploratory Study of the Validity of Visual Fit Assessment from Three-Dimensional Scans," *Clothing and Textiles Research Journal* 28, no. 4 (2010): 263–78.
[19] QiMing Tian, YuPin Luo, and DongCheng Hu, "Spiral-Fashion Embroidery Path Generation in Embroidery CAD Systems," *Computer-Aided Design* 38, no. 2 (2006): 125–33.
[20] Su, Li, and Sun, "The Computer Aided Methods for Tie Dyeing Pattern."
[21] Jie Xu et al., "A Web-Based Design Support System for Fashion Technical Sketches," *International Journal of Clothing Science and Technology* 28, no. 1 (2016): 130–60.
[22] Nicolette Van der Merwe, "Teaching Fashion Computer Aided Design (CAD): A Design Research Approach.," 2014.
[23] Xu et al., "A Web-Based Design Support System for Fashion Technical Sketches."
[24] Loh et al., "Re-Examining Students' Perception of e-Learning: An Australian Perspective."

Research undertaken in South African universities about CAD in fashion design education programmes shows that academic staff lack the technical skills to comprehensively apply CAD T&L strategies.[25] A study done in the United States corroborates the above:

> *"The use of CAD in every stage of the technical designer's process is crucial to the next generation of apparel practitioners. Every stage of apparel production from design, through product development, patternmaking, manufacturing, and distribution is driven by technology. Yet, it can be difficult for those of us who have not grown up with computers to understand the value of these technologies and to incorporate them into our already crowded curriculum. Learning new technologies ourselves can be difficult and time-consuming."*[26]

Similar findings to the above were found by Kobe in a South African context.[27] Based on these studies, one can argue that these findings on CAD skills competencies contribute to students' comprehension of CAD processes, negatively affecting their employability.[28] The latter suggests that in their current form, South African university fashion design programmes go against key roles played by universities, as advised by Daniel:

> *"In the discourse of labour economics, labour supply refers to the individuals who participate in the labour market with given endowments of human capital, whereas labour demand refers to the private and public entities that employ individuals. Intermediating between these is the set of institutional arrangements that help form and shape the nexus between labour demand and supply, including educational institutions."*[29]

As a result, South African university fashion programmes produce graduates who are under-skilled to service the technologically competitive demands of the apparel manufacturing industries of South Africa.[30]

Sustainability of CAD in the Apparel Manufacturing Industry

CAD software systems and equipment for pattern design, creative design, and technical drawings were found to be expensive for students and South African university fashion design programmes.[31] It is argued that CAD systems are the most efficient software due to long-term use but are expensive for students to own individually.[32] The moderate pace of transitioning from manual T&L strategies to full CAD T&L strategies supports Castells and Cloete's view that South African universities are characterised by a depreciating system. Fashion design education programmes' technological adoption challenges are yet to be fully explored, which indicates a literature gap.[33]

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[25] Minette Coetzee, "Addressing the Skills Shortage of Computer-Aided Design Pattern-Making in the KwaZulu-Natal Clothing Industry" (Citeseer, 2014).

[26] Susan P. Ashdown, "Not Craft, Not Couture, Not 'Home Sewing': Teaching Creative Patternmaking to the IPod Generation," *International Journal of Fashion Design, Technology and Education* 6, no. 2 (July 2013): 112–20, https://doi.org/10.1080/17543266.2013.793747.

[27] Kobe, "Computer-Aided Design: A Study of Fashion Lectures Acceptance."

[28] Coetzee, "Addressing the Skills Shortage of Computer-Aided Design Pattern-Making in the KwaZulu-Natal Clothing Industry."

[29] Reza Daniels, "Skills Shortages in South Africa: A Literature Review," *SSRN Electronic Journal*, 2007, https://doi.org/10.2139/ssrn.992111.

[30] Sipho Mbatha, "Exploring University-Industry-Government Research and Development Linkages in the Clothing, Textiles, Leather, and Footwear Industry of South Africa" (Tshwane University of Technology, 2020); Mbatha and Mastamet-Mason, "Competitive Advantage Challenges Affecting the Apparel Manufacturing Industry of South Africa (AMISA): Application of Porter's Factor Conditions."

[31] Kobe, "Computer-Aided Design: A Study of Fashion Lectures Acceptance."

[32] Van der Merwe, "Teaching Fashion Computer Aided Design (CAD): A Design Research Approach."

[33] Manuel Castells and Nico Cloete, "Informational Development and Human Development: Creative Synergy or Mutually Assured Destruction," 2011.

METHODOLOGY

The research took a case study approach, with one of eight fashion design education programmes studied to answer the above research questions. The South African university fashion design education programmes have different manual T&L costs, financial strengths, and printing costs. These factors influenced the decision of the research towards a case study approach. The quantitative approach was used to explore the cost-effectiveness of manual and CAD T&L strategies. This approach allowed the in-depth study required for understanding the cost implication of manual and CAD-based T&L.

The research used documents containing T&L strategies and material costs for CRD and TD modules as data to arrive at results that address the research questions. Documents are a valid data source that can produce valid research results.[34] As a result, documents were found to be the most effective way to address the research questions. For the research to arrive at valid results, documents were sourced from the following offices within the university and its suppliers:

i. University procurement department,
ii. University printing office,
iii. Cheapest departmental preferred supplier of stationery,
iv. Fashion department staff responsible for facilitating CRD and TD modules, and
v. Fashion department technician responsible for ordering T&L materials and overseeing of budget.

Content analysis was used to analyse procurement documents, budget documents, stationery costs, and printing costs to arrive at the research results. Table 1 shows the materials used to determine manual T&L strategies expenditure for CRD and TD modules. The cost of materials incurred under each module for T&L strategies was isolated and compared against the budget per the number of students. This comparison determined whether manual T&L strategies are cost-effective.

Table I. Modules materials for manual T&L

CRD modules	TD modules
A3 and A2 presentation boards	Clutch pencils
Clutch pencils	A4 office paper
Glue sticks	French curves
Colouring pencils	A4 file
Scissors	A4 filling sleeves
A2 sketch pads	
Eraser	
Clutch pencil leads	
A2 plastic portfolio file	

In order to determine the cost-effectiveness of CAD T&L strategies, printing costs and A4 file costs required to produce the portfolio of evidence for a student to be assessed were determined and compared against the budget to understand whether CAD T&L strategies are cost-effective. The costs of software, licenses, and renewal were excluded from the research because these costs are usually carried out by a separate information and technology department at the university. The abovementioned data was translated into graphs to present results on the research questions. These tables and graphs were later compared to determine which T&L strategy is more cost-effective. The comparison responded to the third question of the research. The university's preferred suppliers' names are concealed to ensure the research conforms to ethical considerations associated with research.

[34] Martyn Denscombe, *EBOOK: The Good Research Guide: For Small-Scale Social Research Projects* (McGraw-Hill Education (UK), 2017).

RESULTS /FINDINGS

Results of the Cost of Manual T&L Strategies

The presented results address the question: a) *What are the manual T&L costs of creative design ii (CRDii), creative design iii (CRDiii), technical drawing ii (TDii), and technical drawing (TDiii) modules?* Figure I presents an analysis of the budget against expenditure. Figure I shows that the budget for all the modules is 100% since these costs are fixed. Figure I shows that CRDiii has the largest over-expenditure at 318%, followed by TDiii at 118%. The results show that CRDii and TDii were within budget, with 88% and 79% expenditures.

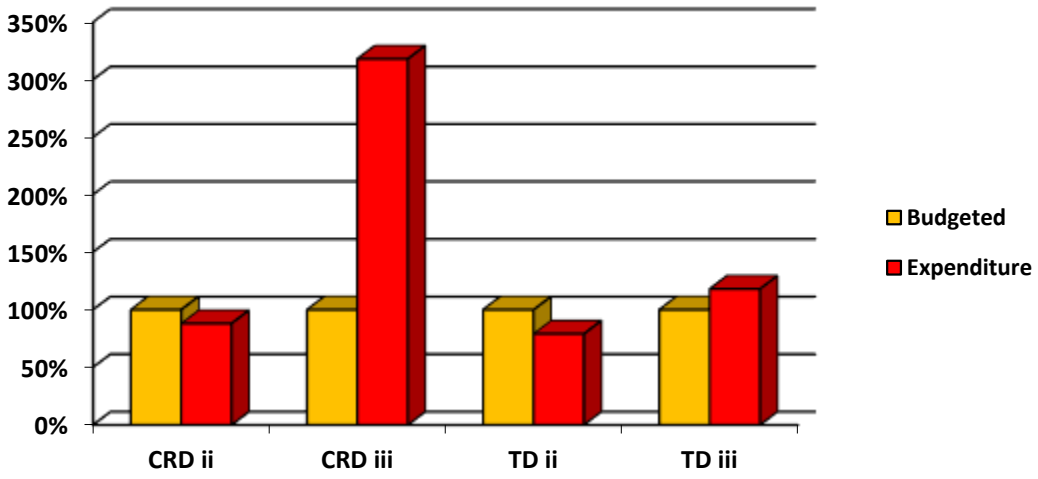

Figure I. Budgeted against manual expenditure T&L costs

These results highlight that the remaining 12% for CRDiii and 21% for TDiii may be returned to the students. However, the results show that the over-expenditure of CRDiii (218%) and TDii (18%) may be expected from students if it is to remain sustainable. These results show that manual T&L strategies of these modules (CRDiii and TDiii) are not costs effective. The results show that fees may not fall in fashion design departments of South Africa with manual T&L strategies. In the next section, the second research question is addressed.

Results of the Costs of CAD T&L Strategies

The second question of the study is: b) *What are the CAD T&L costs of CRD and TD modules?* Figure II indicates that all budgeted amounts are capped at 100% while expenditure varies. Figure II shows that CRDiii had the highest expenditure at 58%, CRDii at 49%, TDii at 32%, and TDiii at 20%. Figure II shows that the expenditure for CRD and TD modules is below 60% of the budget.

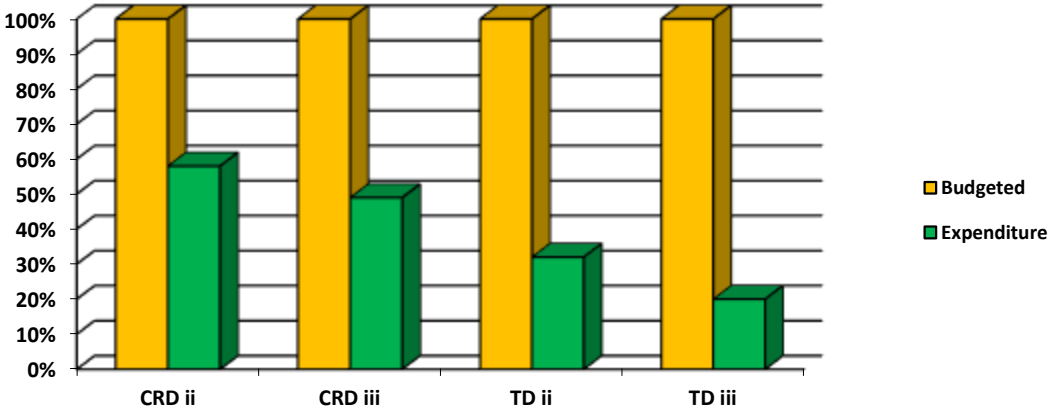

Figure II. Budgeted against CAD expenditure T&L costs

Figure II indicates that the following may be returned to students as unpaid expenditure CRDii (42%), CRDiii (51%), TDii (68%), and TDiii (80%). These results in Figure II indicate that CAD T&L strategies are not a financial burden to the academic department, university, and students. These results show that CAD T&L strategies cut T&L costs for CRD and TD modules in a South African university fashion design education programme. Next, the findings related to the third research question of the study are discussed.

Results of the Most Cost-effective T&L Strategy

The third research question will be addressed in this section: c) What is the cost-effective T&L strategy for *creative design ii (CRDii), creative design iii (CRDiii), technical drawing ii (TDii), and technical drawing (TDiii)* modules? Figure III indicates that CAD T&L strategies are consistently below the budget (CRDiii and TDiii) compared to the expenditure of manual T&L strategies. Even in cases where the manual T&L strategies did not result in overspending (CRD ii and TD ii), CAD T&L strategies still prove to be more cost-effective when compared to manual T&L strategies. The results show that CAD T&L strategies are cost-effective compared to manual T&L strategies for CRDii, CRDiii, TDii, and TDiii modules.

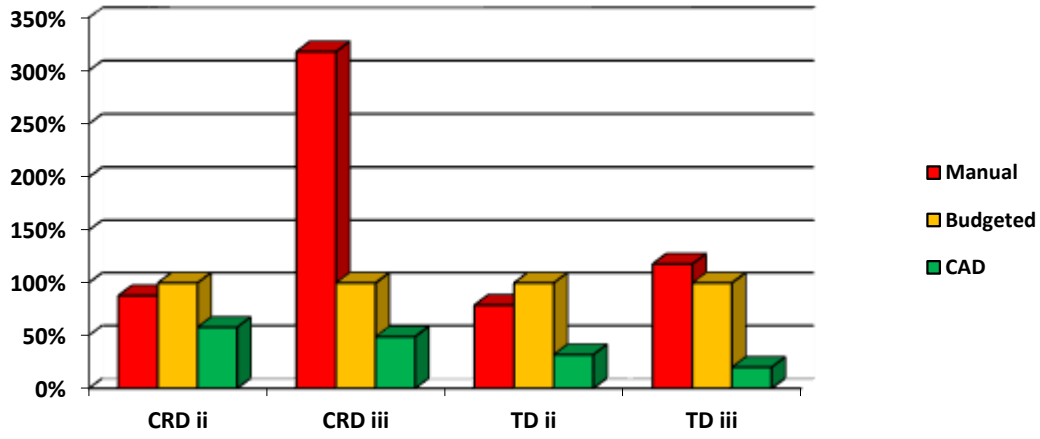

Figure III. Manual against CAD T&L expenditure

The results indicate that CAD T&L strategies drove the costs down by 80% for TDiii, 68% for TDii, 51% for CRDii, and 42% for CRDiii. The findings related to the fourth research question are discussed in the next section.

DISCUSSION

In this section, the study results of research question four are discussed: *d) What are the implications of the results towards sustainability?* The findings around manual T&L strategies indicate that funding fashion design educational programmes is not sustainable for the concerned department, the university, the students, and the government. This lack of sustainability is corroborated by the literature highlighting that funding for higher education in South Africa continues to increase.[35] The literature further shows that universities continue to source other funding sources due to budgetary cuts from government allocations.[36] Given that there have been sharp increases since the COVID-19 pandemic,[37] it follows that prices for T&L materials for fashion design programmes have also increased, thus making it unsustainable for the government to fund free higher education.

[35] Memela, "Investing in Education a Good Strategy"; Hull, "Free University Education Is Not the Route to Social Justice."
[36] Erkan Erdil, "Catching up the Role of University Industry Linkages in Emerging Economies Case of Turkey," 2015.
[37] Grace Gondwe, "Assessing the Impact of COVID-19 on Africa's Economic Development," in *United Nations Conference on Trade and Development*, vol. 3, 2020, 1–21.

Figure III shows that the fashion design education programme will reduce T&L costs if CAD T&L strategies are fully adopted as the main T&L strategy. The university will no longer overspend on CRDiii and TDiii. The students would also no longer be expected to pay for the over expenditure given their socioeconomic status in South Africa. These results show that adopting CAD T&L strategies will play a role in improving the sustainability of funding free higher education in South Africa. These findings add to the body of literature on the positive impact of CAD in higher education.[38]

The findings of this paper corroborate Mbatha's argument that organisations that do not apply technological strategies incur higher operational costs than those that apply technological strategies.[39] The innovations experienced in other industries and fashion design education programmes in other countries are not achieved by those that continue to use manual T&L strategies in fashion design education programmes.[40] This paper's results increased the limited knowledge regarding CAD T&L strategies and using CAD in South African university fashion design programmes.

The university fashion design education programme has more reasons to move towards increased CAD T&L than just cost-effectiveness. The spinoffs from this move could include shorter project execution times, maximising the academic year, and improved quality of projects for assessment, as was the case in other studies.[41] Through improving the use of CAD T&L strategies, this paper advances the current debate on the development of competitive advantage for the clothing industry of South Africa as it advocates for more technological use in South African fashion design education programmes.[42]

Continuing the debate is worthwhile with regard to shifting to technological (CAD) T&L strategies by the South African university fashion design education programmes at the expense of manual T&L strategies. The lack of graduates that are efficient in CAD skills shows that the nexus between labour demand and supply is fractured in the apparel manufacturing industry's context and is thus worth researchers' and industry attention.[43] "The institutions required to create truly advanced factors themselves require sophisticated human resources and technology."[44] More still needs to be done to realign the nexus between labour demand and supply using technological means such as a CAD T&L strategy.

The findings presented in Figure III denote the SDG implications that are possible. Given that the paper found that CAD T&L strategies are sustainable for all role players in the higher education sector of South Africa, there are opportunities to deepen the SDGs contribution via fashion design educational programmes. The findings of this paper indicate that SDGs 8, 9, and 12 may be positively affected. The promotion of sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all may be realised by increasing the technological skill set of graduates entering the labour market.[45] Reducing T&L costs will allow the government to fund more students, thus increasing the number of skilled workforce. The increased skills of participants in the economy (as workers and job creators) will contribute to economic growth. The increased technology

[38] Tian, Luo, and Hu, "Spiral-Fashion Embroidery Path Generation in Embroidery CAD Systems"; Su, Li, and Sun, "The Computer Aided Methods for Tie Dyeing Pattern."
[39] Sipho Mbatha, "Development of Competitive Advantage for Apparel Manufacturing Industries of South Africa" (Tshwane University of Technology, 2014).
[40] Tian, Luo, and Hu, "Spiral-Fashion Embroidery Path Generation in Embroidery CAD Systems"; Su, Li, and Sun, "The Computer Aided Methods for Tie Dyeing Pattern."
[41] Tian, Luo, and Hu, "Spiral-Fashion Embroidery Path Generation in Embroidery CAD Systems"; Su, Li, and Sun, "The Computer Aided Methods for Tie Dyeing Pattern"; Xu et al., "A Web-Based Design Support System for Fashion Technical Sketches."
[42] Miruka, "No Need to Throw in the Towel Yet: The Case for the Revival of South African Textile and Clothing Industries"; Barnes, Fives, and Dacey, "US Teachers' Conceptions of the Purposes of Assessment"; Van der Merwe, "Teaching Fashion Computer Aided Design (CAD): A Design Research Approach."
[43] Daniels, "Skills Shortages in South Africa: A Literature Review."
[44] Michael Porter, *Competitive Strategy*, (New York: The Free Press, 1990).
[45] The sustainable development goals report. United Nations. Accessed April 2 2023. https://unstats.un.org/sdgs/report/2022/.

use and technology-driven T&L strategies in fashion design educational programmes promise to build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation.[46] The reduction of materials used to produce knowledge in fashion design educational programmes ensures sustainable consumption and production patterns.[47] This increase in technical skill sets demonstrates that adopting CAD T&L strategies broadly has far-reaching implications for sustainability.

SUMMARY

The data presented showed that manual T&L strategies are not sustainable and prove that CAD T&L strategies are sustainable in a South African fashion design programme. The implications of this paper's findings have been elaborated on in the previous section. Conclusions are drawn for students, fashion design education programme practitioners, the university, the government, and sustainability.

This paper highlighted for students which T&L strategy (CAD) ensures the most cost-effective means of knowledge acquisition. Given that students are ultimately responsible for any unpaid fees by the government, this paper shows that students cannot be passive about the T&L strategies deployed by the academic departments.

The paper also indicated the negative impact of manual T&L strategies and highlighted that CAD T&L strategies benefit the fashion design education programme more. In an era where the viability/sustainability of educational programmes is constantly in question by university executive managers, this paper educates fashion design education programme practitioners about the sustainability prospects of adopting and deepening CAD T&L strategies in their programmes.
Furthermore, this paper underscores the possibilities of increasing the programme quality given the prospects of increasing the use of technology within its T&L strategies.

Given the discussed free higher education challenges that characterise research in this field, this paper indicates that shifting towards more CAD T&L strategies may reduce the costs per student that government contributes annually. For government practitioners, reducing T&L costs for the fashion design educational programme may mean that more students may be funded under the government's free higher education policy. This paper shows that massification may be deepened, given the findings of this study.[48]

The findings of this paper highlighted aspects of sustainability that can arise out of this paper. The paper indicated that implementing the findings could improve economic sustainability (for the students, university, and government). The paper shows that SDGs can also be realised, given the three goals impacted by the findings. This paper adds crucial literature to the scarce SDG data from the context of fashion educational programmes.

RECOMMENDATIONS

Fashion design educational programmes should explore increasing the use of CAD T&L strategies in CRD and TD modules to improve the sustainability of the programme. Such strategies should include the training of tutors to use CAD technologies for T&L. A study is proposed to deepen sustainability by exploring the cost-effectiveness of applying CAM T&L strategies for pattern design and grading modules in South African fashion design education programmes.

LIMITATIONS

The study was based on one South African fashion design educational programme. Despite these limitations, the paper advances the debates on increasing the use of technology in higher education to achieve various forms of sustainability and advance the #FeesMustFall.

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[46] The sustainable development goals report.
[47] The sustainable development goals report.
[48] Centre for Higher Education Transformation (CHET), "Context and Role in Capacity-Building and Policy Reforms in South African Higher Education," 2012, http://chet.org.za/files/CHET Model Shanghai 2013.pdf.

CONCLUSION

This study has analysed the cost comparison of T&L strategies in a South African university fashion design programme. The following research questions guided this paper: *a) What are the manual T&L costs of CRD and TD modules?, b) What are the CAD T&L costs of CRD and TD modules?, c) What is the cost-effective T&L strategy for CRD and TD modules?, d) What are the implications of the results towards sustainability?* This paper adds to the ongoing discussion regarding using CAD in South African fashion design programmes. Given the limitations of this paper of using one higher education institution, these findings have developed a base for further studies to be undertaken in seven other South African fashion design education programmes to strengthen the debate that fashion design education programmes should move to more CAD T&L strategies and catch up with the world. Studies such as this one will go a long way in advancing the debate on producing graduates that can aid the development of competitive advantage through CAD skills for the clothing industries of South Africa. For technology to gain momentum in university fashion design education programmes, such studies are necessary for South Africa and Africa to strengthen the development of the programmes.

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