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Core Technical Competencies in Ghana's Fashion Technical and Vocational Education and Training Sector: A Comparative Analysis of Student Outcomes and Workplace Requirements

Mawutor Wovenu^{1*}, Prof Ondigi R. S², Dr Shihundu D.A², Dr Kassah J.K¹

¹Ho Technical University, Department of Fashion Design and Textiles, P.O. Box HP 217 Ho, Ghana

²Kenyatta University, Educational Communication and Technology Department. P.O. Box 43844, Nairobi, Kenya

Email: mwovenu@htu.edu.gh; mawutorwk1@gmail.com

Abstract

The purpose of this paper is to examine the extent to which the technical competencies acquired by fashion students in Ghana's technical universities align with the performance requirements of the fashion industry. Specifically, the paper seeks to identify competency gaps across fashion product collection development involving product planning, design production, and product marketing, and to evaluate whether current curricula adequately prepare students for strategic core technical competency demands in the workplace. A mixed-methods design was employed in Greater Accra and Volta, purposively selected for their relevance to fashion education and industry engagement. A total of 252 participants, involving 200 fashion student-interns and 52 industry operatives, were sampled across five competency domains: product planning, design production, product finishing and quality control, product marketing, and equipment operation. Data were collected through surveys, documentary analysis, semi-structured interviews, and the Planning-Production-Promotion (P3) Competency Psychometric Scale (Cronbach's $\alpha = 0.81$). This methodological integration ensured validity, combining statistical generalizations with qualitative insights to rigorously assess competency gaps and the alignment between technical university training and industry performance requirements. Consistent competency gaps emerged across domains. Students showed strengths in creativity, pattern making, and garment construction but were less proficient in strategic skills such as data-informed product planning, iterative design, and machinery operation. Mann-Whitney U tests ($p > 0.001$) confirmed significant differences across technical, digital, and transversal domains. These findings underscore the need for curriculum reforms that integrate advanced machinery training, data-driven planning, and iterative design to enhance employability and strengthen Ghana's fashion Technical and Vocational Education and Training (TVET) sector.

Keywords: Fashion TVET; Competency-Based Training; Human Capital Theory; Industry-Academia Alignment; Employability; Iterative Design

1. Introduction

Human capital development remains a cornerstone of economic growth and industrial competitiveness. Human Capital Theory, advanced by Schultz, Becker, and Mincer, posits that investment in education and training enhances productivity, employability, and innovation (Nadezhina & Aydueyskaja, 2021). In industries such as fashion, where core technical competencies such as product quality and market responsiveness depend heavily on skilled labour, the alignment of training with workplace requirements is critical.

Globally, vocational education systems have increasingly adopted Competency-Based Training (CBT), which emphasizes measurable skills and performance standards over theoretical knowledge. Countries such as Germany, through its dual system, and Australia, through vocational reforms, have demonstrated that industry-aligned competencies foster smoother school-to-work transitions and improve labour market outcomes (OECD, 2025; UNESCO, 2015). Despite these advances, persistent mismatches between educational outputs and industry



expectations continue to undermine employability, contributing to underemployment and reduced returns on human capital investment (ILO, 2020; World Bank, 2019).

Across Sub-Saharan Africa, the urgency of aligning Technical and Vocational Education and Training (TVET) with labour market needs is intensified by rapid demographic growth, high youth unemployment, and limited industrial absorption capacity. The African Union's Continental Education Strategy for Africa (CESA 16-25) explicitly promotes CBT as a framework to enhance employability and bridge skills gaps (African Union Commission, 2015). However, implementation remains uneven. Studies highlight deficiencies in core technical competencies such as production planning, quality control, and product marketing, alongside infrastructural constraints that limit exposure to industrial machinery and advanced finishing techniques (UNESCO-UNEVOC, 2022; AfDB, 2021). Weak industry participation and fragmented quality assurance systems have further constrained the development of competencies that are critical for industrialization and sustainable growth.

In Ghana, fashion education has undergone significant transformation, with technical universities positioned as key institutions for preparing professionals in the expanding fashion and textile industries. The adoption of CBT frameworks has improved practical skills acquisition and enhanced graduate employability (Acquah et al., 2017). However, several scholarly investigations reveal persistent misalignment between curricula and industry requirements (Wovenu et al., 2026). Osei-Poku (2012) identified a disconnect between programme content and workplace demands, noting that curricula remain heavily oriented toward basic garment construction and theoretical instruction, while offering limited opportunities for students to acquire industry-specific competencies in production planning, quality control, supply chain management, and product development. Amegbanu et al. (2023) similarly observed that prevailing pedagogies privilege rote learning over creativity and critical thinking, thereby restricting the development of skills essential for contemporary fashion practice.

Structural limitations further constrain experiential learning. Owusu-Acheampong et al. (2021) reported that institutional workshops are under-resourced, lacking industrial sewing machines and pattern-making tools, while Bekoe and Quartey, as cited in Ademtsu and Pathak (2026), highlighted weak collaborative linkages between universities and fashion enterprises, resulting in limited internships. These antecedents weaken students' exposure to authentic professional workflows and the acquisition of core technical competencies. At the micro level, garment fit emerges as a decisive factor in consumer satisfaction, linking technical precision in pattern construction to market acceptance (Joseph-Armstrong, 2010; MacDonald, 2010). At the macro level, curriculum reform is therefore critical to ensure that graduates are equipped with both technical and strategic competencies to meet evolving industry demands.

Studies emphasize that technology integration enhances creativity among fashion students, yet curricular gaps remain in structured forecasting and innovation training (Fiakpomu, 2022; Ampadu, 2022). Amegbanu et al. (2023) argue that curriculum content must deliberately promote creative teaching and learning to strengthen innovation outcomes. Creativity and innovation underpin product planning, beginning with ideation and concept development. Forecasting connects cultural trends, seasonal cycles, and consumer signals to design narratives and feasibility checks.

In competency-based TVET systems, forecasting often appears implicitly within design projects rather than as a standalone module. Research emphasizes outcomes-based training and stronger industry-academia linkages but does not foreground forecasting as a discrete competency, suggesting a curricular gap (Waiker & Kushare, 2017).

National-level documents highlight efficiency and labour-market alignment yet provide limited explicit guidance on forecasting competencies such as trend analysis, range planning, and line-sheet development, implying inconsistent treatment across providers (Ghana TVET Report, 2021). Ernawati et al. (2022) argue that pedagogy exerts a positive influence on student competence, a finding consistent with earlier studies (Sopegina et al., 2016; Alimuddin et al., 2020; Wang & Calvano, 2018). Without structured forecasting competencies, students may struggle to align output with industry standards.

Scholarship on Ghana's fashion TVET sector emphasizes both strengths and persistent gaps. Students consistently demonstrate competence in creativity, pattern drafting, garment construction, and accessories, yet remain less proficient in strategic domains such as structured ideation, market analytics, and machinery operation (Wovenu et al.,



2026; Agbekey, 2020). While creativity is nurtured through project work, forecasting is rarely codified as a discrete competency, limiting market analysis depth. Ideation occurs within studio tasks but is not explicitly assessed, weakening documentation and pre-production communication. Where ideation is not explicitly assessed, students may under-develop documentation and pre-production communication skills that translate creative concepts into manufacturable products (Lloyd, 2025). As design production progresses from ideation to pattern development, pattern drafting ensures fit fidelity and manufacturability (Kincade et al., 2007; Mete, 2006).

Ghana's TVET syllabi specify structured modules, but industrial grading and tolerance management are inconsistently emphasized. Core skills include block development, measurement accuracy, dart manipulation, adaptation, marking, and grading, indicating structured competency delivery (Asare et al., 2018). Obinnim and Pongo (2018) found that competency training models improved patternmaking instruction but highlighted gaps in industrial grading. Kassah et al. (2023) confirmed that graduates struggle with freehand cutting and tolerance management, limiting employability.

Pattern drafting modules exist but inconsistently emphasize industrial grading and tolerance management, while garment construction and finishing lack standardized SOPs to ensure process consistency and measurable KPIs to benchmark performance, limiting industrial alignment (Chowdhury et al., 2017). Product marketing is treated largely as a business module rather than a technical competency, limiting industrial alignment (Crentsil et al., 2023). Machinery operation training covers basic handling but provides uneven exposure to industrial throughput practices such as line balancing and preventive maintenance (Ghana TVET Report, 2021; Reza et al., 2021). Collectively, these findings highlight systemic misalignment between curricular delivery and industry expectations. Historical antecedents—including supply-driven curricula designed with limited industry consultation, fragmented apprenticeship systems, infrastructural and faculty constraints, and challenges in securing industry attachment—have produced persistent skills gaps that constrain employability and weaken competitiveness in Ghana's fashion sector.

Technical and Vocational Education and Training (TVET) institutions in Ghana play a pivotal role in preparing students for employment in the fashion sector, one of the country's fastest-growing creative industries. Despite this mandate, persistent concerns remain about the adequacy of student-acquired technical competencies in meeting workplace performance requirements. Employers frequently report gaps in garment construction, pattern drafting, finishing techniques, quality control, and strategic competencies such as product planning and marketing, which directly affect productivity and competitiveness.

While TVET curricula emphasize technical skill acquisition, the rapid evolution of the fashion industry, driven by consumer demands, global standards, and technological innovation, has created a mismatch between training outcomes and industry expectations. This misalignment contributes to reduced employment and limited innovation within the sector. Previous studies have examined TVET broadly without isolating the core technical competencies as a distinct area of inquiry (Wovenu et al., 2026).

The lack of empirical evidence on the nuances of core technical competencies needed in TVET programmes to match workplace requirements in Ghana's fashion sector creates a critical knowledge gap. Without such evidence, policymakers, institutions, and industry stakeholders struggle to design responsive curricula, targeted intervention, and competency-based reforms. Addressing this gap is essential for enhancing the relevance of TVET, improving graduate employability, strengthening industry expertise, and positioning Ghana's fashion sector competitively in both local and global markets.

The study sought to:

1. Identify the core technical competencies emphasized in TVET curricula for fashion design and garment technology in Ghana.
2. Assess the level of core technical and strategic competencies acquired by TVET students in selected institutions.
3. Examine the core technical performance requirements of employers in Ghana's fashion sector.
4. Compare student-acquired technical competencies with workplace requirements to determine areas of alignment and gaps.

It addressed the following hypothesis:



- H₁: There is a statistically significant difference between the core technical and strategic competencies acquired by TU students and those required in Ghana's fashion sector.
- H₀: There is no statistically significant difference between the core technical and strategic competencies acquired by TU students and those required in Ghana's fashion sector.

2. Research Methods

To strengthen validity and ensure methodological triangulation, a mixed-methods design was adopted. This design integrated quantitative surveys that captured measurable trends and patterns among participants, documentary analysis of institutional records that contextualized findings within broader operational frameworks, and qualitative interviews that elicited nuanced perspectives and lived experiences, thereby enriching the interpretative depth of the study. The survey employed Likert scales, enabling collection of objective measures of skill proficiency alongside subjective evaluations of nuanced technical industry competencies.

The empirical investigation was undertaken in two strategically selected regions of Ghana, specifically Volta and Greater Accra. The choice of Greater Accra was purposive, informed by its dense concentration of fashion enterprises, with more than 70 percent of establishments actively engaging student interns (Amankwah *et al.*, 2023). This created a fertile ground for experiential learning and industry-academia collaboration. The Volta Region, in turn, was selected for its geographical closeness to Accra and competitive relevance within the technical university education arena.

The study sample comprised 252 participants. Of these, 200 were fashion student-interns purposively drawn from technical universities (TUs), while 52 were industry operatives selected to represent diverse segments within the fashion sector (Wovenu, 2026). The operatives were sampled in line with skill divisions embedded in the industry's structure. Within the framework of technical competencies, five distinct divisions were delineated: product planning (forecasting, resource allocation, and workflow organization); design production (creative conceptualization, pattern drafting, and garment construction); product finishing and quality control (inspection, refinement, and compliance checks); product marketing (branding, promotion, and consumer engagement strategies); and production equipment operation (technical mastery of machinery and tools essential for industrial output). The purposive sampling method limits generalizability, particularly to student cohorts.

A P3 Competency Psychometric Scale, an adaptation of the Triadic Competency Psychometric Scale (Wovenu, 2026), was employed to quantify perceptions of technical competencies. The P3 framework specifically measures competencies across Product Planning, Design Production, and Product Marketing, reflecting the technical competency framework of fashion product development. This contextualized instrument was designed to capture both student and industry perspectives on core strategic technical competencies. Reliability testing yielded a Cronbach's alpha coefficient of 0.81, indicating strong internal consistency. Validity was established through literature review, expert input, and pilot testing, ensuring content relevance and sector alignment. Convergent validity was supported by AVE values above 0.50 and composite reliability exceeding 0.70, while discriminant validity was confirmed through statistical criteria demonstrating distinctiveness among constructs. A semi-structured interview complemented the scale, allowing flexibility while maintaining thematic consistency. The interviews assessed clarity and relevance while identifying benchmarks across critical technical design and production competencies. Thematic analysis of responses informed the refinement of the measurement scales, resulting in a final instrument organized into competency domains, ensuring that language and structure are aligned with industry expectations. Collectively, these results affirmed the robustness of the scale as a psychometric instrument.

Ethical integrity guided the research process, with strict adherence to principles of informed consent, privacy, and confidentiality. Formal approvals were obtained from Kenyatta University (KU), which sanctioned the main original research from which this paper was derived; Ghana Tertiary Education Commission (GTEC)—the umbrella supervisory body for tertiary institutions in Ghana; and Ho Technical University (HTU) - the institution hosting the participant database, before data collection commenced.

The fashion sector in Ghana is dynamic, contributing to employment creation, entrepreneurship, and national economic development. However, its growth potential is constrained by persistent competency gaps among graduates of TVET institutions. By focusing specifically on core technical competencies, this paper provides a targeted analysis that is often overlooked in broader skills development discourse.



Academically, it advances scholarship by isolating technical competencies as a distinct area of inquiry, thereby enriching existing literature on vocational education and industry alignment. A further contribution lies in the adaptation of the Triadic Competency Psychometric Scale into the P3 framework contextualized for Ghana’s fashion TVET sector. This methodological innovation ensures that competency measurement is directly aligned with the realities of fashion product development, offering a more precise tool for evaluating student outcomes against industry technical competency benchmarks.

From a policy perspective, the paper offers evidence-based insights to guide policymakers and curriculum developers in harmonizing training with industry requirements. For industry stakeholders, the findings provide employers with a clear understanding of graduate strengths and weaknesses, enabling more effective workplace training and collaboration. Students also stand to benefit, as the identification of gaps between educational outcomes and workplace expectations enhances employability and career readiness. At the national level, strengthening technical competencies in fashion education contributes to Ghana’s broader goals of industrialization, job creation, and cultural export, positioning the sector as a competitive player in both local and global markets.

3. Findings

The study compared technical competencies of TU fashion students and industry professionals across product planning, design production, and marketing. Mean scores, standard deviations, and competency decisions were analyzed, with non-parametric tests applied to assess statistical significance. This section presents the results, highlighting areas of alignment and gaps that shape employability and industry relevance in Ghana’s fashion sector.

Table 1: Product Planning Competencies

Technical Skills	TU Fashion Students			Fashion Industry		
	Mean	σ	Decision	Mean	σ	Decision
Product forecasting	4.13	.332	C	4.71	.457	C
Design abstraction.	4.13	.332	C	4.75	.437	C
Ideative inspiration.	4.90	.301	C	4.75	.437	C
Trend-informed product roadmapping.	2.04	.393	NYC	4.77	.425	C
7-fold iterative technique for idea development.	3.76	.816	NYC	4.71	.457	C
	3.79	N=200		4.73	N=52	

C= Competent, NYC = Not Yet Competent

Table 1 compares product planning competencies between TU fashion students (Mean = 3.79, N=200) and industry professional (Mean = 4.73, N=52). Students were competent in product forecasting, and design abstraction (Mean = 4.13, σ = 0.332), and ideative inspiration score (Mean = 4.90, σ = 0.301), even surpassing industry professionals (Mean = 4.75, σ = 0.437). However, they were Not Yet Competent in trend-informed product roadmapping (Mean = 2.04, σ = 0.393) and iterative techniques (Mean = 3.76, σ = 0.816), while industry professionals were competent across all domains. This indicates that students excel in creativity but lack structured planning and iterative development skills, which are critical for industrial alignment.

Table 2: Design Production Competencies

Technical Skills	TU Fashion Students			Fashion Industry		
	Mean	σ	Decision	Mean	σ	Decision
Pattern making & Grading	4.85	.358	C	4.67	.474	C
Special purpose machinery operation	3.65	1.155	NYC	4.65	.480	C
Garment construction techniques	4.85	.358	C	4.58	.499	C
Accessorizing garments	4.85	.358	C	4.62	.491	C
Product finishing techniques	4.23	.419	C	4.60	.495	C
	4.49	N=200		4.62	N=52	

In Table .2, both groups demonstrated competence, with students scoring 4.49 overall and industry professionals 4.62. Students excelled in pattern making and grading (Mean = 4.85, σ = 0.358). However, students were Not Yet Competent



in special purpose machinery operation (Mean = 3.65, σ = 1.155) with a high variability, indicating inconsistency and lack of uniform training among students, compared to industry competence (Mean = 4.65, σ = 0.480). They also lagged slightly in product finishing techniques (4.23 vs. 4.60). This suggests strong foundational skills but limited exposure to advanced machinery and finishing processes.

Table 3: Product Marketing & Customer Relations Competencies

Technical Skills	TU Fashion Students			Fashion Industry		
	Mean	σ	Decision	Mean	σ	Decision
Organizing physical exhibitions	4.58	.498	C	4.75	.437	C
Enhancing product market value	4.10	.301	C	4.73	.448	C
Branding to incentivize & sustain customer loyalty	4.08	.272	C	4.75	.437	C
Curated personalized customer service	4.08	.272	C	4.73	.448	C
Advertising & Promotion using visuals & pricing	4.08	.264	C	4.73	.448	C
	4.18		N=200	4.73		N=52

Table 3 compares product marketing and customer relations competencies between TU students (Mean=4.18, N=200) and industry professionals (Mean = 4.73, N=52). Students demonstrate competence across all domains, but their proficiency is consistently lower than industry practitioners, indicating that while foundational marketing and customer services are solid, alignment with advanced strategic and analytical aspects is limited. The findings highlight the need to strengthen the curriculum in branding, market value strategies, and personalized service to align student competencies with industry standards.

Table 4 Comparison of Competences of Students and Industry

Technical Skills Component	Mean Values	
	Students (n=200)	Industry (n=52)
Product Planning	3.79	4.74
Design Production	4.49	4.62
Product Marketing	4.18	4.74
Grand mean	4.15	4.70

Table 4 compares competencies between TU fashion students (N=200) and industry professional (N=52). Students demonstrated competence across all technical domains, but their proficiency is uneven. They are strongest in design production (Mean = 4.49), moderately competent in product marketing (Mean=4.18), and weakest in product planning (Mean=3.79). Targeted training in product planning and marketing is needed to align student outcomes with industry standards.

Table 5 Mann-Whitney U Test – Ranks

Technical Competencies	Participants	N	Mean Rank	Sum of Ranks
	Industry	52	179.10	9313.00
	Students	200	112.83	22565.00
	Total	252		

Table 5 reports Mann-Whitney U Test result comprising technical competencies of TU fashion students (N=200) and industry professionals (N=52). Industry respondents achieved a higher mean rank (179.10) than students (112.83), confirming significant differences in skill levels across the total sample (N=252). The test, a non-parametric measure for independent groups, shows that competency gaps are not due to chance but reflect genuine disparities. Industry professional consistently demonstrate stronger technical competencies, validating earlier descriptive findings that TU students, though competent in several domains, remain below industry benchmarks. This statistical evidence underscores the need for curriculum reforms that integrate industry-aligned technical training to elevate student proficiency to professional standards.

Table 6 Test Statistics^a

Technical Competencies



Mann-Whitney U	2465.000
Wilcoxon W	22656.000
Z	-5.989
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Participants

Table 6 reports Mann-Whitney U Test results comparing technical competencies of TU fashion students and industry professionals. The U value was 2465.000, Wilcoxon W 22,656.000, with a Z score of -5.989 and $p < 0.001$, confirming a statistically significant difference between the two groups. The test confirms that TU students' technical competencies are significantly below industry standards, validating the hypothesis that meaningful differences exist in technical competency levels. These results underscore the need for curriculum reforms that integrate industry-aligned technical training to elevate student competencies to professional standards.

Table 7 Median Scores Report

Participants	Competencies Technical
Industry	12.8000
Students	12.6000
Total	12.6000

Table 7 presents median scores for technical competencies among TU fashion students (N=200) and industry professionals (N=52). Industry practitioners recorded a marginally higher median (12.80) compared to students (12.60). The overall median aligns with the student score (12.60), reinforcing that while students are close to industry benchmarks, they remain slightly below the professional standard.

4. Discussions

Compare technical competencies of TU fashion students and industry practitioners

The comparative analysis reveals a clear pattern: TU fashion students demonstrate competence in foundational and creative domains but fall behind industry professionals in strategic competitive competencies. Specifically, students excel in ideative inspiration (Mean=4.90 vs industry 4.75) and design production skills such as pattern making, garment construction, and accessories (all 4.85 vs industry 4.58–4.67). Tables 5.1–5.4 confirms this comparative analysis, showing students' overall mean scores in product Planning (3.79), design production (4.49), Marketing (4.18) consistently below industry benchmarks of 4.74, 4.62, 4.74 respectively.

Identify areas of alignment and gaps shaping employability

These strengths underscore their imaginative capacity and technical mastery in garment production. However, significant gaps were observed in product planning (Student Mean = 3.79 vs. Industry 4.74), particularly in trend-informed roadmapping (2.04 vs. 4.77) and iterative development techniques (3.76 vs. 4.71). Students were also not yet competent in special purpose machinery operation (Mean = 3.65 vs industry 4.65) and lagged in product finishing techniques (4.23 vs 4.60), highlighting limited exposure to advanced processes. Such deficiencies mirror broader concerns in technical education. As Legg-Jack (2014) notes, many programmes continue to produce graduates whose skills do not adequately meet labour market demands. This misalignment highlights systemic weaknesses and underscores the need for policy reforms and structured collaborative frameworks.

Assess statistical significance of competency differences

Strengthening the interface between policy and skills training is essential to align educational outcomes with industry expectations. Similarly, in product marketing and customer relations (Student Mean = 4.18 vs. Industry 4.73), students scored lower in branding, customer loyalty, personalized service, and promotional communication. These findings suggest that while students are strong in execution and creativity, they lack the strategic commercial acumen required for industry competitiveness.

Statistical tests reinforce these descriptive findings. Mann-Whitney U=2465.000, Z = -5.989, $p < 0.001$ confirm differences are statistically significant. Industry practitioners consistently ranked higher (Mean Rank = 179.10 vs



students 112.83), validating observed competency gaps. Median scores (Industry = 12.80 vs Student = 12.60) further illustrate this pattern.

Provide basis for curriculum and policy recommendations

This challenge echoes broader concerns in higher education. Crentsil et al. (2023) report that graduates fail to demonstrate professional-based competencies in the workplace, and that the HND Fashion and Textiles programme has become increasingly disconnected from the practical realities of industry. Similarly, Vidanapathirana (2000), in a study of undergraduates, highlighted a persistent mismatch between education and employment opportunities, attributing the paradox to the high rate of labour force entry contrasted with the relatively slow pace of economic expansion. The evidence from Table 5.1–5.7 underscore the need for curriculum reform in product planning, marketing, and machinery training, alongside structured industry collaboration. Weligamage (2009) further supports embedding employability skills into higher education programmes. To enhance graduates' competitiveness in the job market, employability skills must therefore be cultivated alongside subject-specific expertise, and higher education institutions should adopt effective strategies to integrate this requirement into their programmes.

The statistical tests (Tables 5.5 and 5.6) reinforce these descriptive findings. The Mann-Whitney U value of 2465.000, $Z = -5.989$, and $p < 0.001$ confirm that the differences between students and industry professionals are statistically significant. Industry professionals consistently ranked higher (Mean Rank = 179.10) than students (Mean Rank = 112.83), validating the observed competency gaps. The median scores (Table 5.7) further illustrate this pattern, with industry at 12.80 compared to students at 12.60. Accordingly, the null hypothesis was rejected, and the alternate hypothesis, that significant differences exist between the two groups, was supported.

5. Conclusions

- TU fashion students demonstrate competence in foundational and creative domains particularly ideative inspiration and design production.
- However, they remain below industry benchmarks in strategic product planning, iterative development, advanced machinery operation, and strategic marketing/customer relations.
- Statistical evidence ($U=2465.00$, $Z=-5.989$, $p<0.001$) confirms these gaps are significant and not due to chance.
- Overall, students are imaginative and technical skilled but lack structured, industry-aligned competencies essential for employability and competitiveness.
- The findings also highlight systemic weakness in technical education, underscoring the importance of stronger policy on TU-industry collaboration and embedding employability skills alongside technical training.
- Purposive sampling could limit generalizability; perspectives of fashion student-interns and industry practitioners might not represent wider populations.
- Self-assessment via Likert scales could have introduced response biases, with participant over- or underestimating competencies.
- Practical skills evaluations could have provided a more objective measure of students' actual competencies.

6. Recommendations

- Curriculum Reform: Integrate industry-aligned training in trend-informed product planning, iterative design techniques, and advanced machinery operation.
- Strategic Marketing: Strengthen modules in branding, customer loyalty, personalized service and analytical marketing strategies.
- Standardization of Machinery Training: Develop uniform training protocols for advanced and special purpose machinery to address the high variability observed among students.
- Policy-Industry Collaboration: Establish structured framework between TUs, policymakers, and industry stakeholders to ensure curricula reflect labour market demands.
- Employability Skills: Embed transferable skills (persuasive communication, adaptability, problem-solving) alongside technical training to enhance graduates' workplace readiness.



- Continuous Review: Implement regular competency audits and feedback loops with industry to sustain alignment and responsiveness to evolving market needs.
- Future Research: Further studies should explore longitudinal tracking of graduate performance in industry using the triadic competency framework, enabling deeper insight into its relevance and applicability.

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