Journal of Education, Society and Behavioural Science

Volume 39, Issue 3, Page 145-163, 2026; Article no.JESBS.155719
ISSN: 2456-981X
(Past name: British Journal of Education, Society & Behavioural Science, Past ISSN: 2278-0998)

TVET Institutions and Industry Partnerships: Academic Staff's Perceptions of their Perceived Effect on Graduates' Employability Skills

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jesbs/2026/v39i31492

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/155719

Original Research Article

Received: 03/04/2026
Published: 02/06/2026

Abstract

Graduate's employability skills remain a vital aspect in the Technical Vocation Education and Training based on the employers' requirements across industries. This study aimed at establishing the perceptions of the TVET academic staff to examine how TVET-industry influence the employability skills of graduates. Particularly, this study focuses on the views of academic staff about how TVET-industry collaboration in curriculum development, sharing of training resources, industry participation in practical training and trainer professional development opportunities influence the TVET graduates' employability skills as the study's key constructs. The study conducted in 2024 utilized a cross sectional study design using a structured questionnaire with 5-point Linkert scale items that was administered to a sample of 217 academic staff who indicated the extent to which they agree with the statements corresponding to each construct. The sample was selected using purposive sampling technique. The perception-based data was coded and analyzed using

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Cite as: *Robert, B., Simiyu, J., & Wanyeki, P. (2026). TVET Institutions and Industry Partnerships: Academic Staff's Perceptions of their Perceived Effect on Graduates' Employability Skills. Journal of Education, Society and Behavioural Science, 39(3), 145–163. https://doi.org/10.9734/jesbs/2026/v39i31492*

correlation, and Structural Equation Model (SEM) using the STATA 17.0 ((Stata-Corp College Station, TX, USA) software to study the relationship among the study variables.
The results grounded in the perceptions of the academic staff showed significant relationships curriculum development, sharing training resources, industry engagement in practical training, professional development and employability skills of the graduates. Additionally, the findings revealed perceived direct perceived effects from practical training on sharing of training resources, professional development opportunities for trainers, and employability. More so, the findings showed that sharing training resources and training opportunities are perceived to have direct perceived effects on graduates' employability. This paper emphasizes, from the perspective of academic staff at TVET institutions, the necessity of reinforcing collaborative relationships between TVET institutions and industry partners recommending joint curriculum design and review committees, industry-based internship, promotion of continuous professional development and sharing resources. While relying on the academic staff's perceptions, this paper provides a great contribution towards the knowledge pool of TVET-industry partnership determinants of the employability skills of TVET graduates.

Keywords: Collaboration; curriculum development; employability skills; practical training; resource sharing.

1. Introduction

High rates of unemployment among graduates has raised concerns about the quality of education received (Suharno et al., 2020). Reported that the unemployment rate among the youth in Africa is about 60% which has emerged as big concern (Chigudu, 2025). And in Uganda, it was established about 60% of the certificates attained by learners from various training and skilling centers were not certified by international bodies (Bbaale, et al., 2025) which could have contributed to the 30% of the youth having no jobs despite holding clear qualifications (UBOS, 2022). Technical and vocational education and training (TVET) has become the global solution to the unemployment problem specifically among the young graduates, with potential to foster economic development and labour productivity (Mante et al., 2025). Consequentially, economies have included TVET in their national programmes and development plans to address the skills gap to enhance employability and fight unemployment (kebede et al., 2024). Nonetheless, there are continuous complaints from employers about the inadequate TVET graduate practical and soft skills needed in the labour market (Maclean & Pavlova, 2011). These employable skills include the technical skills, teamwork, problem solving, communication and computer skills (Suarta et al., 2017). This challenge has mainly been fueled by institution centered curricular which lack critical stakeholder engagement leading to mismatches between the industry needs and what is taught in class (Klieger, 2026). This mismatch in skills has triggered partnerships between the TVET institutions and the industry to collaborate in training processes especially in the curriculum development processes (kebede et al., 2024).

As a result, the TVET institutions and the industry have embarked on joint curriculum development to enhance relevant training and equipping the graduates with the required skills (Maltseva et al., 2025). Joint curriculum development allows for contribution from both the industry stakeholders and the TVET institutions to design course content thus incorporating occupational skills, valid competencies, quality to align with the required industry practices and market needs (Hasan et al., 2026). This implies that such collaboration facilitated and translates into acquisition of both technical and soft skills which are highly appreciated by employers.

Despite the emphasis on the joint curriculum development approach, little is known about how this approach enhances the employability skills of the TEVT graduates. Majority of the existing studies focus on TEVT-Industry collaboration in terms of internship placements and appointments on the governing boards (Assanbayev, & Makoelle, 2024; kebede et al., 2024). Additionally, the studies that have studied about curriculum development and employability skills, have not been clear about the mechanisms that enhance this relationship (Scandurra, et al., 2024, Hazelkorn, 2020; Page, et al., 2019).

This paper argues that the TVET institution-Industry collaboration in curriculum development does not singly enhance employability skills of the TVET graduates, but rather through other mechanisms including industry involvement in industrial training, sharing of training resources, training of trainers, professional development industrial visits among others (Okoye, et al., 2025; kebede et al., 2024; Mhando et al., 2024). For instance, sharing of training resources between the industry and the TVET institutions helps improve the quality of skills

delivered to the learners (Okanya et al., 2023). Additionally, industry involvement in practical training sat the TVET institutions improves the work-related skills acquired by learners which are relevant to and meet the market needs (Ramli, et al., 2024). Lastly, continuous skills development of trainers through professional development activities related to industry practice improves practical knowledge of the instructors and trainers (Odjo et al., 2024). These strategies are essential and potentially supplement the aligned curriculum in delivery of quality and appropriate skills that match the industry needs.

However, there is not much information about how these mechanisms directly or indirectly improve employability skills of the TVET graduates. Therefore, this paper examined the perceptions of the academic staff in TVET institutions on how the TVET institution-industry collaboration in curriculum development, sharing training resources, industry participation in practical training and continuous professional development of trainers influence employability skills of graduates.

2. Materials and Methods

2.1 Research Design and Approach

The study utilized a cross-sectional research design using a quantitative approach. This approach helps to establish the prevailing relationship between TVET-industry collaboration mechanism and employability skills of the graduates.

2.2 Study Population and Sampling

According to the staffing requirements and guidelines by the TVET policy in Uganda, the 11 institutions in the selected districts in Western Uganda, altogether should have approximately 495 academic staff that was considered as the study's population size. Thus, from the target population, one sample was selected consisting of 217 participants that included academic staff whose perceptions about the study constricted were obtained. This sample size was determined using the Krejcie and Morgan (1970) table for sample size determination.

From Table 1, majority of the participants were male (63.13%), with females making up 36.87%. Most respondents were in the 30–39 years (44.24%) and 40–49 years (21.2%) age brackets, reflecting a relatively mature workforce. In terms of education, the majority of the participants held degrees (46.08%) or diplomas (43.32%), while only a small proportion had certificates (3.69%) or postgraduate qualifications (6.91%). The sample was largely married (74.65%), and nearly all technical institutes were equally represented, indicating a good geographical and institutional spread.

Table 1. Descriptive characteristics of study participants (N=217)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	137	63.13
	Female	80	36.87
Age Group	20–29 years	45	20.74
	30–39 years	96	44.24
	40–49 years	46	21.2
	50–59 years	29	13.36
	Over 60 years	1	0.46
Highest Education Level	Certificate	8	3.69
	Diploma	94	43.32
	Degree	100	46.08
	Postgraduate	15	6.91
Marital Status	Married	162	74.65
	Single	54	24.88
	Divorced	1	0.46
Employment Type	Government	131	60.37
	Board of Governors	86	39.63
Years of Experience	Below 2 years	26	11.98
	3–5 years	76	35.02
	6–10 years	52	23.96
	Above 10 years	63	29.03

With regard to employment, 60.37% of participants were in government positions while 39.63% were employed through Board of Governors' decision. In terms of experience, 35.02% had 3–5 years, and nearly 29.03% had more than 10 years, suggesting a strong representation of both relatively new and highly experienced staff. These characteristics highlight a knowledgeable and experienced respondent base, suitable for evaluating their perceptions about how the collaboration mechanisms between TVET institutions and industry enhance employability skills.

2.2.1 Sampling Techniques

Multistage sampling was used in the study to select districts, institutions and then specific academic staff. However, purposive sampling was used to select both institutions and academic staff. This technique was preferred by the researcher because it helps select the most relevant participants for the study. The academic staff including the heads of department were the most relevant respondents for the questionnaires since they are the direct trainers and instructors of these students and their responses are believed to provide a clear picture given their experience with the students.

2.3 Data Collection

The data collected included the academic staff's perceptions about the TVET-industry partnership perceived benefits such as curriculum development, industry involvement in practical training, sharing of training resources, training opportunities for trainers and employability skills of TVET graduates. Due to lack of an already existing tool, the researcher developed a questionnaire which was given to the identified academic staff for filling as a way of data collection. The questionnaire was preferred because of its ability to quantify perceptions to be analyzed statistically.

2.3.1 Questionnaire Designing

A structured questionnaire was developed by the researchers including several questions under each study construct using a 5-point Linkert scale (Strongly Agree, Agree, Not Sure, Disagree, strongly Disagree) showing the extent to which the respondent agreed and disagreed with the statements under the study constructs. Thus, the respondents selected the score that best represented their perception regarding the statements in the questionnaire.

2.3.2 Validity and Reliability of the Questionnaire

The questionnaire was pre-tested using 8 academic experts that were not directly part of the study. The Content Validity index and Cronbach's Alpha coefficients for validity and reliability were calculated respectively.

Referring to Tables 2 and 3, the questionnaire items that Content Validity index and Cronbach's Alpha coefficients values above 0.70 were retained while those below were strengthened or eliminated. The identified weaknesses corrected to allow for consistency and accuracy of data.

Table 2. Validity diagnostic results

Constructs	No. of Items	Average number of valid items	Content Validity Index
Stakeholder Involvement in Syllabus Design	7	6	0.86
Curriculum development	7	6	0.86
Industry participation in practical training	6	5	0.83
Sharing of training resources	8	7	0.88
Professional development opportunities	9	8	0.89
Employability skills	4	4	1.00
Total	41	36	

Constructs are the key mechanisms of collaboration, No. of Items- refers to the total number of questions for all constructs

Table 3. Summary of scale reliability for key constructs (n = 217)

Constructs	No. Of Items	Inter-Item Covariance	Cronbach's Alpha
Stakeholder Involvement in Syllabus Design	7	0.518	0.842
Curriculum development	7	0.628	0.863
Industry participation in practical training	6	0.343	0.776
Sharing of training resources	8	1.135	0.971
Professional development opportunities	9	0.768	0.924
Employability skills	4	0.363	0.830

Referring to Table 2, all study constructs have their content validity indices greater than 0.7 implying that the remaining items under each construct were relevant and valid to measure the construct. Additionally, according to Table 3. The Cronbach's Alpha coefficients for all study constructs are above the 0.7 threshold implying that there is internal consistency among items under each construct. Generally, the Tables 2 and 3 show that the questionnaire items for each study construct were relevant, valid and consistent showing the questionnaire's strength to collect the right data.

2.4 Data Processing and Analysis

Data analysis was conducted using the STATA 17.0 ((Stata-Corp College Station, TX, USA) software. The total score for each construct was calculated from the responses about the perceptions of the respondents. Using these total scores as variable values, multicollinearity testing was performed using the Variance Inflation Factor and tolerance values and association among independent variables was corrected.

Pearson's correlation analysis as per Table 4, was conducted to explore the strength and direction of linear relationships among the core study variables, offering basic insights into their associations. Then, mediation analysis using Structural Equation Modeling as per Table 5, was used to explore relationships among the underlying mechanisms, dissecting direct and indirect pathways through which collaborative practices influence employability skills and evaluating the theoretical model's overall fit to the empirical data.

3. Results and Interpretation

3.1 Perceived Relationship between Curriculum Development, Practical Training, Sharing of Training Resources, and Training Opportunities of Trainers and Employability Skills by Correlation Analysis

From Table 4, according to the academic staff's perceptions, positive associations among the constructs were observed and perceived to be statistically. These findings provide initial evidence supporting the conceptual model, which posits that collaboration between TVET institutions and industry is perceived to positively influences employability skills outcomes. Importantly, Curriculum Development is perceived by academic staff to be strongly and positively correlated with Sharing of Training Resources ($r = 0.875 > 0.5$; p-value<0.05) and moderately associated with Training Opportunities ($r = 0.461 < 0.5$; p-value<0.05) and employability ($r = 0.394 < 0.5$; p-value<0.05), indicating that when curricula are collaboratively developed with stakeholders, institutions are more likely to share resources and create training opportunities that ultimately boost employability.

Table 4. Result of testing for correlation of the study variables

Variable	1	2	3	4	5
Curriculum Development (1)	1				
Practical Training (2)	0.097	1			
Sharing of training resources (3)	0.875 *	0.088	1		
Training Opportunities (4)	0.461 *	0.039	0.583 *	1	
Employability Skills (5)	0.394 *	0.190 *	0.609 *	0.624 *	1

** Significant at 0.05 level*

The academic staff's perceptions further showed that practical Training, though positively correlated with all other variables, shows relatively weak relationships but has a strong correlation is with Employability (r =

0.190<0.5; p-value<0.05), implying that academic staff perceive practical training to greatly contribute to employability enhancement though its influence may be less direct or possibly mediated through other factors like resource sharing or opportunities created through industry partnerships. Its weak correlations with Curriculum Development (r = 0.097<<0.5) and Sharing of Training Resources (r = 0.088<<0.5) may reflect gaps in integration between practical training implementation and curriculum or resource planning, indicating a potential area for strengthening collaboration.

More so, from the perceptions of academic staff, the relationship between Sharing of Training Resources and Employability (r = 0.609>0.5; p-value<0.05) was observed to be both strong and significant, suggesting that active resource sharing (e.g., equipment, facilities, personnel) between TVET institutions and industry is crucial in enhancing students' job readiness. The perceptions of academic staff highlights the importance of collaborative investments in infrastructure and learning tools as a direct pathway to improving graduate outcomes. Similarly, Training Opportunities are significantly correlated with Employability (r = 0.624>0.5; p-value<0.05) and Sharing of Training Resources (r = 0.583>0.5; p-value<0.05), showing that when students are exposed to industry-based training or internships, their chances of securing employment increase notably.

Furthermore, the perceptions showed a strong correlation between Curriculum Development and Sharing of Training Resources suggests a tightly linked process where jointly developed curricula are likely to be supported by tangible industry contributions in terms of training materials and environments. This supports the idea that operative collaboration is multi-dimensional where planning, design, and implementation of training programs are interconnected and mutually reinforcing. It highlights that successful curriculum development does not happen in isolation, but is facilitated by resource commitments that improve implementation quality.

Finally, the positive and significant correlations between most constructs and employability are not only reflected in the academic staff's perceptions but also validate the theoretical assumption of the study that collaborative efforts between TVET institutions and industry partners are vital enablers of employability. These correlations lay the groundwork for more complex analyses, such as regression and structural equation modelling, to assess causal relationships and mediation pathways. The findings indicate that enhancing curriculum relevance, fostering practical exposure, encouraging resource sharing, and providing real-world training opportunities can collectively and significantly improve graduate employability outcomes in the Ugandan TVET sector.

3.2 Perceived Mediation Influences of Practical Training, Sharing of Training Resources, and Training Opportunities on the Relationship between Curriculum Development and Employability Skills

The mediation analysis was conducted to examine the underlying mechanisms through which association influences graduate employability in Uganda's Technical Vocational Education and Training (TVET) institutions. Specifically, the analysis sought to determine whether and how intermediary variables such as practical training, sharing of training resources, and training opportunities mediate the academic staff's perceived effect of curriculum development on the ultimate outcome of employability. This approach is theoretically grounded in human capital theory and systems thinking, which suggest that improved educational inputs (like updated curricula) enhance outcomes (like employability) through a chain of interrelated activities. Therefore, mediation analysis was done to allows us to test and identify which pathways are significant and thus providing evidence for more targeted reforms in TVET–industry collaboration. Table 5 presents the mediation analysis results showing how the study constructs influence each other and the major dependent variable (employability sills).

3.2.1 Interpretation of the Perceived Mediation Effects between Study Constructs

The results reveal both perceived direct and mediated relationships between the study variables according to the academic staff's perceptions. The path from curriculum development to practical training was perceived to be positive but not statistically significant (β = 0.104, p = 0.147), suggesting that academic staff perceive that curriculum improvements alone may not strongly influence practical training implementation unless additional support structures are in place. Similarly, the perceived effect of practical training on sharing training resources was minimal and statistically insignificant (β = 0.003, p = 0.901), implying that practical training may not drive resource sharing in isolation. However, the perceived direct path from curriculum development to sharing

training resources was both strong and significant (β = 0.781, p < 0.001), indicating that curriculum reforms that involve stakeholders directly lead to better access to industry tools and environments likely due to joint planning and aligned expectations.

In contrast, the pathway from sharing training resources to training opportunities showed a large and significant perceived effect (β = 0.843, p < 0.001), suggesting that when resources are shared, students benefit from increased chances of engaging in internships or on the job training. Interestingly, curriculum development also had a significant perceived direct effect on training opportunities (β = 0.207, p = 0.035), demonstrating a dual pathway where both resource sharing and curriculum design directly influence training access. Finally, employability was significantly influenced by all the mediators practical training (β = 0.169, p = 0.001), sharing training resources (β = 1.107, p < 0.001), and training opportunities (β = 0.446, p < 0.001) as well as directly by curriculum development (β = 0.619, p < 0.001). These results suggest partial mediation, where curriculum development affects employability both directly and indirectly through multiple pathways. The error variances for all latent variables were low, reinforcing model reliability. This highlights the complex nature of employability, emphasizing that to achieve meaningful impact, TVET reforms must enhance curriculum design while also investing in training quality, industrial partnerships, and access to experiential learning.

A further break down of the SEM perceived effects both direct, indirect and total perceived effects are presented in Table 6. Thus, Table 6 presents the direct and indirect perceived effects of the study constructs on employability skills.

The structural equation modelling (SEM) results in Table 6 provide strong empirical support for the theorized relationships between curriculum development, practical training, sharing of training resources, training opportunities, and employability among TVET institutions in Uganda. The direct perceived effects reveal that curriculum development significantly and positively influences sharing of training resources (β = 0.781, p < 0.001), training opportunities (β = 0.207, p = 0.035), and employability (β = 0.619, p < 0.001), but does not have a statistically significant perceived direct effect on practical training (β = 0.104, p = 0.147). These findings indicate that academic staff believe that when curriculum reforms are undertaken in collaboration with industry stakeholders, they substantially enhance the availability of industrial tools and spaces (resource sharing), create more structured avenues for experiential learning (training opportunities), and ultimately increase employability of graduates. However, the weak direct influence on practical training suggests that merely updating curricula may not automatically lead to more hands-on training unless accompanied by deliberate pedagogical and institutional support.

Further insights come from the relationships between the mediators and the outcome variable. For instance, the academic staff perceive that sharing of training resources exerts a particularly strong and direct influence on both training opportunities (β = 0.843, p < 0.001) and employability (β = 1.107, p < 0.001), highlighting the central role of resource accessibility in linking educational content to industry needs. Likewise, training opportunities directly enhance employability (β = 0.446, p < 0.001), confirming the importance of internships, apprenticeships, and attachments in preparing graduates for the labour market. Practical training also shows a significant positive perceived direct effect on employability (β = 0.169, p = 0.001), though it does not significantly influence resource sharing or training opportunities. This suggests that while practical training itself is crucial, it may operate as a parallel rather than a mediating mechanism unless well integrated within the broader institutional infrastructure of TVET-industry collaboration.

The indirect perceived effects offer further clarity into the mechanisms at play. Notably, curriculum development significantly influences training opportunities indirectly through sharing of training resources (β = 0.659, p < 0.001), and it also has a large and significant total inperceived direct effect on employability via all mediators (β = 1.084, p < 0.001). These pathways highlight that the respondents perceive that curriculum reform is amplified when institutions work closely with industry to share training resources and open up real-world learning opportunities. Although practical training and its downstream indirect perceived effects (e.g., on training opportunities or employability) were not statistically significant, it remains an important piece in the total perceived effect on employability, suggesting that its role may be more nuanced or context-dependent. Interestingly, sharing of training resources also has an inperceived direct effect on employability through training opportunities (β = 0.376, p = 0.001), reinforcing the argument that resource-sharing arrangements catalyze opportunities that, in turn, drive better employment outcomes.

Table 5. Mediation result

Outcome Variable	Predictor	Coefficient Bootstrap (Std. Err.)	z	p-value	95% CI
Practical Training	Curriculum Development	0.104 (0.072)	1.5	0.147	[0.037, 0.244]
	Constant	3.130** (0.269)	11.6	<0.001	[2.602, 3.658]
Sharing Training Resources	Practical Training	0.003 (0.024)	0.1	0.901	[0.043, 0.049]
	Curriculum Development	0.781** (0.029)	27.0	<0.001	[0.724, 0.837]
	Constant	0.776** (0.128)	6.1	<0.001	[0.525, 1.028]
Training Opportunities	Sharing Training Resources	0.843** (0.122)	6.9	<0.001	[0.605, 1.082]
	Curriculum Development	0.207* (0.098)	2.1	0.035	[0.102,0.399]
	Constant	1.301** (0.312)	4.2	0.000	[0.690, 1.912]
Employability	Practical Training	0.169** (0.050)	3.4	0.001	[0.072, 0.267]
	Sharing Training Resources	1.107** (0.154)	7.2	<0.001	[0.805, 1.410]
	Training Opportunities	0.446** (0.117)	3.8	<0.001	[0.217, 0.676]
	Curriculum Development	0.619** (0.119)	5.2	<0.001	[0.387,0.852]
	Constant	0.380 (0.295)	1.3	0.197	[0.198,0.456]
Variance Estimates of Error Terms					
Latent/Observed Variable					
Practical Training	0.328 (0.030)				[0.275, 0.392]
Sharing Training Resources	0.055 (0.005)				[0.046, 0.065]
Training Opportunities	0.182 (0.038)				[0.121, 0.274]
Employability	0.177 (0.025)				[0.135, 0.233]

*$p < 0.05$ = *, $p < 0.01$ = **; Standard errors in parentheses*

Table 6. Direct, indirect and total perceived effects in the structural equation model (N=217)

Perceived effect Type	Path	Estimate (Std. Err.)	z	p-value
Direct Perceived effects	Curriculum Development → Practical training	0.104 (0.072)	1.45	0.147
	Curriculum Development → Sharing Training Resources	0.781 ** (0.029)	26.99	<0.001
	Curriculum Development → Training opportunities	0.207 *(0.098)	2.1	0.035
	Curriculum Development → Employability	0.619** (0.119)	5.22	<0.001
	Practical training → Sharing Training Resources	0.003 (0.024)	0.12	0.901
	Practical training → Employability	0.169 **(0.050)	3.41	0.001
	Sharing Training Resources → Training opportunities	0.843** (0.122)	6.94	<0.001
	Sharing Training Resources → Employability	1.107 **(0.154)	7.18	<0.001
	Training opportunities → Employability	0.446 **(0.117)	3.81	<0.001
Indirect Perceived effects	Curriculum Development → Sharing Training Resources (via Practical training)	0.000 (0.002)	0.12	0.901
	Curriculum Development → Training opportunities (via Sharing Training Resources)	0.659** (0.101)	6.54	<0.001
	Curriculum Development → Employability (via all mediators)	1.084 **(0.119)	9.09	<0.001
	Practical training → Training opportunities (via Sharing Training Resources)	0.002 (0.020)	0.12	0.901
	Practical training → Employability (via all mediators)	0.004 (0.035)	0.12	0.901
	Sharing Training Resources → Employability (via Training opportunities)	0.376 *(0.109)	3.45	0.001
Total Perceived effects	Curriculum Development → Practical training	0.104 (0.072)	1.45	0.147
	Curriculum Development → Sharing Training Resources	0.781** (0.029)	27.26	<0.001
	Curriculum Development → Training opportunities	0.452** (0.078)	5.8	<0.001
	Curriculum Development → Employability	0.465 **(0.083)	5.63	<0.001
	Practical training → Sharing Training Resources	0.003 (0.024)	0.12	0.901
	Practical training → Training opportunities	0.002 (0.020)	0.12	0.901
	Practical training → Employability	0.174 *(0.064)	2.72	0.007
	Sharing Training Resources → Employability	1.484 **(0.141)	10.49	<0.001
	Training opportunities → Employability	0.446** (0.117)	3.81	<0.001

*$p < 0.05$ = *, $p < 0.01$ = **; Standard errors in parentheses; Model fit indices: Chi-square p-value=0.125; RMSEA=0.001; SRMR=0.002; CFI=1; TLI=1.02; AIC=1227.3; BIC=1284.8*

The total perceived effects confirm the strong role of curriculum development, not only directly (β = 0.465, $p < 0.001$) but also indirectly through resource access and experiential learning channels. The total perceived effects of sharing training resources on employability are remarkably high (β = 1.484, $p < 0.001$), making it the strongest predictor in the model. From a policy and implementation perspective, this indicates that strengthening partnerships between TVET institutions and industry through resource-sharing agreements and structured training programs is critical for enhancing employability outcomes.

The SEM model fits the data exceptionally well, as evidenced by the model fit indices: Chi-square p = 0.125 (indicating good fit), RMSEA = 0.001, SRMR = 0.002, CFI = 1.000, and TLI = 1.020—all pointing to an excellent model fit. The low AIC (1227.3) and BIC (1284.8) further support model parsimony. Altogether, these results offer compelling evidence that curriculum reforms must be embedded within a broader ecosystem of institutional collaboration, industrial support, and experiential opportunities to yield tangible improvements in graduate employability in Uganda's TVET sector.

4. Discussion of Results

4.1 Direct Perceived Effects

The results from the respondents' perceptions showed that curriculum development has a positive and significant perceived direct effect on employability skills of the TVET graduates. The findings of this study match the results of a study by Abd Majid et al. (2024) and Yoto et al. (2024) who established that a well-designed curriculum incorporates both technical and technological skills which give the graduates capacity and ability to perform roles and responsibility of the world of work. More so, curriculum development is one critical area where the TVET institutions and the industry come together to design relevant courses as per the needs of the potential employers thus brings on board market needs which shape the skills to be attained by the learners in order to be relevant.

Additionally, the respondents' perceptions showed that industry participation in practical training has a significant perceived direct effect on enhancing employability skills of graduates. These results are consistent with the findings of Nadrljanski & Vidovic, (2020) and Hussain et al., (2021) who found out that industry involvement in practical training boosts career readiness in addition to skills as well as balancing theory and practice among graduates in order to foster good professional skills. Similarly, Hussain et al., (2021) found that industry involvement in practical training allows room for industry led programs and courses which are embedded with the industry needs and employer demands which are transformed into skills advanced to the learners. This leads to building technical competency, adaptability and professionalism among TVET graduates (Mwaura et al., 2022).

Furthermore, the results of this study showed that sharing training resources has a significant perceived direct effect on improving employability skills of TVET graduates. These findings match the results of Mutembei et al. (2024) who argued that resources facilitate hands-on learning and training which promotes employability of the graduates having obtained technical skills that match the industry needs. This is because, sharing training resources enhances practical skills training at TVET institutions.

The results of this study show that availability of training opportunities for Trainers at the TVET institutions is very pivotal in streamlining the skills and knowledge of the TVET graduates thus significantly improving their employability skills. The findings of this study match the results of a study by Manase & Nyamu (2024) who established that the competences of the trainers influenced by their skills and qualifications greatly impact the employability skills of the graduates. This is because training of trainers, supports flexibility and adoption of new trends in the industry, thus continuous training of the trainers should be embraced by TVET institutions. More so, Muriuki & Magut (2022) established that training of trainers at TVET institutions improves the quality of training through acquisition of real practical skills that match the industry standards and demands because the instructors are up-to-date with the trends and changes in the market.

Additionally, the results established that sharing of training resources between the industry and TVET institutions has a significant perceived direct effect on professional development of the trainers. In line with this, Zhang, (2023) argued that training resources contribute greatly in education and profession growth through facilitating class lessons, and workshops. Generally, sharing of training resources helps the trainers access

updated information which improves the quality of knowledge transferred to the learners. More so, the findings established that curriculum development has significant direct perceived effects on sharing training resources and training opportunities for trainers (Yoto et al., 2024). Notably, Turner & Farr (2023) argued that curriculum development provides an avenue to enhance training of trainers through information sharing. More so, Hylén (2006) stated that curriculum development often goes hand in hand with sharing of training resources to facilitate learning. These findings stress that curriculum development is a foundational mechanism that dictates other strategies that are meant to enforce development of appropriate curricula.

Therefore, from the perceptions of the academic staff, it is evidenced that TVET-industry collaborations enhance employability skills of graduates through enhancing designing of appropriate curricula, sharing of training resources, industry participation in practical training, and availability of staff professional development opportunities.

4.2 Indirect Perceived Effects

The results of the study showed that there is a significant indirect path from curriculum development to employability skills via al the mediators. These results imply that curriculum development can influence employability skills of TVET graduates through, sharing training resources, training opportunities for trainers and industry involvement in practical training. These findings are an indication that TVET-industry collaboration in curriculum development alone cannot improve employability skills of TVET graduates but also through other mechanisms like sharing training resources, industry involvement in practical training and professional development opportunities. These findings match the arguments by Nikly (2012) who stated that collaboration between the TVET and industry through Public Private Partnerships provides opportunities to share training resources, practical training through industrial attachments, curriculum development and staff retooling.

5. Conclusions and Recommendations

5.1 Conclusions

The relationship between curriculum development and employability skills of the TVET graduates remains a critical issue in the Technical Vocational, Education and Training. The industry players who are the potential employers require these TVET graduates to possess both technical and soft skills which meet the job demands. This study examined the perceptions of the TVET academic staff about the influence of the TVET-industry partnership on the employability skills of graduates. Their perceptions were about how collaboration in curriculum development, sharing training resources, professional development opportunities and industry involvement in practical training between TVET institutions and industry enhance of employability skills of TVET graduates in Uganda.

The results from the respondents' perceptions showed that curriculum development, industry participation in practical training, sharing of training resources and training opportunities for the trainers are perceived to greatly influence on employability skills of the TVET graduates. These areas altogether are perceived to facilitate practical and quality learning ensuring that learners acquire the required labour market skills. However, it was also established that curriculum development is perceived to enhance employability skills through other mediating factors stated earlier. These findings imply that the perceived effect of curriculum development on employability skills is strengthened by other factors within the collaboration context such as sharing training resources, availability of opportunities for trainers to undergo retooling as well as the practical training opportunities at the industries during internship and fieldwork. alone may not shape thus, it is clear that a well-designed curriculum enhances practical training among the learners which well aligns with the prevailing technologies and changing market dynamics. Vividly, when the industry participates in practical training at the TVET institutions, the learners are provided an opportunity to practical skills and experience which helps meet skills expectations of the industry employers. More so, access to relevant training resources like current text books, materials, and equipment, facilitates hands-on and practical student learning which eventually bridges the theory and practical gap in learning processes. Furthermore, availability of training opportunities for the trainers at TVET institutions improves the competency, knowledge base and practical skills which facilitates provision of relevant and competitive skills to the TVET graduates. These key areas altogether ensure that the graduate is

prepared well to be competent enough for the job market demands and responsibilities. This study provides empirical evidence supporting the need for the collaboration between the TVET institutions and the industry.

However, the results reflect the situation in Uganda a developing country which limits their generalizability especially in developed countries which are believed to have better education systems. More so, the results were obtained from a sample of 217 participants and 11 institutions in Western Uganda though the sample size was statistically significant. These limitations imply that the results should be used for policy and decision making cautiously.
Nonetheless, the results of this study provide an insightful knowledge towards understanding the interplay between curriculum development, industry participation in practical training, training opportunities for trainers and employability skills of the TVET graduates. The findings provide a strong foundation for developing practical and relevant strategies for developing and maintaining the collaboration between the TVET institutions and the industry.

5.2 Policy Recommendations

Creating and empowering joint curriculum design and review committees comprising of members from both the TVET institutions and the industry partners. This is evidenced by the perceived direct effect of collaboration on curriculum development on employability skills by the academic staff. This shows that curriculum development should go beyond the mere stakeholder consultations as a step-in curriculum design and review but rather have a well-structured committee comprising of the team from the TVET institution and the industry players. This helps strike a balance between the theory and practical work, include currents technological trends and industry standards.

Establishing non-existing, formalizing and strengthening partnerships between TVET institutions and industry players. These collaborations provide an avenue for sharing training resources, training opportunities for staff and students to enhance practical learning. These practices facilitate teaching and learning at TVET institutions to equip learners with practical skills that match the industry demands in terms of labour capacity and requirements.

Consent

As per international standards or university standards, Participants' written consent has been collected and preserved by the author(s).

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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Questionnaire for TVET Trainers and Heads of Departments

TOPIC: Evaluating the effectiveness of collaborations between TVET institutions and industry in the enhancement of employability skills in Uganda

Dear Respondent

I am Bagumisiriza Robert, a Doctor of Philosophy in Technology Education-VET student at the University of Eldoret (Kenya), carrying out a study titled "**Evaluating the effectiveness of collaborations between TVET institutions and industry in the enhancement of employability skills in Uganda**." You have been sampled to participate in this study, and the information you provide will be used strictly for academic purposes and will never be used against you or your office. The information I get from you will be kept confidential. You are also asked not to write your name on this questionnaire. After filling out the questionnaire, return it to the research Assistants or me. Your participation in this study is entirely voluntary. Your consent to participate is implied by your decision to complete this questionnaire. I greatly appreciate your assistance in this exercise. If you have any questions or concerns about being in this study or any other questions, contact me at telephone number 0772897317. The University of Eldoret has approved this study.

Section A: Background information of respondents. (Tick the best option)

A1. Gender

Gender	Tick	Measure
Male		1
Female		2

A2. Age group

Age group	Tick	Measure
20-29 years		1
30-39 years		2
40-49 years		3
50-59 years		4
Over 60 years		5

A3. Highest level of education

Education level	Tick	Measure
Certificate		1
Diploma		2
Degree		3
Postgraduate		4

A4. Marital status

Marital status	Tick	Measure
Married		
Single		
Divorced		
Widow		
Other		

A5. Name of your Institution …….....

A6. Employment by Government or Board of governors

Employment status	Tick	Measure
Government		1
Board of Governors		2

A7. Duration of employment Vocational training institutions (VTIs)

Employment in VTIs	Tick	Measure
Below 2 years		1
3-5 years		2
6-10 years		3
Above 10 years		4

Section B: Areas of collaboration between industry and TVET institutions

Part I- Please fill in appropriately, by ranking the questions provided under each section according to the scores provided; (5,4,3,2 and 1).

		Scores				
		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
		5	4	3	2	1
Section B1: Stakeholder involvement in Curriculum development or review						
Codes	The following key stakeholders were fully involved in the development or review of curriculum for VTIs					
STHLD1	Trainees					
STHLD2	Trainers					
STHLD3	Heads of departments					
STHLD4	Academic registrars					
STHLD5	Deputy principals					
STHLD6	Principals					
STHLD7	Industry experts					
Section B2: Collaboration in Curriculum Development						
CurDev1	Industry representatives are actively involved in the development of our institution's curriculum.					
CurDev2	The curriculum reflects current industry practices and requirements.					
CurDev3	Collaboration with industry has improved the relevance of course content.					
CurDev4	Feedback from industry is regularly used to update the curriculum.					
CurDev5	Joint curriculum development between TVET institutions and industry enhances training quality.					
CurDev6	Curriculum changes based on industry input are implemented effectively.					
CurDev7	There is a formal framework guiding collaboration between institutions and industry in curriculum development.					
Section B3: Practical training in TVET institutions						
PracTra1	Practical lessons are conducted by experienced TVET trainers (with industrial experience).					
PracTra2	Most of the training in TVET institutions is					

	focused on real-world applications that are matched to industry job demands.					
PracTra3	Training provided in TVET institutions meets industry standards.					
PracTra4	TVET trainers upgrade their practical skills to meet technological changes.					
PracTra5	Industry experts participate in practical training in TVET institutions.					
PracTra6	Industrial training equips with adequate employability skills					
Section B4: Sharing of training resources						
TrainRes1	The industry provides training materials to TVET institutions to enhance the practical skills of TVET.					
TrainRes2	Industry equips workshops with equipment and tools to enhance the practical skills of TVET					
TrainRes3	The industry supports TVET institutions to acquire emerging technologies to meet employment requirements in the industry					
TrainRes4	Our institution has active partnerships with industry for the sharing of training resources (e.g., equipment, materials, or facilities).					
TrainRes5	Collaboration with industry has helped us improve the quality of hands-on training through shared resources.					
TrainRes6	Industry partners are responsive and supportive when we request access to their training resources.					
TrainRes7	Our institution contributes its own training resources for use in joint programs or industry-led sessions.					
TrainRes8	There are regular review and communication with industry partners to ensure shared resources meet training needs.					
Section B5: Training opportunities for TVET trainers						
TrainOpp1	The industry provides training opportunities for trainers to be exposed to new technologies and practices prevalent in the industry.					
TrainOpp2	The industry offers on-the-job training to TVET trainers.					
TrainOpp3	TVET trainers are attached to the industry to upgrade their skills.					
TrainOpp4	There is an established partnership between our institution and industry for the continuous professional development of trainers.					
TrainOpp5	Our trainers participate in industry attachments or exchange programs to gain practical experience.					
TrainOpp6	TVET trainers are encouraged and supported by the institution to take part in industry-based training programs.					
TrainOpp7	Collaboration with industry has improved the technical competencies of our trainers.					
TrainOpp8	The institution and industry jointly design and implement training programs for trainers.					
TrainOpp9	There are mechanisms in place to evaluate the effectiveness of industry-provided training for trainers.					

Section C: Collaboration between TVET institutions and industry

C1. What kinds of collaborations exist between your institution and industry to enhance your graduates' employability skills?
……
……
C2. Enumerate the ways in which your institution is collaborating with industry to increase the number of TVET graduates who gain employment in or as self-employed.
……
……
C3. What type of industry support does your institute get to improve TVET graduates' employability skills?
……
……
C4. How does your institution's collaboration with business impact the employability skills of TVET graduates?
……
……..
C5. What difficulties does your institution face when collaborating with industry?
……
……..
C6. Share your thoughts on the outcome of your institution's and the industry's collaboration about the employability skills of TVET graduates.
……
……..

Section D: Employability skills of TVET graduates

D1. How do you rate the employability skills of TVET graduates from your institution?

Year	Very high	High	Moderate	Low	None
2023					
2022					
2021					

D2. What is the approximate percentage of TVET graduates that are self-employed in the private sector or employed in the industry from your institution in the last 3 years?

Year	Self-employed (%)	Employed in industry (%)	If other, specify
2023			
2022			
2021			

D3. Tick areas of collaboration between your institution and industry that you think is required to enhance the training and employability skills of TVET graduates.

	Area of collaboration	Collaboration status in your institute				
Code		Very high	High	Moderate	Low	None
Area1	Internship opportunities- to allow gain practical experience in area work environment					
Area2	Industries providing amenities to such as lunch and allowances					
Area3	Training opportunities for TVET trainers					

Area4	Placement of female -promote gender exclusivity and creating opportunities for female in male dominated industries					
Area5	Apprenticeship training programs - interns/TVET graduates and under job placements					
Area6	Research and development- drive innovation (address skill gaps of TVET graduates and trainers)					

Section E: Rate the extent to which collaboration areas between your institution and industry enhance the training and employability skills of TVET graduates

Rate each statement and tick the appropriate item using the scale. 1 = strongly disagree (SD), 2 = disagree (D), 3 = not sure (NS), 4 = agree (A), 5 = strongly agree (SA).

Code	Statement	SA	A	NS	D	SD
Collab1	Collaborations in industrial practical training to enhance the employability skills of TVET graduates					
Collab2	Collaborations in curriculum design or review improve the employability skills of TVET graduates					
Collab3	Collaborations in training resources sharing promotes employability skills of TVET graduates					
Collab4	Collaborations in providing training opportunities for TVET trainers improve the employability skills of TVET graduates					

THANK YOU FOR YOUR TIME

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/155719