



TVET-industry Collaboration Mechanisms Enhancing Employability Skills of Technical and Vocational Education and Training (TVET) Graduates: Evidence from Selected Institutions in Uganda

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Authors' contributions

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

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Abstract

The purpose of this study was to explore the influence of TVET-Industry collaboration in curriculum development, industry participation in practical training, sharing of training resources and training opportunities on employability skills of TVET graduates. This study considered more factors that influence graduate employability skills in addition to curriculum development as has been studied by many scholars. This study utilized cross sectional survey data collected from 217 trainers & heads of department. The data was analyzed using correlation, stepwise OLS multiple regression to study the relationships among the study variables using the Stata 17.0 (Stata-Corp College Station, TX, USA) software. The study findings showed that curriculum development ($\beta=0.619$, $p<0.05$), industry involvement in practical training ($\beta=0.169$, $p<0.05$), sharing of training resources ($\beta=1.107$, $p<0.05$), and training opportunities for trainers ($\beta=0.446$, $p<0.05$).

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have significant positive effects on the employability skills of the TVET graduates. These results implied that employability skills of graduates rely heavily on the nature of curriculum studied, transfer of practical skills by industry experts to the learners through industrial training, availability of training resources that facilitate learning as well as level of knowledge possessed by the trainers. The findings suggested establishment of joint curriculum design and review committees, the promotion of continuous professional development and research activities, and the creation of dedicated liaison offices. This research provided a great contribution towards the knowledge pool of key determinants of the employability skills of TVET graduates as well as establishing the need to formalize, strengthen and coordinate collaborations between the TVET institutions and the industry.

Keywords: Collaboration; TVET; industry; curriculum; practical training; resource sharing.

1. Introduction

Employability skills have merged as a vital aspect and requirement in the current job market across the globe, not only to the TVET graduates but all the rest of graduates from other disciplines in order to be considered ready for employment in the labour-led industry (Bassah & Noor, 2023). These skills are categorized as follows; “social, knowledge, communication, information & technology, creativity and innovation, management, critical thinking and problem solving.” (Nugraha et al., 2020). Employability refers to portable competencies and qualifications that enhance an individual’s capacity to make use of the education and training opportunities available in order to secure and retain decent work, to progress within the enterprise and between jobs, and to cope with changing technology and labor market needs and standards (Dyson, 2005).

Recently, there has been numerous complaints from employers across the world but especially in the developing and underdeveloped countries about the inadequate skills possessed by staff, this has made employability skills surface as a global issue considering the present-day technological changes (Fajaryati et al., 2020). More so, several questions have been raised about the quality of the graduate labor market and the ability of graduates to meet the needs of employers Chitema (2021). Additionally, a study examining the employability skills in the 21st century established that there was a mismatch between the employers’ expectations and the skills possessed by the graduates stipulating that the graduates lack relevant skills that match the market demands (Tushar & Sooraksa, 2023).

According to Nayan & Nayan (2024), a lot can be done to improve the employability skills of the TVET graduates, including practical and hands-on training involving the industry to participate in the training of trainees as well as improving the employability of graduates through soft skills training, involvement in extracurricular activities, and project and work placements. Nayan also indicated that industry involvement in the training of trainees can only be achieved through the collaboration between the TVET institutions and the industry for purposes of equipping TVET trainees with the skills needed to be gainfully employed in the industries upon graduation (Akinola et al., 2020).

This collaboration, supported by clear policies, promotes participation of industries in curriculum development and review processes, which facilitates practical skills training to match the changing technologies and market needs (Siddiky & Uh, 2020). Moreover, when industries cooperate with the TVET institutions, this increases the chances of students getting placements in industries to obtain work experience, and as well, the industry staff are able to upgrade through exchange programs (Singh & Tolessa, 2019).

Previous studies have established that critical areas of collaboration between the Industry and TVET institution such as Curriculum development., sharing of training resources, industry participation in practical training as well as training opportunities for the Trainers as key factors that influence employability skills of the TVET graduates (Nthako & Khumalo, 2025). For instance, Rohanai et al. (2020) established that there is a positive association between active learning and employability skills of TVET graduates by imparting relevant skills among the learners improving their working skills and personal quality. More so, Okolie et al. (2020) established that TVET trainers employ numerous approaches to impart employability skills to their TVET students. Additionally, sharing training resources between the TVET institutions and industry supports learning processes which imparts the level of knowledge and skills possessed by graduates thus influencing their employability skills (Scott & Willison, 2021). Furthermore, Suarta et al. (2020) argues that a well-designed

curriculum delivers competences, capacities and knowledge to the learners which improves their employability skills to meet the needs of the industry.

In Uganda, the TVET policy (2019) and BTVET strategic plan (2011-2020) indicate that the current TVET training in Uganda emphasizes the acquisition of academic qualifications instead of the requisite skills and competencies needed in the labor market. This has led to major loss of economic productivity and competitiveness and consequently to the high level of unemployment or underemployment. The NDP strategic plan (2025/26-2029/30) further shows that there is a persistent disconnect between the training provided by TVET institutions and the practical skills required in the labor market (Ministry of Finance, Planning and Economic Development, 2025). This implies that the TVET system in Uganda does not produce the appropriately skilled workforce that Uganda needs to increase incomes and employment and to compete in the East African and international labor markets (The Technical and Vocational Education and Training Policy, 2019). The government of Uganda has put in place strategies and interventions to enhance employability skills of TVET graduates through strengthening collaborations between TVET institutions and industry (Kalanda, 2025; Uganda BTVET Strategic Plan, 2011 & Uganda TVET policy, 2019).

Therefore, this research established the influence of curriculum development, sharing of training resources, industry participation in practical training, and training opportunities for the trainers on the employability of TVET graduates. The findings are critical in laying down strategies to improve the employability skills of the TVET graduates.

2. Literature Review

2.1 Impact of TVET-industry in Curriculum Development on Graduate Employability

According to Lukitasari, F., & Suhartini, R. (2025), joint curriculum development or review between TVET institutions and industry stakeholders is widely recognized as a fundamental mechanism for bridging the skills gap and enhancing the employability of TVET graduates. Employers' involvement in curriculum development and design is key as it provides critical insights into the identification of occupational skills aligned to the needs of the employers and TVET graduates (Kebede et al., 2024). More so, employer input often highlights the increasing need for digital literacy, teamwork, problem-solving, and communication skills, alongside technical expertise (Taylor et al., 2022). Industry partners may advocate for experiential learning approaches such as simulations, project-based tasks, and real-world problem-solving exercises that better prepare students for workplace challenges Klieger (2024). This alignment of training provided in TVET institutions also increases the quality of training and boosts trainee motivation and engagement in training activities by connecting theoretical knowledge to practical application (Rajamanickam et al., 2024).

Strong partnerships between TVET institutions and industry are essential for delivering relevant, workforce-ready education. Industry participation helps align curricula with evolving labor market needs through collaborative curriculum design, skills mapping, and evaluation processes (Yahya et al., 2024). Such cooperation supports the integration of emerging technologies like artificial intelligence and robotics into training programs. Recent research emphasizes the pivotal role that curriculum development and implementation strategies play in improving the employability of graduates from Technical Vocational Education and Training (TVET) institutions. Ajani et al. (2024) highlight the need for curricula that are closely aligned with industry requirements, stressing that the integration of practical training and emerging technologies such as digital tools and automation significantly enhances the readiness of graduates for the modern workforce. Klieger (2026) advocate for instructional strategies that prioritize hands-on learning and active industry engagement, both inside and outside the classroom. These approaches such as internships, simulations, and project-based learning bridge the gap between academic learning and workplace expectations.

However, despite these benefits, several challenges limit the effectiveness of collaboration in curriculum development. For instance, Oketch (2007) identifies a persistent misalignment between academic calendars and industry production cycles, which complicates the scheduling of joint activities such as curriculum reviews or practical attachments, industrial placement of trainees and trainers, industrial tours. In addition, issues of resources constraints, bureaucratic rigidity and inadequate faculty expertise (Oyetade et al., 2025). Mocanu et al., (2014) adds that in most case, curriculum committees lack sufficient representation of professional experts

from the labour market to contribute to development of practical skills aligned to industry standards and emerging technologies.

2.2 Impact of Industry Participation in Practical Training on the Employability Skills of TVET Graduates

In Technical Vocational Education and Training (TVET) institutions, practical training is equally critical, although distinct challenges exist. A significant issue is the persistent gap between theoretical knowledge and practical skills, which has been repeatedly highlighted by industry stakeholders (Abd Rahman et al., 2025). To bridge this divide, institutions have adopted supplementary training modules and developed industry collaborations. These efforts have yielded positive outcomes, as evidenced by improved skill acquisition among students, as well as favorable feedback from lecturers and industry supervisors (Abdullah et al., 2022). Industry-TVET collaboration remains a cornerstone of effective practical training. Research underscores that industrial attachments are instrumental in equipping TVET students with current, market-relevant skills (Karuhanga & Muhwezi, 2025). Successful collaborations require alignment between institutional curricula and industry demands, as well as focused training for both teachers and learners (Mahalingam, 2024). Despite policy frameworks that encourage private sector involvement, such partnerships remain weak in some developing countries, such as Nepal (Regmi, 2021). Strengthening these linkages is therefore essential to improving training quality, enhancing graduate employability, and supporting broader economic development goals (Karuhanga & Muhwezi, 2025; Regmi, 2021).

However, Kiruga et al. (2018) observed that certain TVET courses continue to fall short in imparting the necessary employability skills required by industry, highlighting a misalignment between training and labor market needs which results into skill gaps, underemployment, and a lack of readiness among graduates. To bridge this gap, several interventions have been proposed including regular curriculum reviews to ensure relevance and responsiveness to market needs, harmonizing industrial attachment programs with institutional learning goals (Skakova et al., 2026), and fostering collaboration between TVET institutions and industry stakeholders to co-develop and update training programs (Kiruga et al., 2018). Such collaborative and adaptive strategies are essential in making TVET education more responsive, inclusive, and effective in addressing labor market dynamics.

2.3 Enhancing TVET Graduate Employability through Collaboration and Trainer Professional Development

In Technical Vocational Education and Training (TVET) institutions, Training of trainers (ToT) plays a critical role in improving instructional quality and aligning training with evolving industry demands. Muriuki and Magut (2022) emphasize the importance of retraining TVET instructors to respond to technological shifts and labor market changes. Similarly, Kim et al. (2019) demonstrated that targeted trainer development programs in Rwanda enhanced instructional competencies and positively influenced student outcomes. The quality and relevance of Technical and Vocational Education and Training (TVET) largely depend on the competence and continuous professional development of trainers. As Oketch (2007) emphasize, continuous upskilling of trainers is essential to ensure they remain conversant with current technological innovations, pedagogical advancements, and sector-specific best practices.

Collaboration between TVET institutions and industry is also central to bridging skill gaps and improving graduate employability as many institutions recognize the importance of aligning with industry requirements, actual collaboration remains limited (Kebede et al., 2024). Industry support plays a pivotal role in enhancing trainer capacity through various initiatives. Programs such as instructor internships, where trainers are embedded within companies to gain firsthand experience of contemporary work processes and technologies, are particularly valuable. Such internships expose trainers to practical challenges and innovations that can be translated into enriched teaching practices (Taylor et al., 2022). Additionally, professional workshops, technical seminars, and joint research collaborations between TVET institutions and industry partners offer trainers opportunities to update their technical knowledge and adopt cutting-edge pedagogical approaches (Rajamanickam, et al., 2024).

However, despite its critical importance, limited financial resources and competing institutional priorities restrict the scope and frequency of industry-supported trainer development programs (Oketch, 2007; Oyetade et

al., 2025). Additionally, inadequate policy support and weak institutional commitment contribute to fragmented or ad hoc professional development activities that lack sustainability and measurable impact (Mante et al., 2025)

Addressing these challenges requires multi-faceted strategies involving institutional commitment, enabling policies, and active industry engagement. Governments and TVET institutions must prioritize trainer development within national skills development frameworks and allocate dedicated funding to support sustained professional growth (Taylor et al., 2022). Policy incentives such as tax breaks for industries that invest in trainer internships or collaborative research can stimulate private sector participation and shared responsibility for skills development (Maltseva et al., 2025). Furthermore, fostering long-term partnerships between TVET institutions and industries can institutionalize trainer development activities, creating structured programs that regularly update trainers' skills in alignment with industry innovation cycles (Kebede et al., 2024). Embedding continuous professional development into trainers' career progression pathways also enhances motivation and retention of skilled instructors (Rajamanickam, et al., 2024).

2.4 Influence of Industry-TVET Collaboration on Resource Sharing and Employability Skills of TVET Graduates

Training resources play a vital role in both educational and professional development settings. They encompass a wide range of materials, such as print documents, video tutorials, and instructional guides designed to support effective teaching and learning (Zhang, 2023). Sharing of training resources between industry and Technical and Vocational Education and Training (TVET) institutions is a strategic approach that enhances the quality, relevance, and cost-effectiveness of vocational education. Training resources including machinery, workshops, laboratories, modern technology, and specialized expertise are often expensive for TVET institutions to acquire and maintain independently (Kennedy et al., 2017).

kennedy et al. (2017) noted that resource-sharing arrangements strengthen the institutional capacity of TVET centers and reduce operational training costs, creating a sustainable model especially vital in resource-constrained environments such as many Sub-Saharan African countries. This integration fosters innovation and equips learners with relevant skills that directly correspond to labor market demands (Taylor et al., 2022). More so, the availability of adequate and modern teaching-learning resources is critical for equipping learners in Technical Vocational Education and Training (TVET) institutions with employability skills that meet current industry demands (Mutembei et al., 2024). Teaching resources such as up-to-date tools, equipment, learning materials, and access to modern technologies play a central role in enhancing practical competencies and job readiness (UDEZE, 2024).

However, many TVET institutions continue to operate with outdated, insufficient, or poorly maintained facilities, which undermines the effectiveness of skill development initiatives (Mutembei et al., 2024). In Technical Vocational Education and Training (TVET) institutions, the availability and quality of training resources remain a significant concern. Research conducted in countries such as Nigeria, Zambia, Kenya, and Ethiopia pointed out common issues like outdated equipment, limited access to modern technology, and a shortage of up-to-date instructional materials (Igberaharha, 2021; Abd Rahman et al., 2025).

In Uganda and other developing countries, many institutions face infrastructural challenges, including outdated or insufficient machinery and inadequate workshop facilities, which undermine practical training quality (Oyetade et al., 2025). Additionally, there is a lack of formal mechanisms or legal frameworks guiding resource-sharing agreements between TVET institutions and industries. Without clearly defined roles, responsibilities, and protections for shared assets, institutions and industries remain hesitant to engage in long-term resource-sharing partnerships due to concerns about misuse, maintenance costs, and asset depreciation (UBTEB, 2024). Addressing these challenges requires stronger collaboration among TVET institutions, industry stakeholders, and government bodies to align resources with practical training needs (Abd Rahman et al., 2025).

3. Methodology

3.1 Research Design and Approach

The study used a combination of cross-sectional survey, correlational and regression research designs to study existing relationships between study constructs and enable comparison. Additionally, the study was guided by

the positivism. The positivism a paradigm helps in generalization of quantitative results give a clear understanding of the research problem (Tashakkori & Teddlie, 2008).

3.2 Study Population and Sampling

This study targets a total population of 495 academic staff including heads of department who are academic staff also. This is because all these categories of respondents are expected to be knowledgeable about the collaborations between TVET institutions and industry. Basing on Krejcie and Morgan's (1970) sample size determination table, a sample of 217 respondents was drawn from this population. A combination of sampling techniques simple random and purposive was employed to select participants.

3.3 Data Processing and Analysis

Stata 17.0 software has been used for analysis. The study used descriptive statistics to summarize participant characteristics and perceived levels of various constructs, Pearson's correlation and multiple OLS regression to establish relationships between study variables. More so, stepwise regression was used to generate the 4 models as indicated in Table 3. Diagnostics test of validity, reliability, and multicollinearity were tested and made sure the data conforms for proper analysis. Finally, the normality of data distribution for the study variables was visually inspected through graphical representations to ensure the parametric statistical tests were appropriate.

4. Results

4.1 Descriptive Statistics

Table 1 presents the descriptive characteristics of the 217 study participants. 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.

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 collaboration effectiveness between TVET institutions and industry on employability.

4.2 Correlation Analysis

Table 2 presents the Pearson correlation coefficients assessing the strength and direction of the linear relationships between the core variables in the study. Overall, the results indicate positive associations among the constructs, with several statistically significant correlations at the 0.05 level. These findings provide initial evidence supporting the conceptual model, which posits that collaboration between TVET institutions and industry positively influences employability skills outcomes. Importantly, Curriculum Development is strongly and positively correlated with Sharing of Training Resources ($r = 0.875 > 0.5$; $p\text{-value} < 0.05$) and moderately with Training Opportunities ($r = 0.461 < 0.5$; $p\text{-value} < 0.05$) and employability ($r = 0.394 < 0.5$; $p\text{-value} < 0.05$), indicating that when curricula are collaboratively developed with stakeholders, institutions are more likely to share resources and create training opportunities that ultimately boost employability.

Practical Training, though positively correlated with all other variables, shows relatively weak relationships. Its strongest correlation is with Employability ($r = 0.190 < 0.5$; $p\text{-value} < 0.05$), which is statistically significant but modest in magnitude. This suggests that while practical training contributes to employability enhancement, its impact 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.

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	24.89
	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	35.03
	6–10 years	52	23.96
	Above 10 years	63	29.03

Table 2. Results 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 (5)	0.394 *	0.190 *	0.609 *	0.624 *	1

* Significant at 0.05 level

Table 3. Regression results predicting employability

Variable	Model 1	Model 2	Model 3	Model 4
Curriculum Development	0.465 *** (0.074)	0.447 *** (0.074)	0.711 *** (0.121)	0.619 *** (0.112)
Practical Training		0.170 * (0.069)	0.166 ** (0.055)	0.169 *** (0.051)
Sharing Training Resources			1.484 *** (0.136)	1.107 *** (0.136)
Training Opportunities				0.446 *** (0.068)
Constant	1.895 *** (0.282)	1.363 *** (0.353)	0.211 (0.302)	0.380 (0.290)
Model fit Indices				
N	217	217	217	217
R ²	0.155	0.178	0.474	0.563
AIC	387.7	383.6	288.8	250.4
BIC	394.5	393.8	302.3	267.3

$p < 0.05 = *$, $p < 0.01 = **$, $p < 0.001 = ***$; Standard errors in parentheses; Dependent variable is employability; AIC – Akaike Information Criterion; BIC – Bayesian Information Criterion

The relationship between Sharing of Training Resources and Employability ($r = 0.609 > 0.5$; $p\text{-value} < 0.05$) is both strong and significant, suggesting that effective resource sharing (e.g., equipment, facilities, personnel) between TVET institutions and industry is crucial in enhancing students' job readiness. This result 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 ($r = 0.624 > 0.5$; $p\text{-value} < 0.05$) and Sharing of Training Resources ($r = 0.583 > 0.5$; $p\text{-value} < 0.05$), showing that when students are exposed to industry-based training or internships, their chances of securing employment increase notably.

4.3 Regression Analysis

The regression analysis evaluates how curriculum development, practical training, sharing of training resources, and training opportunities contribute to enhancing employability outcomes. Model fit is assessed using the coefficient of determination (R^2), Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) to identify the most explanatory and parsimonious model.

The first model focuses solely on the impact of curriculum development, specifically the active involvement of industry stakeholders in shaping TVET curricula, on graduate employability. The results reveal a strong positive and statistically significant relationship ($\beta = 0.465$, $p < 0.001$). Its R-squared value is 0.155 implying that curriculum development explains 15.5% in the total variations in the employability skills.

In the second model, practical training is introduced alongside curriculum development. The coefficient for practical training is positive and statistically significant ($\beta = 0.170$, $p < 0.05$), while curriculum development remains significant ($\beta = 0.447$, $p < 0.001$). This model explains 17.8% of the variance in employability ($R^2 = 0.178$), representing a meaningful increase in explanatory power.

The third model incorporates sharing of training resources such as joint utilization of modern machinery, workshops, laboratories, and instructional materials as an independent variable alongside curriculum development and practical training. The coefficient for sharing training resources is notably large and highly significant ($\beta = 1.484$, $p < 0.001$), signaling a powerful effect on employability. Curriculum development ($\beta = 0.711$, $p < 0.001$) and practical training ($\beta = 0.166$, $p < 0.01$) also remain significant. This model explains a remarkable 47.4% of the variance in employability ($R^2 = 0.474$).

The final model adds training opportunities including structured internships, apprenticeships, and on the job training placements as a key predictor of employability, in addition to curriculum development, practical training, and sharing of training resources. All predictors in this model are statistically significant: curriculum development ($\beta = 0.619$, $p < 0.001$), practical training ($\beta = 0.169$, $p < 0.001$), sharing of training resources ($\beta = 1.107$, $p < 0.001$), and training opportunities ($\beta = 0.446$, $p < 0.001$). This model accounts for 56.3% of the variance in employability outcomes ($R^2 = 0.563$), marking the highest explanatory power observed across all models.

Across all models the coefficients of AIC and BIC are reducing as explanatory variables are being added, for example, 387.7, 383.6, 288.8, 250.4, and 394.5, 393.8, 302.3, 267.3 respectively. This shows that adding more explanatory variables increases the power of the model.

4.3.1 Effect of Curriculum Development on Employability

The results of Model 1 focus solely on the impact of curriculum development, specifically the active involvement of industry stakeholders in shaping TVET curricula, on graduate employability. The results reveal a strong positive and statistically significant relationship ($\beta = 0.465$, $p < 0.001$). This implies that a unit improvement in the quality of curriculum improves the employability skills of the TVET graduates by 0.465 units. This emphasizes that curriculum development is a crucial starting point for enhancing employability. The finding validates the evidence that collaboration in curriculum design enables TVET institutions to tailor training content to current and anticipated labour market demands, thereby improving the relevance and applicability of graduates' skills which matches the qualitative findings that established.

In Uganda, where rapid technological changes and evolving industrial sectors demand specific skill sets, stakeholder participation in curriculum development ensures that training programs are not outdated but rather aligned with practical realities. The model explains 15.5% of the variance in employability outcomes ($R^2 = 0.155$), which, while modest, indicates that curriculum relevance is a significant but partial predictor of employability. Thus, this is an indication that curriculum development is an area that calls for collaboration between the TVET institutions and the industry to ensure the right skills are extended to the learners to match the demands of the employers in the industry.

This reflects the complexity of employability as a construct, which is influenced by multiple educational and non-educational factors. Nonetheless, the strong effect of curriculum development highlights that reforms focusing on collaborative curriculum design can serve as a foundation for broader improvements in graduate outcomes.

4.3.2 Influence of Industry Involvement in Practical Training on Employability

Practical training in TVET institutions is critical towards development of employability skills of TVET graduates in order to fit in the job market. The results in regression model 2 show that practical training is introduced alongside curriculum development. The coefficient for practical training is positive and statistically significant ($\beta = 0.170$, $p < 0.05$), while curriculum development remains significant ($\beta = 0.447$, $p < 0.001$). This implies that a unit increase in quality of curriculum and practical skills, the employability skills improve by 0.447 units and 0.170 units respectively. This model explains 17.8% of the variance in employability ($R^2 = 0.178$), representing a meaningful increase in explanatory power. The results show that the industry can significantly influence practical skills training in the TVET institutions regarding the learners, trainers and the training processes. This ensures that the TVET institutions are updated on the new technologies used by the industry so as to equip the learners with relevant knowledge and skills.

Practical training comprising internships, apprenticeships, and hands-on skills development is critical in Uganda's TVET landscape, where employers highly value tangible experience and competencies over theoretical knowledge alone. This finding reinforces the notion that TVET programs must go beyond classroom instruction to include immersive practical learning experiences that simulate or occur within real-world industrial environments. By doing so, graduates acquire not only technical skills but also workplace behaviours, problem-solving abilities, and adaptability. For many industries in Uganda, practical training serves as a form of informal vetting, where employers assess candidates' readiness and fit before offering permanent employment.

Hence, practical training is a vital link between education and employment, reducing the transition friction faced by graduates.

4.3.3 Influence of Sharing Training Resources in Employability

The third regression model results incorporate an extra variable of sharing of training resources such as joint utilization of modern machinery, workshops, laboratories, and instructional materials as an independent variable alongside curriculum development and practical training. The coefficient for sharing training resources is notably large and highly significant ($\beta = 1.484$, $p < 0.001$), signaling a powerful effect on employability. Curriculum development ($\beta = 0.711$, $p < 0.001$) and practical training ($\beta = 0.166$, $p < 0.01$) also remain significant. These results imply that unit increases in the sharing resources, curriculum development and practical training increases the employability skills of TVET graduates by 1.484, 0.711, and 0.166 respectively. This model explains a remarkable 47.4% of the variance in employability ($R^2 = 0.474$), indicating a substantial boost in predictive capacity. The dramatic increase suggests that sharing training resources is a critical mechanism by which TVET-industry partnerships translate into improved graduate outcomes. This implies that with the right training resources, the TVET graduates are able to obtain to accumulate the key skills which are key in employment whether employed in the businesses or helping them start up their own businesses.

In many Ugandan TVET institutions, lack of access to up-to-date and functional equipment is a significant barrier to quality training. Collaborative arrangements that enable resource sharing effectively mitigate this challenge, providing students with exposure to industry-standard tools and environments. The importance of resource sharing also aligns with the principles of collaborative governance and resource optimization in resource-constrained settings, ensuring that limited assets are leveraged to maximize training quality. This

collaborative resource provision fosters hands-on learning, technological familiarity, and confidence among students' attributes highly sought after by employers. Therefore, the findings suggest that enhancing physical and instructional resource partnerships should be prioritized alongside curriculum reforms and practical training. Given this opportunity, knowledge about the current technologies and innovation flows to the TVET institutions which prepares the graduates better.

4.3.4 Impact of Training Opportunities on Employability (Model 4)

The final regression model 5, adds training opportunities including structured internships, apprenticeships, and on the job training placements as a key predictor of employability, in addition to curriculum development, practical training, and sharing of training resources. All predictors in this model are statistically significant: curriculum development ($\beta = 0.619$, $p < 0.001$), practical training ($\beta = 0.169$, $p < 0.001$), sharing of training resources ($\beta = 1.107$, $p < 0.001$), and training opportunities ($\beta = 0.446$, $p < 0.001$). These results of this model imply that a unit increase in curriculum development, practical training, sharing of training resources and training opportunities increase on the employability skills of the TVET graduates by 0.619, 0.169, 1.107 and 0.446 respectively. This model accounts for 56.3% of the variance in employability outcomes ($R^2 = 0.563$), marking the highest explanatory power observed across all models.

These findings emphasize that employability is a multifaceted outcome that benefits from a comprehensive approach to TVET-industry collaboration. Training opportunities serve as a vital bridge, providing graduates with real-world exposure, industry networking, and a platform to demonstrate their competencies. In Uganda's competitive labour market, such opportunities often differentiate employable candidates from others. They enhance soft skills, workplace adaptability, and professional socialization, all of which complement technical abilities acquired through curriculum and practical training.

The combined effect of these four collaborative components indicates that improving employability requires integrated interventions rather than isolated efforts. The model's robust explanatory power suggests that policymakers and TVET stakeholders must foster synergies among curriculum design, practical experience, resource sharing, and workplace learning opportunities to meaningfully address youth unemployment and skills mismatch challenges.

From a policy perspective, these results highlight critical leverage points for TVET reforms in Uganda. Strategies aimed at promotion of inclusive stakeholder participation in curriculum development, scaling practical training programs, facilitating resource sharing agreements, and expanding structured training opportunities are likely to yield significant improvements in graduate employability. Such holistic collaboration can help close the skills gap, reduce youth unemployment, and contribute to Uganda's socio-economic development goals. The results suggest that in order to boost the knowledge and skills of the trainers, the principals at the TVET institutions noted the need to participate in skills training and upgrading activities within and outside the TVET institutions.

5. Discussion

5.1 Curriculum Development and Employability Skills

The results of this study show that 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. The results showed that curriculum development has a positive significant 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) in Malaysia which 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. Abd Majid et al. (2024) employed a quantitative research design and collected data from the final year students. These results are consistent with the findings of Yahya et al. (2024) who established that industry's participation in curriculum development brings on board market needs which shape the skills to be attained by the learners in order to be relevant. This ensures that the learners acquire appropriate skills marketable skills among employers by considering the current and future needs of the industry. These findings are due to the fact that the industry is the direct and major consumer of the products of the TVET institutions in terms of human resource.

Additionally, the findings of this study indicate that curriculum development has an influence on the employability skills of the TVET graduates. These results match the findings of Ajani et al. (2024) who established that a well-designed curriculum incorporates in industry demands in terms of skills, knowledge and training which improve the employability of a graduates since he or she is able to execute tasks allocated. Additionally, the results are consistent with findings of Abdullah et al. (2022) , Ritter (2018) and De Villiers (2010) who respectively found out that a good curriculum incorporates practical skills and goes beyond the technical skills of a graduates to include other soft skills to help graduates be able to work in diverse environments.

The results of this study clearly show that collaborating with the industry, the TVET institutions are able to design curricula reflecting the industry partnership to include industry needs into the programs (Ismail et al., 2021). This partnership influences TVET curriculum by incorporating the labour market requirements which are transformed into practical skills advanced to the learners and this eventually improves the employability skills of the TVET graduates.

5.2 Participation of Industries in Practical Training and Employability Skills of TVET Graduates

The results of this study establish that industry participation in practical training is a vital aspect in higher education to balance theory and practice among graduates in order to foster good professional skills. These results are consistent with the findings of Okolie et al., (2021) who found out that practical training boosts career readiness in addition to skills development. These results are possible as a result of the industry development in practical training.

Additionally, the results show of this study indicates that industry participation in practical training at the TVET institutions has a significant positive effect on the employability of the graduates. The results of this study agree with the findings of a study carried out by Hussain et al. (2021) who 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. Hussain et al. (2021) utilized a systematic literature review approach to assess the industry involvement in the TVET system. These results match the findings of Skakova et al. (2026) who established that practical training builds technical competency, adaptability and professionalism among TVET graduates which are key attributed demanded by the employment market. The industry provides training materials and resources which may not be available at the TVET institutions and these training materials are resources are key in skilling of the learners to transform theory into practice. More so, the industry provides field attachments to TVET learners where they are able to interface with the employment environment to learn and get conversant with the organizational etiquettes.

Therefore, regarding the relationship between industry involvement in practical training and the enhancement of employability skills of the TVET graduates, the results established that industry participation in practical training through provision of places for industrial training to the learners provides a chance for attaining practical skills and knowledge regarding current technologies and industry trends which improves their employability likelihood since they have experience with the real work life.

5.3 Promoting Sharing of Training Resources and Employability Skills of TVET Graduates

The results of this study showed that training resources is one key component among the requirements of the enhanced practical skills training at TVET institutions. These findings match the results of the study conducted in Meru, Kenya, by 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. The results of this study establish and recognize the critical role of sharing training resources between the industry and TVET institutions. These findings match the study results of Zhang (2023) who argued that training resources contribute greatly in education and profession growth. This is attributed to the fact that training resources support training through facilitating class lessons, and workshops. This therefore supports the need for the TVET institutions to collaborate with the industry players to make available such resources since the industry is always more equipped than the TVET institutions.

Additionally, the results of this study show that sharing training resources between the TVET institutions and the industry produces significant positive results on the employability skills of the graduates. These results agree with the findings in the report by the 2018 International Labour Organization (ILO) which established that TVET institutions benefit from the sharing resources with the industry which resources enable practical skills training (Palmer, 2020). More so, these results match the findings of Mutembei et al. (2024) who established that the availability of training resources facilitates the skills equipping processes in order to match the industry requirements. Mutembei et al. (2024) employed a mixed methods approach utilizing the theory of employability and human capital theory. Additionally, UDEZE (2024) indicated that availability of training resources enhances practical sessions in TVET institutions which improves the competencies of the learners and prepare them effectively for the job in the industry. This is possible because sharing resources helps the trainers access updated information which improves the quality of knowledge transferred to the learners.

5.4 Training Opportunities for Trainers and Employability Skills of TVET Graduates

The results of this study show that training of Trainers at the TVET institutions is very pivotal in streamlining the skills and knowledge of the TVET 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. The findings of this study match the results of a study by Geressu (2017) in Kenya who established that the competences of the trainers influenced by their skills and qualifications greatly impact the employability skills of the graduates. Geressu (2017) utilized a descriptive and inferential designs employing the human capital, skills mismatch and social learning theories using data collected from trainees, trainers and industry partners. More so, these results match the findings of Muriuki and Magut (2022) who established that training of trainers at TVET institutions improves the quality of training. Furthermore, the results show that training of trainers significantly improves the employability skills of the TVET graduates since they will be equipped with 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. They ensure to extend the relevant skills and knowledge to help the graduates at their places of employment in the industry. These findings agree with the results of Abdullah al. (2022) who found out that training the trainers influences the skills attained by the learners such as interpersonal skills, teamwork and other requires practical skills. This is possible because training the trainers improves their capacity and ability to train and instruct learners efficiently which leads to positive outcomes in terms of skills and practical knowledge.

More so, the results of the study indicate that collaborating with the industry to creates more opportunities to train the TVET instructors through workshops, retooling lessons, and attachments. These results match the findings of Kebede et al. (2024) who established that collaborating with the industry, the TVET acquire practical training which bridges the skills gaps with the practical operations within the industries with improves the employability of the graduates.

Therefore, the results of this study provide evidence that cooperation between the TVET institutions and the industry creates training opportunities to the TVET trainers through workshops, industry visits and tours. This improves their knowledge especially regarding the current technologies and market trends which they incorporate in the teaching processes thus providing practical and relevant skills to the learners which fosters graduates' employability skills like the technical skills.

6. Conclusion

Employability skills of the TVET graduates remain a concern for the industry players who consume their services considering the job demand. This study examined how collaborations between TVET institutions and industry enhance of employability skills of TVET graduates in Uganda. This collaboration was highlighted in four basic areas including curriculum development, industry participation in practical Training, sharing of training resources and training opportunities for the trainers at the TVET institutions.

The results established that the TVET institution - industry collaboration regarding curriculum development has a significantly effect on employability skills of the TVET graduates. More so, the results showed that there is a significant positive relationship between collaboration on the enhancement of industry participation in practical training in TVET training institutions and the enhancement of the employability skills of TVET graduates. Furthermore, the findings identified that collaboration between industry and TVET training institutions in

promoting the sharing of training resources positively influences the enhancement of the employability skills of TVET graduates. Lastly, the findings of this study established that collaboration between the TVET institutions and the industry on the training opportunities for TVET trainers has a significant positive effect on the enhancement of the employability skills of TVET graduates.

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. The results of this study established that the industry has a vital role to play in shaping the quality of skills of the TVET graduates in Uganda. The results of this study form a strong foundation towards the implementation of the TVET policy of 2019 and the TVET Act of 2025 which aim at enhancing the employability skills of graduates, quality of learning and supporting critical collaborations with the stakeholders.

Whereas this study presents significant insights into the collaboration between TVET institutions, it is critical to recognize the embedded limitations that may hinder generalizability of the study results in other contexts. This study focused on Greater Mbarara, Bushenyi, Ntungamo and Kabale found in Western part of Uganda. More so, the study was limited to the Government owned and aided TVET institutions leaving out the private TVET institutions. Thus, it is not clear what the results would be if other areas in Uganda and private TVET institutions were included in this study. Furthermore, this study utilized a cross sectional research design which does not provide the longitudinal dynamics which may inform the study results. This implies that the previous trends in the employability skills of TVET graduates has been left out and thus unable to tell whether there is an improvement or deterioration in the kills of learners over time. However, this does not nullify the importance of this study since it has provided the present impression about the skills of the TVET graduates considering the job markets needs and employer expectations.

Nonetheless, the result of this study provides 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. This study highlights the need for skills training and development, joint curriculum design, internships and apprenticeships, workshops and study tours. Furthermore, this study greatly contributes to the existing literature regarding collaboration between TVET institutions and the industry and the associated factors and areas. Generally, this study established the need to improve and strengthen the existing collaborations between the TVET institutions and industry, plan new strategies and explore potential opportunities of this collaboration.

7. Recommendations

Cultivating joint curriculum design and review committees. This is evidenced when a participant noted the need of having joint review meetings in curriculum development to include the industry stakeholders. Thus, the curriculum development committees should comprise of both people from the TVET institutions and the industry players. This shows that the collaboration should go beyond the mere stakeholder consultations to a well-structured joint 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 TVET Institutions-Industry Liaison offices. This is because two participants noted that there is a communication gap between institutions and industry. These liaison offices in the TVET institutions offer

support in coordinating with the industry regarding internship, job placements, guest lectures, workshops and other education related projects which require the industrial input.

Supporting continuous professional development and joint research programs. The results noted that much as the Trainers have adequate knowledge to deliver to learners, they still need continuous training and skilling as a result of changing technologies and job market demands and also learn new trends in upcoming technologies hence the need for re-tooling or refresher courses. Thus, the TVET institutions and industry should put in place structures supporting joint staff retooling and upgrading through exchange programs and short professional courses. Also, joint research initiatives should be embraced to explore projects and programs that address real industry challenges. This can be done through involving learners and trainers in research innovation challenges with mentorship from industry experts.

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 they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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