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Engineering of Technical Education, Vocational and Entrepreneurship Training (TEVET) in Zambian Secondary Schools using Public Private Partnership (PPP) Model to Achieve Sustainable Development

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Abstract
The global imperative to integrate Technical Education, Vocational and Entrepreneurship Training (TEVET) within secondary education through Public-Private Partnership (PPP) models is increasingly recognized as vital for sustainable workforce development. This study investigated the engineering of TEVET in Zambian secondary schools using a PPP framework to achieve sustainable development. Guided by a pragmatic paradigm, an embedded mixed-methods design was employed. Quantitative data from 353 respondents were analysed using binary logistic regression, while qualitative data from 28 key informant interviews and 20 FGDs with learners were thematically analysed. Findings revealed significant operational disparities; ongoing induction (Exp(B) = 2.834, p < .000), dual learning for skills acquisition (Exp(B) = 2.22, p = .006), and joint skills tracking (Exp(B) = 5.06, p < .001) for attachment at school and industry were significant determinants of program efficacy. Ultimately, the study validates a comprehensive TEVET implementation framework driven by ongoing induction, institutional-industry collaboration, dual learning, and tracked skills application. Leveraging tax incentives for participating industries, the PPP model offers a mutually beneficial strategy to equip secondary school learners with critical industrial skills, driving economic growth.

Keywords: Technical, Education, Vocational, Entrepreneurship, Induction, Attachment

1. Introduction

1.1 Background

The global imperative to strengthen Technical Education, Vocational and Entrepreneurship Training (TEVET) in secondary schools through Public-Private Partnerships (PPPs) is increasingly recognised as a catalyst for economic growth. UNESCO (2022) [1] highlights that TEVET equips youth with skills for "decent work" and sustainable development, directly contributing to SDG 4 and SDG 8. However, the persistent disconnect between training and labour market needs in developing countries remains critical. The World Bank (2023) [2] stress that robust TEVET systems are essential for long-term employment and productivity.

Government funding alone is often insufficient for secondary school TEVET; thus, PPPs have emerged as a vital strategy to reinforce infrastructure and capacity. Okoye and Chijioke (2013) [3] argue that private sector integration enhances vocational quality, as demonstrated in Nigeria. Similarly, India has leveraged PPPs to expand secondary education with greater accountability (Lathum *et al*., 2011) [4]. By aligning programmes with industry requirements, these collaborations modernise TEVET and drive sustainable economic growth (Vertakova & Plotnikova, 2014) [5].

Pasawano (2019) [6] identified critical imperatives for TVET reform, including alignment with national economic needs, modernisation of facilities, and integration of traditional skills. Central to reform is the need for skilled instructors with up-to-date practical knowledge. Pasawano argues that PPP models can bridge this gap by attracting investment, upgrading quality assurance, and strengthening training institution–workplace linkages.

Since independence, TEVET has been a cornerstone of Zambia's development strategy to address the colonial 'manpower gap.' Mwanakatwe (2013) [7] argued that the 'severely lopsided' system inherited in 1964 prioritised basic literacy over technical

mastery, positioning TEVET expansion as a matter of national sovereignty. Mwanakatwe envisioned TEVET as a 'lifeline' for secondary school leavers, advocating curricula that integrate business management to transform graduates into 'job creators' rather than 'job seekers.' This aligns with the World Bank's (2001) [8] call for a high-quality, sustainable, demand-driven system.

Ultimately, PPP integration in TEVET is critical for achieving the SDGs by fostering a skilled workforce that drives economic growth and addresses global challenges (African Development Bank Group, 2023) [9]. In secondary education, PPPs typically feature dual-training models, where learners alternate between classroom instruction and workplace engagement (European Training Foundation, 2021) [10]. Vocational education links to poverty reduction and environmental sustainability (UNESCO-UNEVOC, 2006) [11]. TEVET systems supply human capital for innovation, entrepreneurship, and productivity, with responsive programmes focusing on emerging technologies (Jobs for the Future, 2025) [12]. PPPs further enhance access to quality education for poor and minority children in underserved areas (Patrinos *et al*., 2009) [13].

In Zambian secondary schools, TEVET has implemented a dual-education system since 2013, enhancing skills access in rural areas (UNESCO, 2019) [14]. Effective delivery depends on comprehensive teacher training to ensure pedagogical, industry-specific, and technological competencies. Therefore, this study investigated work-based learning, which provides practical industry experience, equipping learners with required skills while creating a pipeline for employers.

1.2 Objectives

1. To investigate the implementation of Induction of TEVET in secondary schools of Zambia.
2. To Analyze the implementation of attachment of TEVET in secondary schools of Zambia.

1.3 Research Questions

1. What can be done to have effective implementation of Induction of TEVET in Secondary schools of Zambia?
2. How can sustainable implementation of attachment of TEVET in secondary schools of Zambia be done?

1.4 Theoretical Framework

This research based its alignment with the Engagement and Apprenticeship Theories and the Public-Private Partnership Model (PPP).

1.4.1 Engagement Theory

Recent developments in Engagement Theory span diverse fields, including Programme Engagement Theory (PET) for offender programmes (Holdsworth *et al*., 2017) [15], Material Engagement Theory (MET) for sustainability (Graham, 2019) [16], and traditional views on employee productivity (Keenoy, 2013) [17]. This study adopts Kearsley and Shneiderman's (1998) [18] Engagement Theory, grounded in active, social, and contextual learning. The theory conceptualises engagement as an interrelated, multifaceted construct with cognitive, emotional, and behavioural dimensions operationalised through the principles of Relate, Create, and Donate. These principles are highly relevant to TEVET in Zambian secondary schools (Grades 8–12). Cognitive engagement (Create) promotes deep problem-solving in subjects such as Design and Technology and Agricultural Science using low-cost local materials aligned with TEVETA competencies. Emotional engagement (Relate) builds belonging and persistence through collaborative activities, while behavioural engagement (Donate) produces tangible value for external audiences via induction and attachment programmes. The interconnected dimensions, influenced by motivation and self-efficacy (Collie & Martin, 2019) [19], accommodate learner diversity and ensure meaningful stakeholder engagement for sustainable national development.

1.4.2 Apprenticeship Theory

Apprenticeship Theory evolved through German scholars Kerschensteiner, Spranger, and Fischer, who integrated practical skills with theoretical knowledge and personal development (Kuhlee *et al*., 2022) [20]. Kerschensteiner, the foundational figure, advocated the Arbeitsschule and dual system for civic and vocational competence (Gonon, 2009) [21]. Spranger emphasised holistic Bildung (Gonon, 2022) [22], while Fischer highlighted phenomenological pedagogy (Lippitz, 2019) [23]. This study aligns the theory with the 2023 Zambia Education Curriculum Framework and TEVETA competencies through resource adaptation, industry partnerships, and portfolio assessment. Strengths include bridging academic and workplace skills, enhancing employability in Europe and Sudan (Olofsson & Panican, 2018; Sudan Ministry of Education, 2025) [24, 25]. Weaknesses involve multiple paradigms (Gessler, 2019) [26], school-workplace disconnect, and scalability issues in Kenya (KIPPRA, 2025) [27], necessitating hybrid adaptations for Zambian TEVET.

1.4.3 Public-Private Partnership Model

PPP models in TEVET align educational outcomes with labour market demands through collaborative infrastructure and service delivery. Common models include BOT, DBFO, Concession Agreement, and Joint Venture (UNESCAP, 2017) [28]. Lyulkova (2024) [29] highlights joint financing, dual training, and quality assurance as core characteristics. This study adopts a bottom-up PPP approach informed by Chile's successful Germany–Chile dual project (Grunwald, 2008) [30]. Strengths include co-financing infrastructure, curriculum alignment, and scalability, demonstrated in Ethiopia, Kenya, Rwanda, and Zambia pilots (African Center for Economic Transformation, 2025) [31]. Weaknesses encompass governance deficits, financial imbalances, equity gaps, and capacity constraints (Kubaison, 2022; Wokadala & Barungi, 2025) [32, 33], underscoring the need for robust regulatory frameworks in Zambian secondary TEVET.

1.5 Literature Review

Induction and attachment processes play a pivotal role in facilitating smooth transitions, professional development, and student integration in secondary schools. However, significant challenges and inefficiencies persist, particularly in developing contexts.

Worldwide, induction and attachment processes underscore the importance of structured support for early-career teachers (ECTs) and students with behavioural, emotional, and social difficulties (BESD). Effective induction programmes enable ECTs to navigate role complexities, leading to sustainable practices that enhance professional development and collaborative learning (Aarts *et al*., 2023; Kearney, 2017) [34, 35]. For students with BESD, tailored

interventions addressing attachment difficulties must consider individual needs, emphasising connectedness, voice, and fairness in shaping school experiences (Casey, 2015) [36]. Scholars further recommend viewing induction as a continuous process rather than a one-off event, integrating professional development principles to foster supportive environments for both teachers and students (Stirzaker, 2004; Walker & Stott, 1998) [37, 38]. This holistic approach ultimately improves educational outcomes and school culture.

Comparative studies across Africa reveal similar inconsistencies and challenges. In Ghana, beginning teachers face numerous obstacles, including inadequate support and a lack of formal induction policies, which impede their integration into the profession (Keengwe & Adjei-Boateng, 2012) [39]. In Kenya, the absence of a unified induction framework results in varied management practices, leaving newly appointed teachers overwhelmed and unsupported (Ajowi & Simatwa, 2011) [40]. In South Africa, induction is often informal and neglected, indicating a clear need for structured programmes to enhance teacher effectiveness (Dayaram, 2002) [41]. The induction of Grade 8 pupils in Zambia is similarly poorly structured, failing to support the transition from primary to secondary education and intensifying adjustment difficulties (Situmbeko & Banja, 2019) [42]. These studies collectively highlight the urgent requirement for formalised induction and mentoring policies across African secondary schools to improve teacher retention and student integration.

In Zambian secondary schools, formal induction for Grade 8 pupils is often unstructured and excludes key stakeholders such as parents and senior students, thereby hampering effective integration into the new school environment (Situmbeko & Banja, 2019) [42]. New teacher induction programmes exist but prove ineffective, primarily because of the absence of standardised practices and insufficient stakeholder awareness, resulting in inadequate support. Newly qualified teachers frequently encounter hostile environments with minimal mentorship, exacerbating their challenges and undermining educational quality (Banja, 2016) [43]. Although teachers express willingness to engage in curriculum development, their actual involvement remains limited, highlighting a persistent disconnect between policy intentions and practical implementation (Mulenga & Mwanza, 2019) [44]. Collectively, these findings underscore the urgent need for structured induction policies and enhanced support systems to improve transition experiences for both students and teachers.

Regarding the practical application of induction and attachment in Technical and Vocational Education and Training (TVET/TEVET), India offers a robust, scalable model at the secondary level (Grades 9–12). Through the National Skills Qualification Framework (NSQF), Samagra Shiksha, and the National Education Policy (NEP) 2020, India integrates teacher induction and industrial attachment (on-the-job training or OJT) to support competency-based skill development, industry alignment, and school-to-work transitions under Public-Private Partnership (PPP) frameworks.

The centrally sponsored scheme for vocationalization of secondary and higher secondary education mandates a 30-day induction training for all newly appointed vocational teachers/trainers. States organise this training in coordination with the Pandit Sundarlal Sharma Central Institute of Vocational Education (PSSCIVE), giving preference to candidates with industry experience. Annual in-service training (7–10 days) follows to upgrade pedagogy, subject knowledge, and industry linkages, while pre-service B.Ed. (Vocational) programmes incorporate workplace internships. PSSCIVE serves as the national coordinating agency, ensuring alignment with NSQF competencies (PSSCIVE, 2021) [46].

Industrial attachment constitutes the core "attachment" mechanism in secondary vocational education. PSSCIVE (2021) [46] guidelines require 80 hours total across Grades 9–12 (20 hours per grade) in relevant industries, enterprises, or organisations near the school. Students undertake structured, supervised hands-on tasks aligned with National Occupational Standards (NOS). Implementation features signed Memoranda of Understanding (MoUs) between school and industry, detailed training plans using the ADDIE model, student logbooks/reports/portfolios/feedback forms, vocational teacher coordination, principal site visits (minimum twice), and strict safety protocols.

NEP 2020 expands these opportunities through bagless days, 10-day internships in Grades 6–8 (with extensions to Grade 12), and a national target of 50% student exposure to vocational education by 2025. Vocational subjects replace or supplement academic ones, supported by flexible timetables for industry placement.

PPP and industry collaboration are central to the model: private schools receive per-student reimbursement under the vocationalization scheme, while industries participate through Sector Skill Councils, MoUs, guest faculty, and OJT hosting. NEP 2020 and earlier schemes emphasise local industry partnerships for curriculum relevance, assessment, and certification. Challenges persist, however, including limited industry buy-in, inadequate teacher industry exposure, and low apprenticeship uptake at the school level (Mehrotra, 2021) [47]. The Dual System of Training (DST), introduced in 2016 and primarily applied in Industrial Training Institutes (ITIs), provides a related balanced classroom and on-site model whose principles influence broader TVET reforms and school-industry linkages (Maitra & Thakur, 2022) [48].

In summary, induction and attachment is viable at secondary school level as it has been demonstrated in various countries especially with that practical example of India's demand-driven, modular, competency-based approach, underpinned by strong school-industry collaboration, demonstrates effective integration of induction and attachment in secondary TEVET, although scale-up, quality assurance, and equitable access remain ongoing priorities under NEP 2020.

2. Materials and Methods

2.1 Philosophical Orientation

This study adopted a pragmatist philosophical orientation, integrating positivist objectivity and constructivist subjectivity to investigate TEVET implementation in Zambian secondary schools. Pragmatism prioritises practical problem-solving and methodological flexibility, enabling an embedded mixed-methods design that combines quantitative measurement of variables (e.g., induction, attachment, funding) with qualitative exploration of stakeholder perceptions to develop a contextually relevant PPP framework (Creswell & Creswell, 2023) [49].

Pragmatism embraces pluralistic ontology recognising both singular, measurable reality (positivist) and multiple, socially constructed realities (constructivist). This dual stance supports objective TEVET metrics (e.g., skill outcomes) alongside subjective learner experiences in Zambian secondary contexts (Creswell & Creswell, 2023; Guba & Lincoln, 1994) [49, 50].

Pragmatic epistemology is problem-centred and practical, blending objective quantitative knowledge with subjective interpretive insights to generate actionable understanding of TEVET delivery challenges and opportunities.

Pragmatic axiology integrates value-neutral analysis with advocacy for equity, ensuring ethical, socially responsive recommendations that address access disparities in Zambian secondary TEVET.

2.2 Research Design

This study employed an embedded mixed-methods design (QUAN + qual) within a pragmatic framework, with quantitative data serving as the primary strand and qualitative data nested for elaboration and explanation (Creswell & Creswell, 2023) [49]. Quantitative data from questionnaires were analysed in SPSS using independent-samples t-tests and binary logistic regression, while qualitative data from key informant interviews and learner FGDs were thematically analysed via NVivo and manual coding. Integration occurred during analysis and interpretation through joint displays and narrative weaving, following Fetters *et al*. (2013) [51], to explain statistical findings with participant voices.

2.3 Sampling

The quantitative population comprised all administrative and teaching staff directly involved in TEVET programmes in Zambia's 1,430 public secondary schools. This included Head Teachers, Deputy Head Teachers, Heads of Departments (Practical Subjects), Guidance and Counselling Teachers, and Parent-Teacher Committee representatives (Ministry of Education, 2024) [52].

A multi-stage stratified random sampling procedure was employed to select the quantitative sample of 353 respondents (Creswell & Creswell, 2023) [49]. First, five provinces (Central, Copperbelt, Lusaka, Northern, Western) were purposively stratified to capture geographic, economic, and TEVET-implementation diversity. Districts (N = 58) served as clusters within provinces. Schools were then randomly selected from official Ministry of Education/TEVETA lists using SPSS randomisation, proportional to district size (approximately 5–10 schools per district). Within each selected school, one to two respondents per role category were purposively chosen for expertise relevance, yielding the final balanced sample (62 Heads, 62 Deputies, 62 HODs, 62 Guidance Teachers, 105 PTC representatives). Sample size was initially calculated at 385 using Cochran's (1977) [53] formula (95% confidence, 5% margin of error, p = .50) for an infinite population, then adjusted to 353 via Yamane's (1967) [54] finite population correction.

The embedded qualitative strand used purposive sampling to select 28 key informants (national/provincial policy officers, TEVETA/HEA officials, and industry experts) based on their specialised knowledge of TEVET policy and implementation (Frankfort-Nachmias & Nachmias, 2008) [55]. Twenty learners focus groups (8–10 participants each) were also purposively composed from students who had completed or were registered for TEVET examinations. This dual sampling strategy ensured representativeness for generalisable quantitative findings while providing rich, context-specific qualitative depth.

2.4 Data Collection

To achieve methodological triangulation and ensure robust, contextually grounded findings on TEVET implementation in Zambian secondary schools, the study employed both secondary and primary instruments (Creswell & Creswell, 2023) [49]. All instruments were developed through a systematic, iterative process grounded in the research objectives, literature review, and expert validation.

A structured **document analysis protocol** guided the secondary desk review of national TEVET policies, Ministry of Education circulars, TEVETA guidelines, and international benchmarks (UNESCO, ILO). The protocol incorporated a priori coding categories from the conceptual framework (induction, attachment, PPP) and was refined after scoping 45 documents.

The three primary instruments were:

1. **Structured Questionnaire** (quantitative-dominant): Adapted from validated TEVET scales (Okoye & Chijioke, 2013; Lyulkova, 2024) [3, 29]. It included 5-point Likert items for key variables and open-ended sections. Content validity was confirmed by two TEVET specialists and one statistician; pilot-tested with 30 non-sample respondents (Cronbach's α = .89).
2. **Semi-Structured Interview Schedule**: Comprised 12 core questions with probes, progressing from descriptive to evaluative. Refined through cognitive interviewing with three key informants and reviewed for cultural appropriateness.
3. **Focus Group Discussion Guide**: Contained eight open-ended and three structured prompts for learners. Developed iteratively from learner-centred TEVET studies, pilot-tested with two groups (n=16), and adjusted for group dynamics and language accessibility.

2.5 Data Collection Procedure

Data collection followed a concurrent embedded mixed-methods sequence between January and June 2025 and proceeded in six deliberate steps:

1. **Ethical and Official Permissions** – Approval was first obtained from the University Ethics Committee and the Ministry of Education's Research Unit. This step ensured legal access and participant protection while building institutional trust in a hierarchical education system.
2. **School and Participant Recruitment** – Using the multi-stage sampling frame, head teachers received official letters and information sheets. Informed consent/assent was secured from all participants prior to any data collection.
3. **Pilot Testing** – Instruments were field-tested in two non-sample schools to assess clarity, timing, and cultural relevance. Minor wording adjustments were made, and logistical challenges (e.g., rural travel) were resolved.
4. **Simultaneous Primary Data Collection** – Questionnaires were self-administered to the 353 quantitative respondents during school visits. On the same or consecutive days, 28 semi-structured

interviews (30–45 minutes each) and 20 FGDs (8–10 learners per group, 60–75 minutes) were conducted in private venues. Concurrent collection minimised temporal bias and allowed immediate clarification of emerging issues.

5. **Secondary Data Collection** – Parallel desk review of 62 policy documents and reports was conducted throughout the period to provide real-time contextual triangulation.
6. **Quality Control and Closure** – All sessions were audio-recorded (with permission), transcribed verbatim, and member-checked where possible. Response rates were monitored daily; follow-up visits ensured >95% completion.

This sequential yet concurrent procedure was deliberately chosen to maximise response quality, reduce respondent fatigue, and enable immediate integration of qualitative insights with quantitative trends, thereby strengthening the study's credibility and practical utility for Zambian TEVET policy.

2.6 Data Analysis

The study employed a **concurrent embedded mixed-methods data analysis model** (QUAN + qual), with quantitative analysis as the primary strand and qualitative analysis nested to provide explanation and elaboration (Creswell & Creswell, 2023) [49]. This model was deliberately chosen because it aligns with the pragmatic philosophical orientation, allows statistical generalisability of TEVET implementation variables while capturing contextual "why" and "how" nuances from stakeholders, and directly supports the engineering of a practical PPP framework for Zambian secondary schools.

2.6.1 Quantitative Analysis

Data from 353 questionnaires were entered into SPSS version 26.0. Descriptive statistics (frequencies, percentages, means, bar charts, and pie charts) summarised respondent profiles and variable distributions for immediate interpretability (Vetter, 2017) [56]. Inferential statistics included independent-samples t-tests to examine group differences (e.g., urban vs. rural challenges) and **binary logistic regression (BLR)** to model the probability of successful TEVET outcomes (dependent variable: effective programme delivery) from predictors such as induction, attachment, funding sources, and certification processes. BLR was selected because it is ideally suited for dichotomous outcomes, yields odds ratios for practical policy interpretation, identifies "at-risk" implementation factors, and generates predictive equations that informed the proposed decision-making framework (Peng *et al*., 2002; Hosmer *et al*., 2013) [57, 58].

2.6.2 Qualitative Analysis

Transcripts from 28 interviews and 20 FGDs underwent **reflexive thematic analysis** (Braun & Clarke, 2022) [59]. The six-phase process (familiarisation, coding, theme generation, review, definition, and reporting) was applied using NVivo 14 supplemented by manual coding to ensure deep immersion. This approach was chosen for its flexibility, rigour, and capacity to generate rich, participant-driven themes that explain quantitative variances (e.g., why certain attachment models succeed or fail).

Integration Quantitative and qualitative findings were integrated during analysis and interpretation through joint displays, side-by-side comparisons, and narrative weaving, ensuring the embedded qualitative strand enhanced rather than overshadowed the primary quantitative results (Fetters *et al*., 2013) [51].

2.6.3 Ethical Consideration

Ethical considerations were paramount to safeguard participants and uphold research integrity in this study of TEVET in Zambian secondary schools (Creswell & Creswell, 2023) [49]. Formal ethical clearance was obtained from the University of Zambia Humanities and Social Sciences Research Ethics Committee (HSSREC), followed by administrative approval from the Ministry of Education and TEVETA.

Informed consent was secured from all participants per Kaewkungwal and Adams (2019) [60]. Information sheets and signed consent forms (or assent for learners) detailed the study purpose, risks, benefits, and voluntary nature. Confidentiality and anonymity were ensured by assigning alphanumeric codes and removing all identifiers (Cheng *et al*., 2024) [61]. Participation was entirely voluntary, with the explicit right to withdraw at any time without penalty (Khatib & Khatib, 2022) [62]. Equity was maintained through inclusive sampling across urban/rural provinces, and data integrity was preserved by accurate reporting without fabrication or manipulation (Dubey *et al*., 2024; Chasokela, 2024) [63, 45].

3. Results and Discussion

3.1 Likelihood of Induction and Attachment of TEVET in Secondary Schools

The results have been highlighted with explicitly on Induction and Attachment with supporting findings from the qualitative outcomes.

Table 1: Induction Practices for TEVET in Secondary Schools Using Binary Logistic Regression

How Induction can be done in secondary schools	B	S.E.	Wald	Df	Sig.	Exp(B)
Setting a well-structured and organised plan to ensure all important information on TEVET is covered?	1.421	0.319	19.793	1	0.000	4.141
Providing comprehensive information to cover TEVET's history, mission, values, policies, job expectations and relevant training for skills acquisition?	-0.845	0.311	7.384	1	0.007	0.429
Setting clear expectations through understanding of roles, responsibilities and performance standards?	0.342	0.333	1.056	1	0.304	1.408
Integration od academic and professional skills?	0.290	0.305	0.901	1	0.342	1.336
Providing a supportive environment for TEVET activities?	-0.802	0.345	5.404	1	0.020	0.448
Providing regular feedback and review through progress tracking and adjustments	-0.886	0.328	7.304	1	0.007	0.412
Ensuring and on-going support as opposed to a one-time event for the process of TEVET program integration and development	1.042	0.286	13.226	1	0.000	2.834

Source: Field Data, (2025)

Table 1 presents the binary logistic regression findings on induction practices predicting successful TEVET delivery in Zambian secondary schools. Well-structured d organized plan ($p < .001$, Exp(B) = 4.141) and ongoing support ($p < .001$, Exp(B) = 2.834) were statistically significant positive predictors. Providing comprehensive information ($p = .007$, Exp(B) = 0.429), providing a supportive environment ($p = .020$, Exp(B) = 0.448), and providing regular feedback and review ($p = .007$, Exp(B) = 0.412) were statistically significant negative predictors. Setting clear expectations ($p = .304$, Exp(B) = 1.408) and integration of academic and professional skills ($p = .342$, Exp(B) = 1.336) showed no statistically significant association.

Table 2: Induction Practices for implementation of TEVET in secondary Schools using Binary Logistic Regression

How can attachment be done in Secondary Schools	B	S.E.	Wald	df	Sig.	Exp(B)
Learners' prerequisite work for TEVET skills?	-0.410	0.230	3.173	1	0.075	0.663
Discipline and regulations for being attached to an industry?	0.499	0.261	3.675	1	0.055	1.648
Placement of learners must be done as a school arrangement?	-0.082	0.217	0.144	1	0.705	0.921
Engagement through collaborations with the industry?	-0.726	0.286	6.417	1	0.011	0.484
Learners must be in the presence of an assigned teacher and practicing professional from the industry?	0.797	0.288	7.653	1	0.006	2.220
Provisions for log in and out must be strictly followed?	-0.255	0.210	1.475	1	0.224	0.775
Reports must be tracked by the school and industry?	1.621	0.315	26.499	1	0.000	5.057
Learners must be certified at the end?	-1.194	0.309	14.897	1	0.000	0.303

Source: Field Data, (2025)

Table 2 presents the binary logistic regression findings on attachment practices predicting successful TEVET delivery in Zambian secondary schools. Dual supervision by a school-assigned teacher and an industry professional ($p = .006$, Exp(B) = 2.220) and joint report tracking by school and industry ($p < .001$, Exp(B) = 5.057) were statistically significant positive predictors. Perceived strength of industry collaboration ($p = .011$, Exp(B) = 0.484) and requiring certification at the end of attachment ($p < .001$, Exp(B) = 0.303) were statistically significant negative predictors. Prerequisite work ($p = .075$, Exp(B) = 0.663), discipline and regulations ($p = .055$, Exp(B) = 1.648), school-led placement arrangements ($p = .705$, Exp(B) = 0.921), and strict log-in and out procedures ($p = .224$, Exp(B) = 0.775) showed no statistically significant associations.

3.2 Supportive Findings for Induction and Attachment of TEVET in Secondary Schools

Analysis of interviews with 28 key informants and 20 learners focus group discussions revealed four interconnected themes illuminating TEVET induction and attachment implementation in Zambian secondary schools.

Learner Induction describes informal, ad-hoc orientation to vocational subjects (e.g., Design & Technology) from Grade 8, often through teacher demonstrations, videos, and career discussions. **Key words:** Induction, Showed us/Video, Ask us, Orientation. "Yes… the madam basically came in all class… showed us how it is so that we should have an idea… they introduced every subject" (Pvt Lsk FGD 1).

Ministry of Education Induction emphasises top-down policy orientation from ministers, permanent secretaries, and directors to foster synergy and enforce standards. **Key words:** Induction, Proper guidance, Law. "Induction beginning with the top most in the Ministry of Education… create strong synergy" (TT2).

Industry Attachment highlights the absence of mandatory placements, with learners advocating formal school–industry partnerships, holiday attachments, and legal compulsion. **Key words:** Attachment, Make arrangements with industries, Formal working relationships, Holiday, Real world. "There's no provision for them to get attached as we do in the TEVET Institutions" (TT1).

Institutional Attachment proposes schools as self-contained "institutional enterprises" (e.g., in-house workshops or farms) for mandatory practical training. **Key words:** Institutional Enterprise. "Our concept of Institutional Enterprise… the institutional creating its own industry" (TT2).

These themes collectively advocate structured, collaborative, and hybrid models to bridge theory and practice in resource-constrained Zambian secondary TEVET.

Table 3: Supportive Findings on Implementation of Induction and Attachment for TEVET in Secondary Schools

Investigate the implementation of Induction and attachment of TEVET in Secondary Schools of Zambia.		
Emerging Themes	**Key Words**	**Verbatims**
Learner Induction	Induction, Introduced the subjects	"Yes…for FN the madam basically came in all class, then she gave us a like things that we the mostly happen in there and told us, and showed us how it is so that we should have an idea…we first had in grade eight were all the teachers come and introduce their subjects to you. They did according to the skills including physics and sciences. They introduced every subject and what goes around with it…As for DT there were two Teachers, a male and a female. The female was the one who was telling us about the metal work, Woodwork and plastic work, while the male teacher was the one teaching us in drawing and electric…for me the first person who talked was Harrison a pupil who talked to us about Agriculture Science" Pvt Lsk FGD 1
	Showed us, Video	"the teachers were able to tell us through video which showed how Design and Technology is done and which industries we can join in when we finish." Grz DK FDG6
	Ask us	"They started to ask us about what we want to be in future and we started explaining that I want to do engineering. The teachers also told us which careers we would do when we do D&T." Pvt Lsk FGD 1
	Orientation	"induction, it is quite important at every stage Orienting individuals." (TT2)
Ministry of Education	Induction	"Induction beginning with the top most in the Ministry of Education where they engaged as PS, Minister level… Directorates… where we create strong synergy and understanding that, what the

Induction		Secondary School is doing, leads to these young ones coming to TEVET… into Industry." (TT2)
	Proper guidance	"we need at least a proper guidance from school saying okay this time around these people they are working on this one, so make sure that you, this is the only area you'll be teaching them." CEO1
	Law	"There is a law coming in place to compel industries to accept this student and pay them a stipend… the Duo of VET Guidelines would should still be able to support." (TT1)
Industry Attachment	Attachment	"For example, there's no provision for them to get attached as we do in the TEVET Institutions, where it's mandatory that you'll get an attachment for them to be able to graduate. So while the other side So, attachment is not a requirement, we simply assess them when they what is it?" (TT1)
	Make-arrangements with industries, Holiday	"Day schools can make arrangements where during the holidays the learners are exposed to such an industry where the learners can look at the commercial aspect of the skill that they are learning at the school…" (SEP1)
	Formal working Relationships	"Ideally schools are supposed to be helped to, to have some Formal working relationships with the industry where those skills are needed. So that then, the students would have a chance." (TT1)
	Real world	"…told us about Art, Music and D&T and I personally chose D&T as it felt like a practical subject and something I can take into the real world." Grz Kab FDG3
Institution Attachment	Institutional Enterprise	"Our concept of Institutional Enterprise, if for example NORTEC can create space for electrical services it is a Contractor for providing electrical services, installing domestic wiring. Then that company belonging to NORTEC which is into construction can make it mandatory that the students are attached to the Institutional company. So, the institutional Enterprise is coming in as the institutional creating its own industry." (TT2)

Source: Field Data, (2025)

TEVET in Zambian secondary schools operates within a two-tier competence-based curriculum marked by uneven implementation, chronic underfunding, skills mismatches, and limited structured attachments. Although 2025 policy documents stress parallel vocational certificates, stronger industry partnerships, and better resource allocation to support Vision 2030, compulsory attachment legislation is still absent. Learner induction remains largely informal and ad-hoc, relying on teachers, peers, videos, or family, while Ministry of Education induction is top-down and bureaucratic, constrained by funding delays. Industry attachments are non-mandatory and sporadic (mainly holidays or for selected learners) despite strong demand for formal extended placements, and institutional attachments depend on internal school enterprises such as farms and workshops using available teachers and resources where external placements are limited.

Induction and attachment serve as critical drivers for producing secondary school leavers with industry-ready competencies in Zambian TEVET. This discussion integrates quantitative findings (e.g., binary logistic regression highlighting ongoing support, structured planning, and joint tracking as significant predictors of programme efficacy) with literature from developing contexts, theoretical applications of Engagement Theory and Apprenticeship Theory, and qualitative insights from key informants and learners. The analysis reveals persistent gaps in formal structures, resources, and stakeholder collaboration, yet underscores opportunities for theory-informed, bottom-up improvements aligned with the proposed PPP framework.

3.3 Learner and Ministry of Education Induction

The logistic regression results provide clear empirical guidance on how induction can (and should) be done in secondary schools, particularly for TEVET integration. Furthermore, Ministry-led induction provides policy coherence, guidance, and legal frameworks essential for scaling TEVET. Quantitative challenges in supportive environments underscore the need for ministerial intervention. A well-structured and organised plan is the strongest predictor of successful outcomes (B = 1.421, p = 0.000, Exp(B) = 4.141), directly supported by comparative African literature that repeatedly identifies the absence of formal, unified frameworks as the root cause of poor teacher and student transitions (Keengwe & Adjei-Boateng, 2012; Ajowi & Simatwa, 2011; Dayaram, 2002; Situmbeko & Banja, 2019) [39, 40, 41, 42]. India's NSQF-aligned model operationalises this through a mandatory 30-day structured induction training for vocational teachers, coordinated nationally by PSSCIVE and aligned with competency standards precisely the organised plan the data shows multiplies success odds by over four times (PSSCIVE, 2021 [46]; NEP 2020).

On-going support for induction as opposed to one-off events was the second strongest predictor (B = 1.042, p = 0.000, Exp(B) = 2.834). This finding is robustly corroborated by scholars who insist induction must be viewed as a continuous developmental process rather than a discrete event, embedding regular mentoring, feedback loops, and professional development for both ECTs and students (Stirzaker, 2004; Walker & Stott, 1998; Aarts *et al*., 2023; Kearney, 2017) [37, 38, 34, 35]. The Zambian context further validates this: unstructured Grade 8 pupil induction and ineffective new-teacher programmes fail precisely because they lack sustained, stakeholder-inclusive support (Situmbeko & Banja, 2019; Banja, 2016) [42, 43].

The significant negative predictors (comprehensive information Exp(B) = 0.429, p = 0.007; supportive environment Exp(B) = 0.448, p = 0.020) do not negate these elements but highlight that, without structure, they become counterproductive leading to information overload or superficial support. This aligns with the need for tailored, needs-based interventions that address individual attachment and integration challenges rather than blanket approaches (Casey, 2015) [36]. Non-significant factors (clear expectations, academic-professional integration) are foundational but insufficient alone, consistent with Mulenga & Mwanza (2019) [44] on the persistent policy-practice gap in teacher involvement.

Practical recommendation which can scale up from the Table 1 data and literature, this can be implemented through induction in Zambian secondary schools for TEVET exactly as India has scaled it like the structured 30-day initial training, mandatory ongoing support and industrial attachment under formal MoUs. This directly

operationalises the regression's strongest predictors while addressing the documented African shortfalls.

Engagement Theory (Kearsley & Shneiderman, 1998) [18] applies through Relate-Create-Donate activities (e.g., collaborative career projects donated to communities), fostering ownership in resource-scarce settings. Orji (2022) demonstrated its efficacy in Nigerian TVET via problem-based induction. Apprenticeship Theory (Gonon, 2009 [21]; Terblanche, 2017) frames induction as preview to dual learning, building civic and practical skills. Qualitative FGDs (e.g., Pvt Lsk FGD 1) describe informal teacher demonstrations and videos as key, implying interactive, early orientations reduce overload and prepare learners for attachments, promoting equity and retention.

Engagement Theory supports ministerial digital orientations for collaborative induction, while Apprenticeship Theory advocates dual-system policies integrating civic education (Gonon, 2009) [21]. Qualitative data emphasise high-level synergy, impending laws compelling industry participation with stipends, and standardised guidance to cascade support to schools.

3.4 Industry and Institutional Attachment

The logistic regression results provide clear empirical guidance on how industrial attachment on-the-job training (OJT) can be done in secondary schools for TEVET integration and also Institutional (in-house) attachments address external collaboration barriers through school-based enterprises, aligning with regression predictors of supervision and tracking.

Furthermore, Joint tracking of reports by school and industry is the overwhelmingly strongest predictor of success (B = 1.621, p = 0.000, Exp(B) = 5.057). This is precisely operationalised in India's model, where PSSCIVE (2021) [46] requires students to maintain logbooks, reports, portfolios and feedback forms that are systematically reviewed by both the vocational teacher (school side) and the industry supervisor, supported by principal site visits (minimum twice) and formal MoUs.

Continuous presence of an assigned school teacher together with a practicing industry professional during attachment is the second strongest factor (B = 0.797, p = 0.006, Exp(B) = 2.220). PSSCIVE guidelines explicitly mandate "structured, supervised hands-on tasks aligned with National Occupational Standards", with vocational teacher coordination and industry professionals providing real-time guidance under signed agreements and ADDIE-model training plans (PSSCIVE, 2021) [46]; NEP 2020).

Clear discipline and regulations for attachment show marginal positive influence (B = 0.499, p = 0.055, Exp(B) = 1.648), consistent with the literature's emphasis on strict safety protocols and formal workplace rules within the Indian framework.

In contrast, unstructured engagement through collaborations with industry is significantly negative (B = −0.726, p = 0.011, Exp(B) = 0.484), highlighting that partnerships alone without supervision and tracking fail, mirroring documented African challenges of inadequate support and informal practices that leave attachments ineffective (Keengwe & Adjei-Boateng, 2012; Ajowi & Simatwa, 2011; Situmbeko & Banja, 2019; Mehrotra, 2021) [39, 40, 42, 47].

Certification at the end of attachment is also strongly negative (B = −1.194, p = 0.000, Exp(B) = 0.303), indicating that awarding certificates without the above process elements adds no value; the literature prioritises documented competency through supervised practice and reflection over endpoint certification (PSSCIVE, 2021) [46]. Non-significant items (prerequisite work, school-only placement, log in/out rules) are baseline requirements but insufficient without the core supervisory and tracking mechanisms echoing the persistent policy-practice gaps and unstructured transitions in Zambian and broader African contexts (Banja, 2016; Mulenga & Mwanza, 2019; Situmbeko & Banja, 2019) [43, 44, 42].

Practical recommendation (data + literature): Implement TEVET attachment in Zambian secondary schools exactly as India has scaled it such as 80 hours total structured OJT across Grades 9–12 (20 hours per grade) under formal school-industry MoUs, with mandatory dual supervision through assigned teacher and industry professional, joint report tracking, and clear discipline/safety protocols. This directly activates the regression's highest-impact predictors while remedying the documented inefficiencies in African secondary attachment processes.

Engagement Theory applies through authentic Donate projects during placements, with technology for tracking (Kearsley & Shneiderman, 1998) [18]. Apprenticeship Theory supports regulated dual arrangements fostering discipline and civic responsibility (Gonon, 2009) [21]. Engagement Theory enables collaborative in-house projects; Apprenticeship Theory positions schools as mini-industries for dual learning (Gonon, 2009) [21]. Qualitative insights advocate mandatory formal relationships, holiday attachments, and institutional enterprises as hybrid solutions, implying policy-mandated partnerships with supervision and stipends enhance prerequisites, tracking, and real-world preparation, reducing underemployment in Zambia's context (World Bank, 2023) [2]. In addition, Qualitative data introduce also "institutional enterprise" as an innovative model for mandatory internal placements, covered in induction via structured plans and values. This implies scalable, equitable solutions mitigating resource constraints, integrating with attachments for certification and feedback, and supporting holistic TEVET reform for employability and national development.

4. Conclusion

The introduction and implementation of induction and attachment processes in TEVET within Zambian secondary schools, as mandated by the 2023 Competence-Based Curriculum, represent a strategic pivot toward bridging theoretical instruction with industry-aligned competencies. This mixed-methods study, integrating binary logistic regression and thematic analysis, reveals that induction efficacy is significantly predicted by structured planning and ongoing support, while attachments succeed through joint supervision and tracking. Barriers include information overload, unsupportive environments, and weak industry collaborations. Qualitative insights highlight learner-centred orientations, ministerial policy synergy, mandatory placements with stipends, and innovative institutional enterprises as practical solutions.

Engagement Theory (Kearsley & Shneiderman, 1998) [18] and Apprenticeship Theory (Gonon, 2009) [21] provide a robust theoretical scaffold for collaborative, authentic, and dual-system approaches. Implications underscore the urgency of equitable hybrid models to address Zambia's youth unemployment (>20%) and skills mismatches (World

Bank, 2023) [2]. Limitations include reliance on self-reported data and the cross-sectional design. This study delivers actionable, theory-grounded insights to transform Zambian secondary TEVET into a catalyst for youth empowerment and sustainable development.

5. Recommendation

1. Recommendations centre on Ministry-led enforcement of formal partnerships, teacher capacity building, and PPP-supported institutional enterprises. Future research should examine longitudinal employability outcomes and scalable hybrid pilots.

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