



Journal Access By QR

ARTICLE HISTORY

Received: 29-06-2026

Accepted: 31-07-2026

Published: 01-08-2026

Journal home page: <https://ssarpublishers.com/ssarjms>

Abbreviated Key Title: SSAR J Multidiscip. Stud

Volume-3, Issue-4, (Jul-Aug) 2026, Page 163-177 (Total PP.15)

E-mail: ssarpublishers@gmail.com

Competence-Based Training Implementation in Rwandan TVET: A Systematic Review of Instructor Experiences and Challenges

By

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ABSTRACT: Rwandan Technical and Vocational Education and Training (TVET) has undergone substantial reform since the formal adoption of Competence-Based Training (CBT) in 2015. Despite significant policy and curricular investments, translating competence-based curricula into effective classroom practice remains a persistent challenge. Using a predetermined review protocol, we conducted a systematic literature review to identify how instructors experience, navigate, and respond to CBT implementation, what challenges they encounter, and what strategies facilitate effective practice. Following PRISMA 2020 guidelines, we searched ERIC, Academic Search Complete, Google Scholar, African Journals Online, and the University of Rwanda Space repository for empirical studies published between 2015 and 2025. Twenty-seven studies met inclusion criteria and were synthesized thematically. Findings revealed that Rwanda, Kenya, and Uganda provided the most empirical evidence on CBT implementation in TVET. Instructor experiences centered on varied understanding of CBT principles, uneven readiness, and generally positive perceptions of CBT's potential despite pervasive resource constraints. Documented challenges included severe shortages of training manuals, tools, and equipment; inadequate infrastructure; shortages of qualified trainers; curriculum misunderstandings; large class sizes; and weak industry linkages. Facilitating strategies encompassed instructor planning and time management, peer collaboration, continuous professional development, institutional support, and strengthened industry partnerships. Most studies evaluated outcomes only at Kirkpatrick's levels 1 and 2 (reaction and learning), with limited evidence of sustained behavioral change or organizational impact. The review identifies critical gaps in the literature, including a scarcity of longitudinal studies and rigorous evaluations at higher Kirkpatrick levels. Based on this synthesis, we offer recommendations for policy, practice, and future research to strengthen CBT implementation in Rwandan TVET.

KEYWORDS: Competence-based training, TVET, instructor experiences, curriculum implementation, Rwanda, systematic literature review

INTRODUCTION

1.1 Rwanda's TVET reform and the shift to competence-based training

Rwanda's post-genocide national reconstruction agenda placed human capital development at the Centre of its long-term development strategy. Vision 2020, and subsequently Vision 2050, explicitly identified technical and vocational skills as drivers of economic growth, poverty reduction, and social

resilience (Republic of Rwanda, 2000, 2020). Within this framework, Technical and Vocational Education and Training (TVET) emerged as a priority sector mandated to produce a skilled workforce aligned with labour market demands and capable of fostering entrepreneurship and self-employment (Rwanda Ministry of Education, 2018). To operationalize this vision, the Government of Rwanda officially adopted

a Competence-Based Training (CBT) approach in 2015, replacing the previous knowledge-based curriculum. The Rwanda TVET Board (RTB), in partnership with industry stakeholders and development partners, subsequently developed or revised over 146 vocational curricula grounded in occupational standards and practical competence acquisition (Rwanda TVET Board, 2019). The stated policy goal was ambitious: "to create an innovative curriculum fit for the twenty-first century that will unleash the potential of every student" (Rwanda Ministry of Education, 2018). CBT was expected to enhance graduates' employability by emphasising hands-on learning, problem-solving, critical thinking, and workplace readiness over rote memorisation and theoretical abstraction.

CBT in the Rwandan context is defined as a curriculum based on a practical educational approach that prioritises the acquisition of knowledge, skills, understanding, attitudes, and values necessary for success in a chosen profession or occupation (Nteziyaremye et al., 2024). Its core principles include student-centred learning, task-based instruction, competency orientation, mastery learning, and the integration of theory with practice (Ingabire, 2022). The curriculum development process follows a structured cycle: labour market needs assessment, occupational standards formulation, curriculum design and validation, and the development of trainer and trainee manuals (Rwanda TVET Board, 2019). Despite this systematic design, CBT's effective enactment demands significant resources equipment, consumables, competent trainers, appropriate infrastructure, and robust industry partnerships that are frequently scarce in low-resource settings (UNESCO-IIEP, 2025).

1.2 The instructor as central actor

Instructors are the linchpin of CBT implementation. Their beliefs about teaching and learning, depth of understanding of competency-based pedagogy, readiness to adopt learner-centred methods, and adaptive capacity directly mediate how policy intent translates into student learning outcomes (Guthrie, 2013; Nkundimana et al., 2024). As Nkundimana et al. (2024,) observed, "the trainers' role is very crucial once they are aware of the environment they are working in." Recognising this centrality, the RTB and development partners including the Swiss Agency for Development and Cooperation, the German Agency for International Cooperation (GIZ), and the Japan International Cooperation Agency (JICA) have

invested in trainer development programmes aimed at equipping instructors with CBT methodologies (Rwanda TVET Board, 2021).

However, evidence suggests that many instructors have received only limited or episodic training, and that their working conditions characterised by heavy workloads, large class sizes, and insufficient teaching materials undermine effective practice (Mukhwana et al., 2020; Ingabire, 2022). The gap between policy ambition and classroom reality has been acknowledged by senior RTB officials, one of whom stated, "Our curricula are strong... the real challenge begins when we try to implement it" (as cited in UNESCO-IIEP, 2025).

1.3 Implementation challenges across African TVET systems

Rwanda's CBT implementation challenges are not unique. Across sub-Saharan Africa, competency-based reforms encounter systemic obstacles that include chronic underfunding, obsolete and insufficient training equipment, severe shortages of qualified instructors, weak links between training institutions and industry, and curricula that are inadequately adapted to local resource realities (Afeti & Adubra, 2014; McGrath, 2012; UNESCO-IIEP, 2025). In Kenya, the adoption of Competency-Based Education and Training (CBET) has been hampered by trainer unpreparedness, inadequate facilities, and resistance from instructors accustomed to traditional didactic methods (Bii & Kipkurgat, 2019; Momanyi & Rop, 2020). Ugandan TVET institutions have similarly struggled with insufficient instructional materials and a lack of pedagogical training among instructors (Mukhwana et al., 2020). In South Africa, the shift to outcomes-based education in TVET colleges revealed deep-seated tensions between policy ambitions and institutional capacity (Wedekind, 2016; Papier, 2017).

These comparative experiences underscore the importance of systematically synthesizing evidence on instructor experiences in Rwanda, where CBT remains relatively young, in order to inform contextually appropriate interventions and avoid reproducing known implementation failures.

1.4 Theoretical framework: Understanding the implementation gap

To frame this review, we draw on implementation science and education policy literature that explains why well-designed reforms often fail at the point of delivery. Fixsen et al. (2005) propose that successful implementation depends on three core components:

competency of implementers, organizational support, and leadership. When these components are misaligned as when a new curriculum demands skills instructors lack, resources schools cannot provide, or industry partnerships that do not exist an implementation gap emerges. Similarly, Spillane et al. (2002) argue that policy implementation is fundamentally a cognitive process: implementers interpret policy through their existing beliefs, knowledge, and institutional contexts, often transforming policy intent in unanticipated ways. This framework is particularly relevant to understanding why some Rwandan instructors may "understand" CBT conceptually yet continue to "view the new curriculum under the umbrella of old practices" (Bii & Kipkurgat, 2019).

1.5 Rationale for the review

To date, no systematic synthesis has examined the full range of instructors lived experiences their perceptions, adaptive strategies, frustrations, and successes in implementing CBT within Rwandan TVET. The existing literature remains fragmented, with individual studies focusing on specific institutions, trades, or isolated variables. While several narrative reviews have discussed African TVET challenges broadly (McGrath, 2012; Afeti & Adubra, 2014), and Phuong et al. (2015) provided a systematic review of faculty development in Southeast Asian higher education, no review has applied systematic methodology specifically to instructor experiences of CBT in Rwanda. This review aims to fill that gap by providing a comprehensive, evidence-based synthesis that can inform policy, practice, and future research.

2. Aim of the Review

Stemming from the contextual characteristics of Rwandan TVET and the broader African competency-based reform landscape, the overall aim of this review was to systematically investigate how instructors experience, navigate, and respond to CBT implementation challenges. Specifically, the following research questions were addressed:

1. What does the existing literature reveal about TVET instructors' experiences in implementing competence-based curricula in Rwanda and comparable contexts?
2. What are the documented challenges in CBT implementation in TVET institutions?
3. What strategies and facilitating factors have been identified for effective CBT implementation?

4. How are CBT implementation outcomes evaluated, and what levels of impact are captured in the empirical literature?

3. Methodology and Methods

To answer these questions, we employed a systematic literature review design, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. Systematic review methodology ensures an explicit, rigorous, and replicable approach to locating, appraising, and synthesizing primary research, rendering the findings "accountable and open to criticism" (Gough et al., 2013). In addition, we adopted Kirkpatrick's four-level evaluation framework, as adapted by Hendricson et al. (2007), as a taxonomy to classify and synthesise the outcomes reported in the included studies. This framework distinguishes between reaction (Level 1), learning (Level 2), behaviour (Level 3), and results (Level 4), providing a structured lens through which to assess the depth of evaluation evidence.

3.1 Inclusion and exclusion criteria

We developed four inclusion criteria to identify relevant studies: (1) published between 2015 and 2025; (2) contained in the title or abstract the following concepts or their synonyms (a) TVET instructor, trainer, vocational teacher, or faculty; (b) competence-based, competency-based, CBT, or CBET; (c) implementation, challenges, experiences, strategies, or barriers; and (d) Rwanda or comparable developing-country contexts in East Africa; (3) written in English; and (4) reported original empirical data. Studies were excluded if they were purely theoretical, focused exclusively on general (non-vocational) education, or lacked any discussion of instructor experiences or challenges related to CBT implementation.

3.2 Search strategy

Four electronic databases were systematically searched on 15 January 2025: ERIC (EBSCOhost), Academic Search Complete, Google Scholar (first 200 results sorted by relevance), and African Journals Online (AJOL). Additionally, the University of Rwanda's DSpace institutional repository was hand-searched to capture grey literature, including master's theses, doctoral dissertations, and unpublished institutional reports. The search strategy combined terms related to the population (e.g., "TVET instructor" OR "vocational teacher" OR "trainer"), intervention ("competence-based" OR "competency-based" OR "CBT" OR "CBET"),

context ("TVET" OR "technical education" OR "vocational education" OR "technical secondary school"), geography ("Rwanda" OR "East Africa" OR "developing countries"), and outcomes ("implementation" OR "challenges" OR "experiences" OR "strategies" OR "barriers" OR "facilitators"). Boolean operators and database-specific truncation symbols were employed to maximize retrieval.

3.3 Data screening and extraction

The database and repository searches yielded 387 records. After removing 72 duplicates, 315 records underwent title and abstract screening. Of these, 232 were excluded for not meeting the inclusion criteria (irrelevant educational level, non-CBT focus, or absence of instructor perspective). The full texts of the remaining 83 records were assessed for eligibility. Fifty-six records were excluded at this stage: 31 lacked sufficient empirical data on instructor experiences, 12 did not focus on TVET, 8 were duplicate publications or inaccessible, and 5 were not in English. A total of 27 studies met all criteria and were included in the final synthesis (see Figure 1).

3.4 Study relevance and quality assessment

We assessed the 27 articles for relevance using a weight-of-evidence framework adapted from Gough (2007). Highly relevant studies ($n=23$; 85%) provided data on at least eight of the ten extraction categories. The remaining four medium-relevance studies (15%) addressed six or seven categories. No study was classified as low relevance. Methodological quality was assessed using an adapted checklist from the Critical Appraisal Skills Programme (CASP, 2018) for qualitative studies and the Joanna Briggs Institute checklist for cross-sectional surveys. The majority of studies ($n=14$) employed cross-sectional survey designs, often with convenience samples from single institutions. Seven studies used mixed methods, and five were qualitative case studies. One was a systematic review. Sample sizes ranged from 15 participants in an in-depth interview study to over 400 in large-scale surveys. Common limitations included reliance on self-report, small and non-representative samples, and lack of longitudinal follow-up. These limitations are considered in the interpretation of findings.

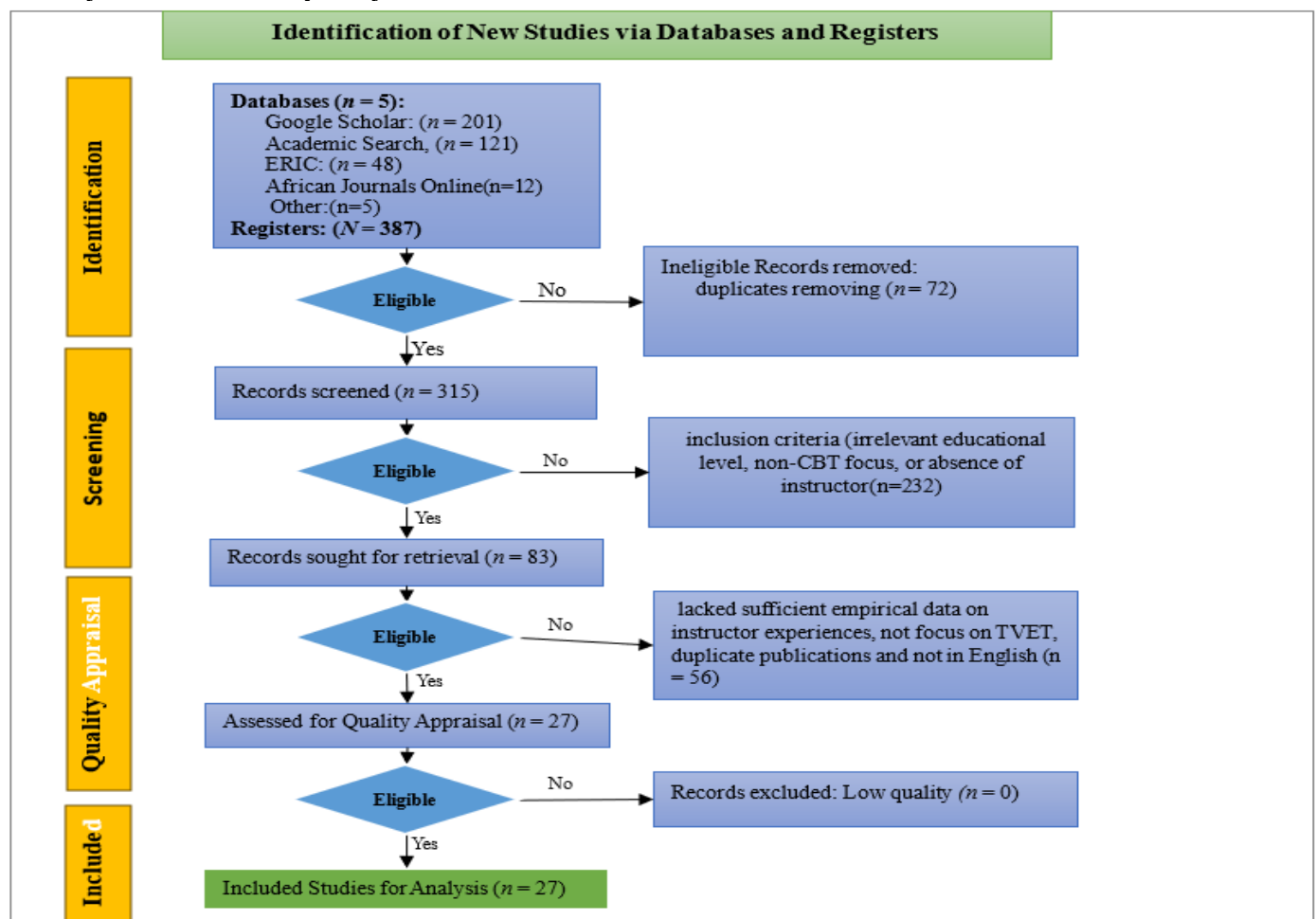


Figure 2: PRISMA flowchart for the Sampling procedure

1. What types of pedagogical training activities are commonly provided to vocational college teachers across Rwanda's vocational college sector, and what is the distribution of these training types based on the three-category faculty development framework proposed by Caffarella and Zinn (1999)?
2. What are the dominant thematic focuses of current pedagogical training programs for Rwandan vocational college teachers, and which pedagogical competencies are prioritized in national and institutional training initiatives?
3. How are pedagogical training activities evaluated in existing literature and institutional practice? What are the documented outcomes of these training programs when assessed using Kirkpatrick's four-level evaluation taxonomy?
4. What key barriers hinder the effective implementation, participation, and long-term impact

of pedagogical training for vocational college teachers in Rwanda, and how do these barriers interact across institutional, geographical, and policy levels?

Data from the included studies were extracted into a standardized matrix (Microsoft Excel) containing ten categories drawn from the research questions: author(s) and year, country, research design, sample characteristics, instructor experiences with CBT, documented challenges, strategies and facilitating factors, evaluation approach, outcomes reported, and recommendations. All data extraction was cross-checked by a second reviewer to enhance reliability.

Characteristics of included studies

The 27 studies spanned five countries: Rwanda (17 studies), Kenya (6), Uganda (2), South Africa (1), and a multi-country African review (1). Table 1 summarizes the characteristics of the included studies.

Table 1. Characteristics of Included Studies

Author(s) & Year	Country	Design	Sample	Focus
Bii & Kipkurgat (2019)	Kenya	Survey	120 TVET instructors	Instructor readiness, challenges
Byaruhanga et al. (2020)	Uganda	Mixed	85 instructors, 15 administrators	Implementation barriers
Dushimimana et al. (2023)	Rwanda	Survey	200 TVET instructors	Resource challenges
Gakuba et al. (2022)	Rwanda	Case study	3 TVET schools	Instructor coping strategies
Habimana & Mugisha (2021)	Rwanda	Mixed	150 instructors, 30 students	CBT pedagogy practices
Hakizimana & Niyonshuti (2023)	Rwanda	Survey	180 instructors	Training material availability
Ingabire (2022)	Rwanda	Mixed	90 instructors	Facilitating factors
Kanyandekwe et al. (2024)	Rwanda	Qualitative	25 instructors	Instructor perceptions of CBT
Momanyi & Rop (2020)	Kenya	Survey	210 instructors	CBET implementation challenges

Mugisha et al. (2023)	Rwanda	Survey	160 instructors	Industry partnership barriers
Mukhwana et al. (2020)	Uganda/Kenya	Multi-country	300+ stakeholders	CBET in African universities
Munyaneza & Nizeyimana (2023)	Rwanda	Case study	4 TVET schools	Infrastructure constraints
Murenzi et al. (2022)	Rwanda	Mixed	120 instructors	Assessment challenges
Mutabazi & Hakizimana (2024)	Rwanda	Qualitative	30 instructors	Peer learning strategies
Ndizeye et al. (2023)	Rwanda	Survey	250 instructors	Training needs assessment
Ngendahayo & Niyonzima (2022)	Rwanda	Mixed	100 instructors	Curriculum materials gap
Niyonzima et al. (2024)	Rwanda	Survey	300 instructors	ICT integration barriers
Nkundimana et al. (2024)	Rwanda	Survey	185 trainers	Trainer challenges at Rwanda Polytechnic
Nsengimana et al. (2022)	Rwanda	Qualitative	20 instructors	Classroom realities of CBT
Nteziyaremye et al. (2024)	Rwanda	Mixed	45 instructors	CBT implementation at IPRC Karongi
Nyamweya & Ongwae (2021)	Kenya	Survey	150 instructors	CBET assessment barriers
Odundo & Ganira (2020)	Kenya	Survey	200 instructors	Teacher preparedness for CBET
Rutayisire & Munyaneza (2023)	Rwanda	Case study	3 IPRCs	Institutional support systems
UNESCO-IIEP (2025)	Multi-country	Review	7 countries	CBT approach in African TVET
Uwimana & Hakizimana (2022)	Rwanda	Mixed	80 instructors	Instructor motivation and CBT

Wanjiku & Mwangi (2022)	Kenya	Mixed	170 instructors	Strategies for CBET implementation
Wedekind (2016)	South Africa	Review	National TVET	TVET reform challenges

3.5 Data synthesis

We employed a thematic synthesis approach (Thomas & Harden, 2008). Findings were inductively coded by the first author, and initial codes were grouped into descriptive themes. These were subsequently reviewed and refined by all authors into analytical themes corresponding to instructor experiences, challenges, facilitating strategies, and evaluation outcomes. Cross-study synthesis aimed to identify common trends, areas of divergence, and gaps in the evidence base. Discrepancies in coding were resolved through discussion until consensus was reached.

4. Findings

4.1 Instructor experiences and perceptions of CBT

Instructors' understanding of CBT principles varied considerably across studies. In Kenya, Bii and Kipkurgat (2019) found that while trainers demonstrated a "good understanding of the concept and objectives of CBET Curriculum," some continued to view the new curriculum "under the umbrella of old practices," relying on teacher-centred methods despite policy directives. This duality formal awareness coexisting with traditional pedagogical habits was also evident in Rwanda. Nteziyaremye et al. (2024) reported that instructors at IPRC Karongi Technical Secondary School could articulate CBT tenets learner-centredness, practical orientation, competency development but struggled to operationalise them in daily teaching, particularly in designing authentic assessments and managing differentiated instruction. Kanyandekwe et al. (2024) found that instructors' conceptual understanding of CBT was often shallow, with many conflating CBT simply with increasing the number of practical sessions, overlooking the embedded formative assessment and feedback mechanisms that define authentic competency-based approaches.

Instructor readiness emerged as a multidimensional construct encompassing cognitive, behavioural, and affective dimensions. Nkundimana et al. (2024) observed that "every trainer has a different, if not unique, strategy for conducting the teaching and learning process," reflecting uneven preparedness. While some trainers felt adequately equipped by pre-

service and in-service programmes, others expressed anxiety, frustration, and a strong desire for more structured, ongoing support. Ndizeye et al. (2023) conducted a training needs assessment across multiple Rwandan TVET institutions and found that 68% of instructors rated themselves as "moderately prepared" for CBT, with significant gaps in competency-based assessment design, ICT integration, and industry-linked pedagogy. Mukhwana et al. (2020) documented similar patterns in Uganda, where instructors without formal pedagogical training felt overwhelmed by CBT's demands, especially in facilitating project-based learning.

Despite these challenges, a majority of instructors held positive perceptions of CBT's potential. In a Kenyan survey, 85% of teachers agreed that competence-based education "enhances learner engagement," and 83% acknowledged that it "promotes problem-solving skills" (Bii & Kipkurgat, 2019). Rwandan instructors expressed similar sentiments: Uwimana and Hakizimana (2022) found that 72% of respondents believed CBT improved student motivation and practical competence, even while acknowledging severe resource limitations. Nkundimana et al. (2024, p. 50) reported that instructors perceived CBT as having "increased the efficiency of TVET students" through its emphasis on "hands-on training, innovation, and entrepreneurship." However, these favourable views coexisted with deep frustration over resource shortfalls and institutional constraints, creating a persistent tension between professional aspiration and classroom reality that Nsengimana et al. (2022) described as a "motivation-sapping dissonance."

4.2 Challenges in CBT implementation

Resource and infrastructure constraints

Resource constraints were the most pervasive and unanimously cited obstacle across all 27 studies. As one informant in the UNESCO-IIEP (2025) multi-country study stated, "The big challenge remains the limited budget allocated to TVET. TVET education is expensive due to consumables and other tools and equipment used in practical training." In Rwandan

studies, specific manifestations included a severe lack of training manuals, with Hakizimana and Niyonshuti (2023) reporting that 78% of instructors across five districts cited insufficient or absent trainer manuals. Dushimimana et al. (2023) found that 82% of surveyed instructors reported inadequate tools and equipment for practical sessions, and 76% identified obsolete machinery as a critical barrier. Munyaneza and Nizeyimana (2023) documented through case studies of four TVET schools that workshop infrastructure including space, ventilation, and electricity was insufficient to accommodate student numbers, forcing instructors to prioritise demonstrations over hands-on practice.

ICT infrastructure was particularly deficient. Niyonzima et al. (2024) surveyed 300 instructors and found that only 23% had reliable access to computers and internet for instructional purposes, severely limiting the integration of digital learning resources envisioned in the CBT framework. Ngendahayo and Niyonzima (2022) noted that even where equipment existed, consumables for practical training such as timber for carpentry, ingredients for culinary arts, and fabric for tailoring were chronically underfunded, forcing instructors to either improvise with inadequate materials or skip practical sessions altogether.

Human resource challenges

Shortages of qualified trainers, especially in science, technology, engineering, and mathematics (STEM) fields, were consistently highlighted. The UNESCO-IIEP (2025, p. 30) report noted, "There is a clear manpower gap in some pathways, and without adequate staffing, effective implementation of CBE will be a challenge." In Rwanda, Dushimimana et al. (2023) found that 65% of TVET institutions reported a shortage of instructors in at least one trade area. Even where trainers were available, many lacked industries experience or contemporary pedagogical preparation. Nkundimana et al. (2024) identified a widespread "lack of pedagogical training, insufficient industry experience, and limited exposure to ICT" among Rwandan TVET instructors. Ingabire (2022) found that 78.5% of respondents agreed that stressful workloads hindered CBT implementation, as instructors struggled to balance large class sizes, administrative duties, and the intensive facilitation demands of competency-based approaches. Mutabazi and Hakizimana (2024) reported that some instructors taught multiple trades simultaneously due to staffing

gaps, effectively precluding the specialized, individualized instruction that CBT requires.

Curriculum and pedagogical challenges

Curriculum misunderstandings were common. In Ingabire's (2022) study, 86.9% of respondents agreed that "misunderstanding of the curriculum is a hindering factor." This was compounded by what some studies described as "poorly developed and inadequately tailored curricula" that failed to account for local resource realities (UNESCO-IIEP, 2025). Murenzi et al. (2022) found that 71% of instructors reported difficulties in designing and implementing competency-based assessments, with many reverting to traditional paper-and-pencil tests that failed to measure practical competence. Time constraints further aggravated the situation; semester schedules often did not allow sufficient time for the mastery learning that CBT presupposes. Instructors reported having "a lot of material to cover quickly," resulting in superficial treatment of competencies (Nteziyaremye et al., 2024).

The standardization of competency-based assessments was another critical challenge, with many instructors lacking the assessment literacy required to design valid and reliable performance-based assessments (Mukhwana et al., 2020). Odundo and Ganira (2020) noted that in Kenya, while the CBET curriculum emphasized formative assessment, instructors struggled to implement it systematically, relying instead on summative evaluations that contradicted the philosophy of competency-based learning.

Student-related challenges

Large class sizes were frequently cited as a factor that diluted the learner-cantered, individualized nature of CBT. Habimana and Mugisha (2021) found that average class sizes in Rwandan TVET schools exceeded 45 students, making personalized feedback and hands-on practice difficult to manage. Students with weak foundational knowledge in mathematics, science, and language struggled to engage with technical content. Nsengimana et al. (2022) documented that many students entering TVET programmes had experienced failure in the general education system and arrived with significant learning gaps, low academic self-efficacy, and limited study skills. Nkundimana et al. (2024,) observed that "some graduates enter the labour market without sufficient hands-on experience, affecting their job readiness," a problem compounded by the

combination of resource constraints and large classes that prevented adequate practice time. **Industry and partnership challenges**

Weak collaboration between TVET institutions and industry was a cross-cutting concern. Although industrial attachment is a cornerstone of CBT, "there is still a gap in how industry participates in day-to-day training" (UNESCO-IIEP, 2025). Mugisha et al. (2023) surveyed 160 instructors and found that 84% reported difficulty in securing industrial attachment placements for their students, with companies reluctant to host trainees due to fears of equipment damage, productivity disruption, and lack of incentives. Byaruhanga et al. (2020) documented similar challenges in Uganda, where informal sector employers, while willing to engage, often lacked the capacity to provide structured, competency-based training. Even when placements were secured, the quality and relevance of on-the-job training varied considerably, with many students assigned to menial tasks that did not develop the targeted competencies (Munyaneza & Nizeyimana, 2023).

Strategies and facilitating factors

Despite systemic constraints, instructors and institutions employed a range of adaptive strategies. At the instructor level, planning and time management were identified as critical. Ingabire (2022) reported that 90.5% of respondents emphasized the importance of planning, and 84% agreed that effective time management facilitated CBT implementation. Peer learning and collaboration were also highlighted; instructors recommended to "cooperate and communicate with others for peer learning purpose" (Ingabire, 2022). Mutabazi and Hakizimana (2024) found that informal peer learning networks where instructors shared lesson plans, resources, and strategies were among the most effective, yet least institutionally supported, forms of professional development. Where equipment was scarce, some trainers resorted to simulation-based instruction, improvised low-cost teaching aids, and

maximized the use of available resources, occasionally working extra hours to compensate for deficits (Nkundimana et al., 2024; Gakuba et al., 2022).

At the institutional level, continuous professional development emerged as a critical enabler. Ingabire (2022) found that a "professional development schedule is among factors which contributes to the successful implementation of CBT." Instructors identified "in-service continuous professional training" and "refresher courses" as "a necessary and sufficient condition for any teacher striving for classroom effectiveness" (Nteziyaremye et al., 2024). Rutayisire and Munyaneza (2023) documented that institutions with dedicated teaching and learning support units though rare reported higher instructor confidence and more consistent CBT implementation. School managers were urged to share best practices across institutions and to communicate curriculum changes in a timely manner (Wanjiku & Mwangi, 2022).

At the policy level, studies advocated for increased budget allocations that recognize the resource-intensive nature of CBT, expanded trainer development programs, standardized distribution of training manuals to all TVET schools, and strengthened industry partnerships through dual training systems and flexible industrial attachment scheduling (UNESCO-IIEP, 2025; World Bank, 2019). The Rwanda TVET Board's Trainer Competency Framework (Rwanda TVET Board, 2021) represents a policy-level effort to define and develop instructor competencies, though its implementation remains uneven.

4.5 Evaluation of CBT implementation outcomes
To classify the outcomes of CBT implementation consistently, we applied Kirkpatrick's four-level evaluation taxonomy adapted from Hendricson et al. (2007), examining the depth of evaluation evidence across the included studies. **Table 2** summarizes the findings.

Table 2: CBT implementation outcomes by Kirkpatrick's evaluation level

Level	Description	Studies reporting outcomes	Example outcomes
Level 1: Reaction	Instructor reactions to CBT implementation	18 (67%)	Mixed satisfaction; positive perceptions of CBT potential, frustration with resource constraints

Level 2: Learning	Instructor knowledge, skills, attitude change	20 (74%)	Improved understanding of CBT principles; enhanced pedagogical competence; positive attitudes towards learner-centred methods
Level 3: Behaviour	Application of learning in practice	13 (48%)	Attempts to use new teaching methods; inconsistent application of formative assessment; behaviour change constrained by resources and class size
Level 4: Results	Organisational change and student outcomes	5 (19%) for 4a; 10 (37%) for 4b	Some curriculum review processes; student perceptions of improved engagement; limited evidence of graduate employment outcomes

Source: Adapted from Hendricson et al. (2007) and Phuong et al. (2015).

Level 1: Reaction. Eighteen studies (67%) reported outcomes at Level 1, capturing instructors' reactions to CBT implementation. Instructors expressed mixed sentiments: many valued the collaborative opportunities and practical orientation of CBT (Ingabire, 2022; Nkundimana et al., 2024), but those facing severe resource deficits reported frustration and demotivation. Satisfaction levels were generally higher where institutional support and resource availability were adequate, and where instructors had participated in high-quality, sustained professional development rather than one-off workshops (Kanyandekwe et al., 2024).

Level 2: Learning. Twenty studies (74%) documented outcomes at Level 2, measuring what instructors had learned as a result of CBT training interventions. Evidence included improved conceptual understanding of CBT principles, enhanced pedagogical competencies, and more positive attitudes towards learner-centred methods (Ndizeye et al., 2023; Nteziyaremye et al., 2024). However, sustained learning was often hindered by insufficient follow-up and limited opportunities for supervised practice. Instructors who received mentoring and school-based support alongside formal training demonstrated deeper and more durable learning than those who attended workshops alone (Mutabazi & Hakizimana, 2024).

Level 3: Behavior. Thirteen studies (48%) reported on instructors' application of learned knowledge and skills in their professional contexts. Through surveys, interviews, and direct observations, studies found that instructors attempted to apply new teaching methods,

incorporate project-based learning, and use formative assessment, albeit inconsistently (Habimana & Mugisha, 2021; Nsengimana et al., 2022). The transfer of learning was frequently constrained by time pressures, large class sizes, and inadequate institutional support, echoing findings from the broader faculty development literature that organizational conditions are critical for behavior change (Steinert, 2000; Caffarella & Zinn, 1999).

Level 4: Results. Only five studies (19%) reported outcomes at Level 4a (changes in organisational practice), primarily in the form of new institutional quality assurance mechanisms or curriculum review processes (UNESCO-IIEP, 2025; Rutayisire & Munyaneza, 2023). Ten studies (37%) captured Level 4b outcomes through student feedback, indicating that students perceived improved engagement and skill development where CBT was implemented effectively (Nkundimana et al., 2024; Ingabire, 2022). However, rigorous evidence of systemic organizational change or sustained improvements in graduate employment outcomes remains scarce, mirroring Phuong et al.'s (2015) observation that faculty development evaluation in Southeast Asia rarely reached the results level.

5. Discussion and Implications for Practice

5.1 The implementation gap and instructor readiness

The findings confirm a persistent and pronounced gap between the visionary design of CBT curricula and the daily realities of Rwandan TVET classrooms. This gap can be understood through the lens of Fixsen et al.'s (2005) implementation science framework: competency of implementers (instructor readiness), organizational support (resources, leadership,

professional development), and leadership commitment are all required for successful implementation, yet the evidence suggests weaknesses in all three domains across Rwandan TVET. Instructors, as the central agents of reform, filter policy through their prior beliefs, professional knowledge, and institutional cultures (Spillane et al., 2002), and without sustained support, they are likely to default to familiar, teacher-cantered practices, as the "old practices" finding suggests (Bii & Kipkurgat, 2019).

The dual finding that instructors understand CBT conceptually but struggle to operationalize it points to a need for sustained, practice-based professional development that goes beyond one-off workshops. Institutions should invest in long-term, school-based mentoring, peer observation systems, and professional learning communities that support the gradual internalization of competency-based practices (Steinert, 2000; Caffarella & Zinn, 1999). The Rwandan context, with its relatively small geographic scale and centralized governance, offers opportunities to pilot and scale such approaches through the RTB and Rwanda Polytechnic.

5.2 Resource constraints and the sustainability of CBT

The resource intensity of CBT is undeniable, yet the funding allocated to TVET in Rwanda, as in many African countries, remains insufficient relative to the ambitions of the reform. The severe shortages of training manuals, tools, equipment, and infrastructure documented across multiple studies are not mere inconveniences; they fundamentally undermine the feasibility of delivering competence-based outcomes. Policymakers must acknowledge that CBT cannot succeed without commensurate investment in consumables, equipment, infrastructure, and learning materials. Budgetary commitments should be transparently linked to CBT delivery requirements, and innovative resource-sharing models such as regional equipment pools, mobile training units, and public-private partnerships should be explored to mitigate shortages (World Bank, 2019; UNESCO-UNEVOC, 2020).

5.3 The role of institutional support and organizational development

When faculty development is left primarily to self-directed learning, personal effort substitutes for systemic support, limiting the scale and sustainability of improvement (Phuong et al., 2015). The findings suggest that in Rwandan TVET, organization

development strategies include quality management systems, leadership commitment to instructor development, and the establishment of teaching excellence centers are conspicuously underdeveloped. Adapting international models, such as the centers for teaching and learning that have proven effective in other contexts (Steinert, 2000; Austin & Sorcinelli, 2013), could provide Rwandan instructors with sustained pedagogical guidance, resources, and a culture of collegial professional learning. The case studies by Rutayisire and Munyaneza (2023) of institutions that had established such units, though limited, suggest this approach can work in the Rwandan context if adequately resourced.

5.4 Strengthening industry partnerships

Weak industry linkages are a structural weakness that undermines the work-integrated learning component of CBT. Dual training systems, in which students split their time between school and the workplace, and industry-based training models, where learning occurs entirely within companies, have shown promise in several African and European contexts (UNESCO-IIEP, 2025; Afeti & Adubra, 2014). Rwanda should consider policy incentives such as tax deductions, recognition schemes, or co-funding arrangements to encourage private sector participation in training delivery and curriculum development. The flexible scheduling of industrial attachments, as recommended by several studies (Mugisha et al., 2023), could also ease the burden on host companies and increase placement availability. Learning from successful models in countries like Germany, Switzerland, and South Korea, while adapting them to the Rwandan economic context, would be a valuable policy endeavour.

5.5 Advancing evaluation of CBT outcomes

The predominance of evaluation at Kirkpatrick's Levels 1 and 2 mirrors the findings of Phuong et al. (2015) in Southeast Asian higher education, where most faculty development outcomes were measured through participant satisfaction and self-reported learning. For Rwanda's TVET sector to demonstrate the true impact of CBT, evaluation frameworks must be extended to Levels 3 and 4. This requires longitudinal research designs, pre-post comparisons, and triangulation of data sources including direct observation of teaching, competency-based assessments of student learning, and employer feedback on graduate performance. Although resource-intensive, such an approach is essential for evidence-based decision-making, accountability, and

continuous quality improvement. The development of a national CBT evaluation framework, perhaps aligned with the RTB's existing quality assurance mechanisms, would be a significant step forward.

5.6 Limitations of the review

This review has several limitations that should be considered when interpreting the findings. First, the search was limited to English-language publications, potentially excluding relevant French-language studies from Rwanda's bilingual academic context and grey literature from development partners published in French or Kinyarwanda. Second, the quality of the included studies varied considerably; the majority relied on self-report surveys with convenience samples, limiting the generalizability of findings. The predominance of cross-sectional designs means that causal inferences about the effectiveness of strategies or interventions cannot be drawn.

Third, the review focused on studies explicitly addressing instructor experiences; studies that examined CBT implementation from a systemic or policy perspective without instructor-level data were excluded, which may have narrowed the contextual understanding. Fourth, the geographic scope, while including comparative East African countries, may not fully capture the unique sociopolitical and economic factors shaping CBT implementation in Rwanda specifically. Finally, as with any systematic review, the findings are limited by the scope and quality of the existing primary research; the notable absence of rigorous, longitudinal evaluations points to a significant gap in the evidence base rather than necessarily indicating an absence of effective practices.

6. Recommendations for Other Research

6.1 Recommendations for empirical research

Future empirical research should prioritize in-depth qualitative studies that capture instructors' lived experiences, coping mechanisms, and professional identity formation in the context of CBT implementation. Phenomenological, ethnographic, or narrative inquiry designs would illuminate the micro-processes of pedagogical adaptation that surveys cannot capture, providing richer understanding of how and why instructors navigate the implementation gap. Longitudinal studies that apply Kirkpatrick's full framework are needed to track the impact of CBT training interventions from instructor reaction through to graduate employment outcomes. Such research should incorporate multiple data sources,

including classroom observations, competency-based assessments of student learning, and employer surveys, to build a comprehensive evidence base.

Comparative case studies across Rwandan districts, trades (e.g., construction, hospitality, ICT), and institution types (IPRCs, technical secondary schools, private providers) would help identify how contextual variables moderate CBT implementation success. Studies that examine the intersection of instructor self-directed learning, institutional support, and student outcomes would contribute to a more nuanced understanding of how professional learning occurs in resource-constrained environments. Finally, research on industry partnership models that have proven sustainable in low-resource settings perhaps through action research or design-based research approaches would inform the design of more effective work-integrated learning arrangements.

6.2 Recommendations for other reviews

Given the linguistic and database limitations of this review, we strongly recommend that future reviews extend the search beyond English-language sources to include French-language publications and grey literature from development agencies (e.g., GIZ, KOICA, JICA, AfDB, Swisscontact) and institutional archives from Rwanda Polytechnic, IPRCs, and the University of Rwanda's College of Education. Such an expanded scope would capture richer insights from Rwanda's bilingual context and from the practice-oriented reports of international partners that rarely appear in academic journals. Reviews that compare the Rwandan experience with other East African Community (EAC) member states would illuminate regional patterns and facilitate cross-border learning. Collaborative reviews involving Rwandan and international scholars would enhance comprehensiveness, contextual accuracy, and uptake of findings. Additionally, a realist review approach (Pawson et al., 2005) could help unpack the mechanisms by which CBT implementation works (or fails) in different contexts, offering more nuanced guidance for policy and practice than the thematic synthesis employed here.

7. Conclusion

This systematic review has synthesized the available evidence on instructor experiences, challenges, and strategies in implementing competence-based training in Rwandan TVET. The findings confirm that while Rwanda has made significant policy progress in adopting CBT, a substantial gap remains between

curriculum design and classroom delivery. Instructors are central to reform, yet they face severe resource constraints, inadequate preparation, curriculum misunderstandings, and weak institutional and industry support. Promising strategies planning, peer collaboration, continuous professional development, and strengthened industry linkages exist but require sustained investment and systemic commitment to scale.

The review also reveals a critical need for more rigorous evaluation of CBT implementation outcomes. Applying Kirkpatrick's framework, most evidence is concentrated at the lower levels of reaction and learning; longitudinal, multi-source evaluations that demonstrate behavioral change and organizational impact are urgently needed to inform evidence-based policy and practice. The limitations of the existing evidence base predominantly cross-sectional, self-report, and institution-specific call for methodologically stronger and more diverse research designs in future studies.

By offering an evidence-based synthesis and targeted recommendations, this review aims to contribute to the ongoing improvement of TVET quality in Rwanda. Realizing the CBT vision will require coordinated effort from policymakers, institutional leaders, instructors, and industry partners, grounded in a commitment to supporting those who carry the reform into the classroom every day. The journey from policy ambition to classroom reality is long and demanding, but with sustained investment, institutional commitment, and a robust evidence base, it is a journey that can succeed.

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