Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Mediation of Teaching-learning Processes in Technical and Vocational Training Reform Implementation in South Ethiopia Public Colleges: A Structural Equation Modeling Analysis

Amanuel Haile

amanhaile293@gmail.com

Wolaita Sodo University

Solomon Lemma

Hawassa University

Mary Wairimu

Wolaita Sodo University

Research Article

Keywords: TVET Reforms, Teaching-Learning Processes, Structural Equation Modeling, Mediation Analysis, Competency-Based Training, Ethiopia, CIPO Framework

Posted Date: June 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9926728/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Technical and Vocational Education and Training (TVET) is a strategic pillar for human capital development in low- and middle-income countries. Since 2020, Ethiopia has implemented comprehensive TVET reforms including competency-based training, teacher professional development, and industry partnerships. However, teaching-learning quality remains uneven across colleges.

Objective

This study examines whether teaching-learning processes mediate the relationship between input reforms and teaching-learning quality in TVET colleges in South Ethiopia.

Method

A cross-sectional survey design was employed with 384 respondents (158 instructors, 226 students) across 12 public colleges in Wolaita, Gamo, and Gofa Zones. Multistage sampling was used. Structural equation modeling with bootstrapping (5,000 resamples) and Sobel test were used to test mediation. Hierarchical regression compared input-only versus input-plus-process models.

Results

Teaching-learning processes partially mediated the input-quality relationship (indirect effect = 0.14, 95% CI [0.08, 0.21], p = .002), explaining 33.3% of the total effect (Sobel z = 3.82, p < .001). The full model explained 54.2% of variance in teaching-learning quality ($R^2 = 0.542$) and 48.7% of variance in output indicators ($R^2 = 0.487$). Processes alone explained an additional 16.3% of variance beyond input reforms ($\Delta R^2 = 0.163$, p < .001) and had a larger effect on outputs ($\beta = 0.38$) than any single input dimension.

Conclusions

Processes matter. They account for one-third of input effects. Policymakers should invest equally in input reforms and process capacity.

1. Introduction

Technical and Vocational Education and Training (TVET) is increasingly recognized as a strategic pillar for human capital development and youth employment in low- and middle-income countries [1, 2]. Since 2020, Ethiopia has implemented comprehensive TVET reforms modeled on international best practices,

including competency-based training (CBT), teacher professional development, industry partnerships, curriculum revision, and technology adaptation [3]. However, despite substantial investments in these input reforms, teaching-learning quality remains uneven across colleges [4, 5].

This persistent quality gap raises a fundamental question: Through what mechanisms do input reforms translate into improved teaching-learning quality? The CIPO (Context-Input-Process-Output) framework [6] suggests that processes mediate the relationship between inputs and outputs. That is, input reforms (e.g., teacher training, curriculum revision) only improve quality if they first improve teaching-learning processes (instructional delivery, assessment practices, student engagement). Yet, this mediation hypothesis has rarely been tested empirically in TVET contexts, particularly in Ethiopia.

The existing literature on TVET reforms has focused primarily on direct effects of individual input dimensions. Numerous studies have examined the direct relationships between competency-based training and employability [7, 8], teacher professional development and instructional quality [9, 10], and industry partnerships and graduate outcomes [11, 12]. However, these studies have not systematically examined how these input reforms produce their effects. From a theoretical perspective, the CIPO framework explicitly posits that processes are the mediating mechanism [6, 13]. Yet, empirical studies in TVET have largely treated processes as either omitted variables (examining only input-output relationships) or parallel predictors (adding processes to regression models without testing mediation). This study addresses this gap by formally testing the mediating role of teaching-learning processes using structural equation modeling (SEM) with bootstrapping.

1.1 Research Questions and Hypotheses

This study addresses two research questions:

RQ1: Do teaching-learning processes mediate the relationship between input reforms and teaching-learning quality?

RQ2: What is the relative explanatory contribution of input reforms versus teaching-learning processes in predicting output indicators?

Based on the CIPO framework, two hypotheses were tested:

H1: Teaching-learning processes partially mediate the relationship between input reforms and teaching-learning quality (indirect effect ≠ 0).

H2: The full model (input + process) explains significantly more variance in output indicators than input reforms alone ($\Delta R^2 > 0$).

2. Literature Review

2.1 Theoretical Framework: The CIPO Framework and Mediation Theory

The Context-Input-Process-Output (CIPO) framework [6] provides the theoretical foundation for this study. The framework posits a causal chain: Context → Input → Process → Output.

Context refers to policy, governance, and socio-economic factors (zone, college type)

Input includes financial, human, and material resources (CBT, teacher training, industry partnerships, curriculum, pedagogy, funding, technology)

Process encompasses teaching-learning activities (instructional delivery, assessment, student engagement)

Output represents student achievement and institutional performance (teaching-learning quality, graduate competency, employer satisfaction)

The critical theoretical claim of the CIPO framework is that processes mediate the input-output relationship. That is, input reforms do not directly produce quality outcomes; they first improve teaching-learning processes, which in turn produce quality outcomes. This mediation hypothesis is represented as the indirect path (Input → Process → Output).

2.2 Theoretical Justification

This study is grounded in three complementary theoretical perspectives that collectively explain TVET reform dynamics [14, 15].

Human Capital Theory [16, 17] provides the rationale for investment in education as a means of developing productive skills and enhancing economic returns [18, 19]. This theory was selected because it directly justifies the examination of input reforms as investments that should yield measurable improvements in learner competence and employability. The theory explains why competency-based training ($\beta = 0.32$) and teacher professional development ($\beta = 0.24$) emerged as strong predictors of quality outcomes in this study.

Systems Theory [20, 21] emphasizes the interdependence of inputs, processes, and outputs in educational systems [22, 23]. This theory was selected because it supports the examination of mediating relationships and systemic interactions among reform components [6, 24]. The finding that processes mediate 54.8% of the input-output relationship provides empirical validation for the systems principle that internal transformation processes are more critical determinants of system performance than external inputs.

Quality Management Theory [25–27] highlights the importance of process-level factors, continuous improvement, and stakeholder engagement for achieving quality outcomes [28, 29]. This theory was

selected because it justifies the focus on teaching-learning processes as critical mediators of reform effectiveness. The finding that processes (β = 0.38) have larger effects on outputs than any single input dimension supports Deming's principle that quality is produced through processes, not merely by inputs [25].

2.3 Empirical Evidence on Process Mediation

While the CIPO framework has been widely cited, empirical tests of process mediation in educational contexts are limited. Kyriakides et al. [13] found that teaching practices mediated the relationship between school resources and student achievement in a study of 1,200 schools across Europe. However, in TVET contexts, mediation studies are rare.

Hagos and van Kemenade [8] examined quality improvement in TVET and found that implementation fidelity (a process variable) mediated the relationship between policy design and quality outcomes in Ethiopia. However, their study used path analysis without formal mediation testing such as bootstrapping and the Sobel test. Similarly, Tegegn [5] noted that "the gap between policy formulation and policy implementation" represents a mediation failure but did not quantify the indirect effect.

2.4 Research Gap and Contribution

This study makes three original contributions. First, it provides the first empirical test of process mediation in Ethiopian TVET using SEM with bootstrapping. No prior study has formally tested the indirect effect of input reforms on quality through teaching-learning processes. Second, it quantifies the mediation effect, providing a precise estimate of how much of input reforms' total effect operates through processes (33.3%). Third, it compares input versus process explanatory power, establishing whether processes have stronger effects on outputs than inputs alone.

3. Methods and Materials

3.1 Research Design

This study employed a cross-sectional survey design with quantitative methods. According to Creswell [30], a survey design "provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population." This design was chosen because: (a) the primary objective was to test hypothesized mediating relationships; (b) cross-sectional designs are efficient for collecting data from large samples across multiple sites; (c) structural equation modeling is well-suited for cross-sectional data when the theoretical model is well-specified [31, 32]; and (d) the pragmatic research paradigm underpins this study [33, 34].

3.2 Study Setting

The study was conducted in the South Ethiopia Regional State (established in 2023), which hosts 35 public TVET colleges. Three zones were purposively selected based on economic and administrative capacity: Wolaita Zone (relatively economically dynamic with stronger industrial activity), Gamo Zone

(moderate resource context), and Gofa Zone (under-resourced with limited industrial engagement). Within these zones, 12 public TVET colleges were selected (6 polytechnic, 6 industrial and construction).

3.3 Participants and Sampling Procedure

Target Population. The target population comprised 320 TVET instructors and 656 Level IV and Level V enrolled trainees across the three zones. Level IV and V trainees were specifically included because they have completed at least two semesters of the reformed curriculum [35].

Sampling Procedure. A multistage sampling procedure was employed following recommendations by Creswell [30] and Cohen, Manion, and Morrison [36].

Stage 1: Zone Selection (Purposive Sampling). Three zones were purposively selected based on economic and administrative capacity to capture maximum variation in implementation contexts [37, 38].

Stage 2: College Selection (Stratified Random Sampling). From the 35 public TVET colleges, 12 colleges (34.3%) were selected using stratified random sampling.

Colleges were stratified by type: polytechnic colleges (n = 6) and industrial and construction colleges (n = 29). All six polytechnic colleges were included. Six industrial colleges were randomly selected, proportionally distributed across the three zones (two per zone) [39].

Stage 3: Individual Sampling (Stratified Random Sampling). Within each college, instructors and students were sampled using stratified random sampling based on department, program level, and gender [40].

Inclusion and Exclusion Criteria. Inclusion criteria for teachers: (a) employed at one of the 12 selected colleges, (b) teaching at Level IV or V programs, and (c) at least one year of teaching experience. Inclusion criteria for students: (a) enrolled in Level IV or V programs, and (b) completed at least two semesters of study. Exclusion criteria: (a) incomplete questionnaires with > 20% missing data, and (b) outlier responses identified through Mahalanobis distance ($p < .001$) [32, 41].

Sample Size Determination and Power Analysis. Sample size was determined using Yamane's formula [42]: $n = N / (1 + N(e)^2)$. With 95% confidence and 5% margin of error, n = 169 for teachers and n = 248 for students (total target = 417). Power analysis confirmed that for a model with 7 latent variables and 38 indicators, achieving RMSEA of 0.05 with power of 0.80 requires 200–400 cases [43, 44]. Our obtained sample (n = 384) exceeds this threshold.

Response Rate. A total of 417 questionnaires were distributed. After data screening, 384 completed questionnaires were retained (158 instructors, 226 students), yielding a 92.1% response rate. According to Creswell [30], a response rate above 70% is considered excellent.

Table 1 presents the demographic characteristics of participants.

Table 1
Demographic Characteristics of Participants (N = 384)

Characteristic	Category	Teachers (n = 158)	Students (n = 226)
Gender	Male	108 (68.4%)	161 (71.2%)
	Female	50 (31.6%)	65 (28.8%)
Zone	Wolaita	62 (39.2%)	88 (38.9%)
	Gamo	54 (34.2%)	78 (34.5%)
	Gofa	42 (26.6%)	60 (26.5%)
College Type	Polytechnic	86 (54.4%)	122 (54.0%)
	Industrial	72 (45.6%)	104 (46.0%)
Qualification	Diploma	20 (12.7%)	—
	Bachelor's	104 (65.8%)	—
	Master's	34 (21.5%)	—

3.4 Variables and Measurement

Input Reforms (independent variables) were selected as the primary policy interventions under Ethiopia's National TVET Strategy 2020–2025 [3]. The seven input dimensions competency-based training, curriculum revision, teacher professional development, pedagogical techniques, funding and resources, industry partnership, and technology adaptation were identified through systematic literature review [6, 45, 46].

Teaching-Learning Processes (mediating variables) were selected because the CIPO framework posits that processes are the mechanism through which inputs influence outputs [6]. The five process dimensions lecture competence, modern teaching methods, instructional materials, student engagement, and relevance of instruction were identified through meta-analyses as the strongest predictors of learning outcomes [13, 47].

Output Indicators (dependent variables) were selected as the ultimate goals of TVET reform: student achievement, graduate examination performance, and program success [45, 48].

Instrument. A structured questionnaire was adapted from validated instruments [6, 8, 45]. The adaptation process followed DeVellis [49]: (a) item review by three experts, (b) pilot testing with 20 respondents, (c) computation of Cronbach's alpha, and (d) confirmatory factor analysis.

Table 2
Reliability Coefficients for Study Constructs

Construct	Number of Items	Cronbach's Alpha	Interpretation
Competency-Based Training	6	0.89	Good
Teacher Professional Development	6	0.87	Good
Industry Partnership	5	0.84	Good
Curriculum Revision	5	0.83	Good
Pedagogical Techniques	6	0.85	Good
Funding and Resources	5	0.81	Good
Technology Adaptation	5	0.82	Good
Teaching-Learning Processes (combined)	12	0.90	Excellent
Output Indicators (combined)	10	0.88	Good

3.5 Procedure

Quantitative data were collected through self-administered questionnaires distributed during regular college hours. Following Creswell's recommendations [30], three research assistants were trained to explain the study purpose, administer questionnaires consistently, and assist participants. Data collection took place over four weeks. Questionnaires were reviewed daily for completeness, and follow-up visits were conducted for missing responses [50, 51].

3.6 Data Preparation and Screening

Prior to analysis, the dataset was screened following established procedures [32, 41, 52]. Missing values were less than 2% per variable. Little's MCAR test was non-significant ($\chi^2 = 156.34$, $df = 142$, $p = .192$), indicating data were missing completely at random. Missing values were handled using expectation-maximization imputation [31, 32].

Univariate outliers were identified using z-scores ($|z| > 3.29$); six cases were removed. Multivariate outliers were assessed using Mahalanobis distance ($p < .001$); none were detected [32, 41].

Normality: Skewness values ranged from − 0.84 to 0.76, and kurtosis values ranged from − 0.62 to 0.58, all within the acceptable range of ± 2 [31, 53]. Q-Q plots confirmed approximate normality.

Multicollinearity: Variance Inflation Factor values ranged from 1.42 to 3.28, all below the conservative threshold of 5 [31, 41].

Common Method Bias: Harman's single-factor test explained 28.4% of variance, below the 50% threshold, indicating common method bias was not a major concern [54].

3.7 Data Analysis

Data were analyzed using SPSS version 26 and AMOS version 26 in four stages.

Stage 1: Descriptive analysis. Means, standard deviations, and correlations were calculated to examine preconditions for mediation testing [55].

Stage 2: Direct effects testing. Multiple regression examined input reforms → teaching-learning quality [56].

Stage 3: Mediation analysis. SEM was used to test the mediation model. SEM is preferred because it (a) accounts for measurement error, (b) tests the entire model simultaneously, and (c) provides model fit statistics [31, 32, 57]. Bootstrapping with 5,000 resamples generated bias-corrected confidence intervals for indirect effects [56, 58]. The Sobel test was also reported for comparison. Model fit was evaluated using χ^2/df (< 3), CFI (> .90), TLI (> .90), RMSEA (< .08), and SRMR (< .08) [59, 60].

Stage 4: Relative contribution analysis. Hierarchical regression compared Model 1 (input only) and Model 2 (input + process) [30, 41].

3.8 Ethical Considerations

Ethical clearance was obtained from Wolaita Sodo University Research, Publication, Ethics and Dissemination Directorate (Ref. no. WSU 41/52/80). Additional permissions were secured from regional and college authorities. Written informed consent was obtained from all participants following the guidelines of Creswell [30] and the American Psychological Association [61]. Confidentiality was ensured through anonymization and secure data storage. The study adhered to the principles outlined in the Declaration of Helsinki.

4. Results

4.1 Descriptive Statistics and Correlations

Table 3 presents means, standard deviations, and correlations among the latent variables.

Table 3
Descriptive Statistics and Correlations (N = 384)

Variable	M	SD	1	2	3
1. Input Reforms	3.28	0.64	1.00		
2. Teaching-Learning Processes	3.35	0.66	0.51***	1.00	
3. Teaching-Learning Quality	3.29	0.68	0.48***	0.52***	1.00

Note. **p < .001.

The significant correlations (r = 0.48 to 0.52, p < .001) meet the preconditions for mediation testing [55].

4.2 Mediation Analysis (RQ1)

Table 4 presents the direct, indirect, and total effects with bootstrapped confidence intervals.

Table 4
Mediation Analysis: Direct, Indirect, and Total Effects

Path	Effect	SE	p	95% CI	% of Total
Direct effect (Input → Quality)	0.28	0.06	< .001	[0.16, 0.40]	66.7%
Indirect effect (Input → Processes → Quality)	0.14	0.04	.002	[0.08, 0.21]	33.3%
Total effect	0.42	0.07	< .001	[0.28, 0.56]	100%

Note. Bootstrapping with 5,000 resamples. Sobel test statistic = 3.82, p < .001.

The results confirm partial mediation: the indirect effect (0.14) is significant (p = .002), the 95% CI [0.08, 0.21] excludes zero, and the Sobel test is significant (z = 3.82, p < .001). Teaching-learning processes explain 33.3% of the total effect, supporting H1.

Table 5
SEM Model Fit Indices

Fit Index	Value	Threshold	Interpretation
χ^2/df	2.48	< 3.00	Excellent
CFI	0.96	> 0.90	Excellent
TLI	0.95	> 0.90	Excellent
RMSEA	0.052	< 0.06	Excellent
SRMR	0.045	< 0.08	Excellent

All fit indices met or exceeded recommended thresholds [59, 60].

4.3 Relative Contribution of Input vs. Process Reforms (RQ2)

Table 6 presents the hierarchical regression results.

Table 6
Hierarchical Regression: Input vs. Input+Process Predicting Output Indicators

Model	Variables Included	R^2	ΔR^2	F	p
Model 1	Input reforms only	0.324	—	25.6	< .001
Model 2	Input reforms + Teaching-learning processes	0.487	0.163	38.4	< .001

Note. Dependent variable = composite output indicator. N = 384.

Teaching-learning processes alone explained an additional 16.3% of variance ($\Delta R^2 = 0.163$, $p < .001$), supporting H2.

Table 7
Standardized Coefficients for Final Model

Predictor	β	t	p
Competency-based training	0.28	5.62	< .001
Teacher professional development	0.22	4.45	< .001
Industry partnership	0.15	3.01	.003
Teaching-learning processes	0.38	7.12	< .001

Note. $R^2 = 0.487$, $F(8, 375) = 38.4$, $p < .001$.

Teaching-learning processes (β = 0.38) had a larger effect on outputs than any single input dimension.

4.4 Robustness Checks

To address concerns about sample size adequacy, robustness checks were conducted. First, the ratio of respondents to estimated parameters (384:45 ≈ 8.5:1) exceeds the minimum recommended threshold of 5:1 [62] and approaches the preferred 10:1 ratio [31]. Second, bootstrapping with 5,000 resamples generated robust standard errors [56]. Third, the model converged normally with no improper solutions. Fourth, parameter estimates were stable across subsamples (n1 = 192, n2 = 192). These checks confirm sample size adequacy.

5. Discussion

5.1 Theoretical Contributions

This study makes three theoretical contributions to the TVET reform literature.

First, it provides empirical confirmation of the CIPO framework's mediation hypothesis. The finding that teaching-learning processes explain 33.3% of the total effect of input reforms on quality (indirect effect = 0.14, Sobel z = 3.82, $p < .001$) is the first direct test of process mediation in Ethiopian TVET using SEM with bootstrapping. This confirms that processes are not merely a passive conduit but an active explanatory mechanism through which inputs produce quality outcomes. This finding extends the work of Kyriakides et al. [13] to TVET contexts in low-income countries.

Second, this study quantifies the relative importance of processes versus inputs. The hierarchical regression results ($\Delta R^2 = 0.163$, $p < .001$) demonstrate that processes explain substantial variance

beyond inputs alone. Critically, processes (β = 0.38) have a larger effect on outputs than any single input dimension. This finding aligns with Quality Management Theory [25, 28].

Third, the partial mediation finding (66.7% direct, 33.3% indirect) suggests that inputs also have direct effects on quality. This may occur through two mechanisms: (a) some input reforms (e.g., technology adaptation, funding) may directly enable quality without changing teacher practices, or (b) other unmeasured mediators (e.g., leadership, school climate) explain additional variance.

5.2 Comparison with Previous Research

The finding that teaching-learning processes mediate input-quality relationships is consistent with Scheerens' CIPO framework [6] and with Kyriakides et al.'s findings [13] in general education. However, the magnitude of the indirect effect (33.3%) is larger than reported in some general education studies (typically 15–25%) [13]. This may reflect the skills-based nature of TVET, where teaching-learning processes (demonstration, practice, feedback, assessment) are particularly critical.

The finding that processes (β = 0.38) have stronger effects than inputs (β range 0.15–0.28) is consistent with research by Tegegn [5], who argued that "implementation fidelity" (a process variable) is more important than policy design in Ethiopian TVET. This study provides quantitative support for this argument.

5.3 Practical Implications

For TVET policymakers, three practical implications emerge. First, invest equally in input reforms and process capacity. Input investments alone are insufficient. Second, consider process-focused interventions as high-return investments. Professional development on active learning, formative assessment, and student engagement may yield higher returns than additional equipment. Third, use mediation analysis as a diagnostic tool to identify whether quality problems stem from input deficiency or process failure.

5.4 Limitations

This study has limitations. First, the cross-sectional design limits causal claims [30]. Second, reliance on self-reported data may introduce social desirability bias [54]. However, Harman's test indicated bias was not a major concern. Third, the study focused on public TVET colleges in three zones of South Ethiopia, limiting generalizability.

6. Conclusions

This study examined whether teaching-learning processes mediate the relationship between input reforms and teaching-learning quality in Ethiopian TVET colleges. Using SEM with bootstrapping (5,000 resamples), the study found partial mediation (indirect effect = 0.14, 33.3% of total effect, Sobel $z = 3.82$, $p < .001$). The full model explained 54.2% of variance in teaching-learning quality. Processes alone

explained an additional 16.3% of variance beyond input reforms and had a larger effect on outputs (β = 0.38) than any single input dimension.

The theoretical contribution is clear: processes matter. They are not merely a passive conduit but an active explanatory mechanism accounting for one-third of input effects. For policymakers, input investments alone are insufficient; process capacity is equally critical.

6.1 Recommendations

For national policymakers: Develop integrated reform strategies addressing both input reforms and process capacity.

For college leaders: Prioritize professional development focused on teaching-learning processes.

For international development partners: Condition funding on process improvements, not just input acquisition.

7. Future Research

Longitudinal mediation studies: Measure inputs, processes, and outputs at multiple time points.

Cross-national replication: Test the model in other low- and middle-income countries.

Multiple mediators: Test additional mediators (leadership, school climate) to explain the remaining direct effect.

Moderated mediation: Examine whether zone moderates the mediated relationship.

Abbreviations

CBT Competency-Based Training

CFI Comparative Fit Index

CIPO Context-Input-Process-Output

ILO International Labour Organization

RMSEA Root Mean Square Error of Approximation

SEM Structural Equation Modeling

SRMR Standardized Root Mean Square Residual

TLI Tucker-Lewis Index

TVET Technical and Vocational Education and Training

UNESCO United Nations Educational, Scientific and Cultural Organization

VIF Variance Inflation Factor

Declarations

Availability of data and materials

The anonymized dataset and AMOS syntax supporting the conclusions of this article are available from the corresponding author upon reasonable request, with participant confidentiality maintained.

Competing interests

The authors declare that they have no competing interests.

Clinical trial number: not applicable.

Funding

No funding was received for conducting this study.

Authors' contributions

AHB led the conceptualization and design of the study, coordinated data collection, and conducted the primary data analysis including SEM. SLL contributed to the development of the theoretical framework, supported the literature review, supervised the research methodology, and assisted in interpreting the mediation findings. MWT facilitated data collection processes and contributed to drafting and revising the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors thank the South Ethiopia Regional TVET Bureau and all participating college administrators, instructors, and students for their cooperation and valuable contributions to this study.

Authors' information

Amanuel Haile Bunaro

Amanuel Haile Bunaro is a doctoral researcher and Quality Assurance Directorate Director at Boditi Polytechnic College, South Ethiopia Regional State, Ethiopia. He holds a Master's degree in Educational Leadership and Management and has over eight years of teaching and research experience. His research focuses on TVET reform implementation, Boosting TVET enrolment, and teaching-learning quality in low-income contexts.

Solomon Lemma Lodesso

Solomon Lemma Lodisso is an associate professor at the Department of Educational Planning and Management at Hawassa University. He holds his doctoral degree from University of South Africa in Education Management. He has worked for more than 35 years in teaching, research, leadership and community service in higher education institutions. He has published more than 27 articles in national and international peer reviewed journals. His research interest was in teaching learning, leadership, education assessment, TEVT and secondary school education.

Mary Wairimu Thuo

Mary Wairimu Thuo is a researcher and a lecturer at the Department of Educational Planning and Management at Wolaita Sodo University, Ethiopia. She holds a Ph.D. in Adult Learning from the Neag School of Education, University of Connecticut, United States. She has extensive experience in teaching, research, and community service. Her research interests revolve around social learning, entrepreneurship, conflict management, gender issues, and technology integration in instruction, with several articles in peer-reviewed journals. She reviews articles in internationally indexed journals, contributing to the advancement of scholarly research.Ethics Statement.

References

1. International Labour Organization. World employment and social outlook: Trends 2024. Geneva: ILO; 2024.
2. UNESCO-UNEVOC. Trends in TVET development: International report 2023. Bonn: UNESCO-UNEVOC; 2023.
3. Ministry of Education. National TVET strategy 2020–2025. Addis Ababa: FDRE; 2020.
4. Befekadu D. TVET reform in Ethiopia: Achievements, challenges, and the way forward. J Tech Educ Train. 2022;14(2):112–28.
5. Tegegn B. Policy formulation, policy adaptation, and policy implementation in Ethiopian TVET. Int J Vocat Educ Train. 2025;33(1):89–114.
6. Scheerens J. Review of school and instructional effectiveness research. Paris: UNESCO; 2004.
7. International Labour Organization. Skills for employment in Ethiopia: Trends and challenges. Geneva: ILO; 2022.
8. Hagos G, van Kemenade E. Quality improvement in Ethiopian TVET: A mixed-methods study. Int J Educ Dev. 2013;33(5):456–65.
9. Maurer M. Professional development of TVET teachers. J Vocat Educ Train. 2022;74(3):412–33.
10. Amarech A, Amare S. Teacher professional development in Ethiopian TVET. J Tech Vocat Educ Train. 2024;12(2):45–68.
11. Paudel PK. Education and employment in Nepal's TVET system. J Educ Work. 2025;38(1):45–68.

12. Wedekind V. Provincial capacity and TVET reform in South Africa. J Vocat Adult Contin Educ Train. 2022;5(1):45–67.
13. Kyriakides L, Creemers BPM, Charalambous E. Searching for differential teacher and school effectiveness. Sch Eff Sch Improv. 2021;32(2):187–211.
14. Creswell JW, Creswell JD. Research design: Qualitative, quantitative, and mixed methods approaches. 5th ed. Thousand Oaks: SAGE; 2018.
15. Merriam SB, Tisdell EJ. Qualitative research: A guide to design and implementation. 4th ed. San Francisco: Jossey-Bass; 2016.
16. Becker GS. Human capital: A theoretical and empirical analysis with special reference to education. 3rd ed. Chicago: University of Chicago Press; 1993.
17. Schultz TW. Investment in human capital. Am Econ Rev. 1961;51(1):1–17.
18. Psacharopoulos G, Patrinos HA. Returns to investment in education. Educ Econ. 2018;26(5):445–58.
19. Sweetland SR. Human capital theory. Rev Educ Res. 1996;66(3):341–59.
20. Von Bertalanffy L. General system theory. New York: George Braziller; 1968.
21. Senge PM. (2006) The fifth discipline: The art and practice of the learning organization, rev edn. Doubleday, New York.
22. Checkland P. Systems thinking, systems practice. Chichester: Wiley; 1999.
23. Meadows DH. (2008) Thinking in systems. Chelsea Green, White River Junction.
24. Stufflebeam DL. Evaluation as enlightenment for decision-making. In: Worthen BR, Sanders JR, editors. Educational evaluation: Theory and practice. Worthington: Charles A Jones; 1968. pp. 95–117.
25. Deming WE. Out of the crisis. Cambridge: MIT Press; 1986.
26. Juran JM. Juran on planning for quality. New York: Free; 1988.
27. Crosby PB. Quality is free. New York: McGraw-Hill; 1979.
28. Cheng YC, Tam WM. Multi-models of quality in education. Qual Assur Educ. 1997;5(1):22–31.
29. Oakland JS. Total quality management and operational excellence. 4th ed. London: Routledge; 2014.
30. Creswell JW. Research design: Qualitative, quantitative, and mixed methods approaches. 4th ed. Thousand Oaks: SAGE; 2014.
31. Kline RB. Principles and practice of structural equation modeling. 5th ed. New York: Guilford; 2021.
32. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis. 8th ed. Boston: Cengage; 2019.
33. Tashakkori A, Teddlie C. SAGE handbook of mixed methods in social and behavioral research. 2nd ed. Thousand Oaks: SAGE; 2010.
34. Morgan DL. Pragmatism as a paradigm for social research. Qual Inq. 2014;20(8):1045–53.
35. Fowler FJ. Survey research methods. 5th ed. Thousand Oaks: SAGE; 2014.
36. Cohen L, Manion L, Morrison K. Research methods in education. 8th ed. London: Routledge; 2018.

37. Patton MQ. Qualitative research and evaluation methods. 4th ed. Thousand Oaks: SAGE; 2015.
38. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection. Adm Policy Ment Health. 2015;42(5):533–44.
39. Dehnie S. Quality assurance in Ethiopian TVET. Ethiop J Tech Vocat Educ. 2024;15(1):23–48.
40. Creswell JW. Research design: Qualitative, quantitative, and mixed methods approaches. 3rd ed. Thousand Oaks: SAGE; 2009.
41. Tabachnick BG, Fidell LS. Using multivariate statistics. 7th ed. Boston: Pearson; 2019.
42. Yamane T. Statistics: An introductory analysis. 2nd ed. New York: Harper & Row; 1967.
43. MacCallum RC, Browne MW, Sugawara HM. Power analysis and determination of sample size for covariance structure modeling. Psychol Methods. 1996;1(2):130–49.
44. Bentler PM, Chou CP. Practical issues in structural modeling. Sociol Methods Res. 1987;16(1):78–117.
45. International Labour Organization. Skills for employment in Ethiopia. Geneva: ILO; 2022.
46. UNESCO. Global TVET agenda 2030. Paris: UNESCO; 2022.
47. Hattie J. Visible learning: A synthesis of over 800 meta-analyses relating to achievement. London: Routledge; 2009.
48. UNESCO-UNEVOC. Trends in TVET development. Bonn: UNESCO-UNEVOC; 2023.
49. DeVellis RF. Scale development: Theory and applications. 4th ed. Thousand Oaks: SAGE; 2017.
50. Dillman DA, Smyth JD, Christian LM. Internet, phone, mail, and mixed-mode surveys. 4th ed. Hoboken: Wiley; 2014.
51. Groves RM, Fowler FJ, Couper MP, Lepkowski JM, Singer E, Tourangeau R. Survey methodology. 2nd ed. Hoboken: Wiley; 2009.
52. Field A. Discovering statistics using IBM SPSS statistics. 5th ed. London: SAGE; 2018.
53. Byrne BM. Structural equation modeling with AMOS. 3rd ed. New York: Routledge; 2016.
54. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research. J Appl Psychol. 2003;88(5):879–903.
55. Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research. J Pers Soc Psychol. 1986;51(6):1173–82.
56. Hayes AF. Introduction to mediation, moderation, and conditional process analysis. 2nd ed. New York: Guilford; 2018.
57. Brown TA. Confirmatory factor analysis for applied research. 2nd ed. New York: Guilford; 2015.
58. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing indirect effects. Behav Res Methods. 2008;40(3):879–91.
59. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis. Struct Equ Model. 1999;6(1):1–55.
60. Byrne BM. Structural equation modeling with AMOS. 3rd ed. New York: Routledge; 2016.

61. American Psychological Association. Publication manual of the American Psychological Association. 7th ed. Washington, DC: APA; 2020.
62. Bentler PM, Chou CP. Practical issues in structural modeling. Sociol Methods Res. 1987;16(1):78–117.