REPUBLIC OF KENYA

KENYA NATIONAL QUALIFICATIONS AUTHORITY

Day 3 Break out room 4 (Eagle)

Multi-Criteria Optimisation Model for Harmonisation of Qualifications

A Quantitative Decision-Support Framework for Kenya's National Qualifications Framework

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Conference: Quality Assurance & Relevance | Sub-theme: Standardisation & Harmonisation

Presentation Outline

30-slide seminar presentation

The Problem: Structural Incoherence in Kenya's Qualification System

74
Chartered Universities (CUE, 2023)

2,000+
TVET Providers (TVETA, 2022)

1,200+
KNQF-registered Qualifications (KNQA, 2023)

The Core Governance Gap

- Kenya's three sub-frameworks (Basic Education · TVET · Higher Education) have evolved distinct credit conventions, outcome philosophies, and assessment frameworks
- Structural incoherence blocks learner mobility, qualification recognition, and employer readability across sectors
- No mathematical, quantitative harmonisation instrument exists within Kenya's KNQF governance toolkit — audits remain qualitative
- Hundreds of thousands of learners annually navigate interfaces where structural misalignment delays or blocks articulation

Kenya's National Qualifications Framework Architecture

KNQF Act No. 22 of 2014 | KNQA operationalised 2016

This study focuses on Levels 3–9

Literature Review: Four Pillars

Theoretical grounding for the MCDA-AHP-Optimisation architecture

01 NQF Theory

Raffe (2009): communication vs transformation frameworks. Allais (2010): coherence depends on granularity and operational binding of level descriptors. Singh (2009): standardisation vs sectoral autonomy tension.

02 MCDA & AHP

Saaty (1980, 2008): AHP for expert-elicited priority weights. Mardani et al. (2015): 393 MCDA applications validate hybrid MCDA-optimisation in policy analytics. Lenn & Miller (2014): AHP applied to qualification alignment in Europe.

03 African Harmonisation

EAC (2015): African Quality & Qualifications Reference Framework (AQRF). Keevy & Chakroun (2015): operational harmonisation at qualification level requires additional quantitative instrumentation — gap this study fills.

04 Optimisation in Education

Charnes & Cooper (1959): constrained deviation minimisation. Johnes (2006): DEA in HE. Saltelli et al. (2004): sensitivity analysis protocols. Present study: first application of constrained LP to NQF harmonisation.

Research Objectives

Three specific, measurable, methodologically grounded objectives

01

Model Development & Validation

Develop and validate a multi-criteria optimisation model integrating AHP-weighted criteria and constrained linear programming to compute Harmonisation Coefficients (HC) for qualifications across three KNQF sub-frameworks, using documentary regulatory data (2015–2025) and structured expert elicitation.

Methodology / Output: HC formula, AHP weights, CR=0.0074

02

HC Computation & Misalignment Identification

Compute sector-specific and cross-sector HC values for eight purposively sampled KNQF-registered qualifications (Levels 3–9) and identify all interfaces falling below the proposed coherence threshold $\theta = 0.75$.

Analysis / Output: HC values, critical interface identification

03

Sensitivity Analysis & 2030 Projections

Assess HC sensitivity to three alternative criterion-weighting scenarios and project the system-wide cross-sector HC trajectory to 2030 under three targeted policy reforms.

Simulation / Output: sensitivity rankings, projection pathways

Research Design & Data Architecture

Post-positivist quantitative design — two clearly distinguished data strands

STRAND 1 — Secondary Data

- Documentary records 2015–2025
- KNQA · TVETA · CUE · KICD · KNEC
- Credit inventories, learning outcome descriptors, competency standards, assessment structures, level descriptors
- ICC reliability 0.87–0.94 (subsample n=4)

→

STRAND 2 — Primary Expert Elicitation

- 5 NQF specialists (KNQA ×2, TVETA ×2, CUE ×1)
- Structured pairwise AHP elicitation (Saaty 1–9 scale)
- Geometric mean aggregation (Forman & Peniwati, 1998)
- CR = 0.0074 (well below 0.10 threshold)

Purposive Sample: 8 KNQF-registered qualifications, Levels 3–9, spanning all three sub-frameworks and critical interface points

Selection criteria: (i) KNQF registration; (ii) cross-sectoral distribution; (iii) disciplinary diversity; (iv) interface representativeness

Eight Sampled Qualifications (Levels 3–9)

Representative of all sub-frameworks and critical cross-sector interfaces

Code	Qualification	Level	Sector	Credits
Q8	Kenya Certificate of Primary Education (KCPE)	3	Basic Education	~40*
Q1	Kenya Certificate of Secondary Education (KCSE)	4	Basic Education	~84*
Q2	KNEC Certificate in Business Administration	4	**TVET**	120
Q3	TVETA Diploma in Electrical Engineering	5	TVET	240
Q4	KNEC Higher National Diploma (HND) in ICT	6	TVET	360
Q5	Bachelor of Commerce (BCom) — University	7	Higher Education	360
Q6	Bachelor of Science in Electrical Engineering	8	Higher Education	480
Q7	Master of Business Administration (MBA)	9	Higher Education	120

** Credit equivalents for Q8/Q1 are researcher-derived estimates via KNQA (2019) volume-of-learning formula — not officially published values. KNQA should commission a formal volume-of-learning study.*

Five Comparability Criteria (C1–C5)

Operationalised from KNQF Act 2014 level descriptor requirements

C1	**Credit Allocation** Volume of learning in standardised credit units (KNQA guidelines; TVETA CATS schedule)	w = 0.074
C2	**Learning Outcome Descriptors** Specificity, cognitive complexity (Bloom's revised taxonomy), and range of stated outcomes vs KNQF level expectations	w = 0.376 ★ Highest
C3	**Competency Standards** Correspondence of competencies to recognised occupational/academic standards (TVETA Occ. Standards; CUE minimum standards)	w = 0.215
C4	**Assessment Structure** Coherence of assessment methods, marking weightings, moderation, and assessment cycle duration with KNQF level norms	w = 0.121
C5	**Level Descriptors** Correspondence of knowledge depth, autonomy, and responsibility indicators with KNQF level definitions (KNQA 2019)	w = 0.215

AHP Pairwise Comparison Matrix

Aggregated expert elicitation (n=5 NQF specialists) — Geometric mean aggregation

Criterion	C1 Credit	C2 Learning Out.	C3 Competency	C4 Assessment	C5 Level Desc.
C1 – Credit Allocation	1.000	0.250	0.333	0.500	0.333
C2 – Learning Outcomes	4.000	1.000	2.000	3.000	2.000
C3 – Competency Standards	3.000	0.500	1.000	2.000	1.000
C4 – Assessment Structure	2.000	0.333	0.500	1.000	0.500
C5 – Level Descriptors	3.000	0.500	1.000	2.000	1.000
Column Sum	13.000	2.583	4.833	8.500	4.833

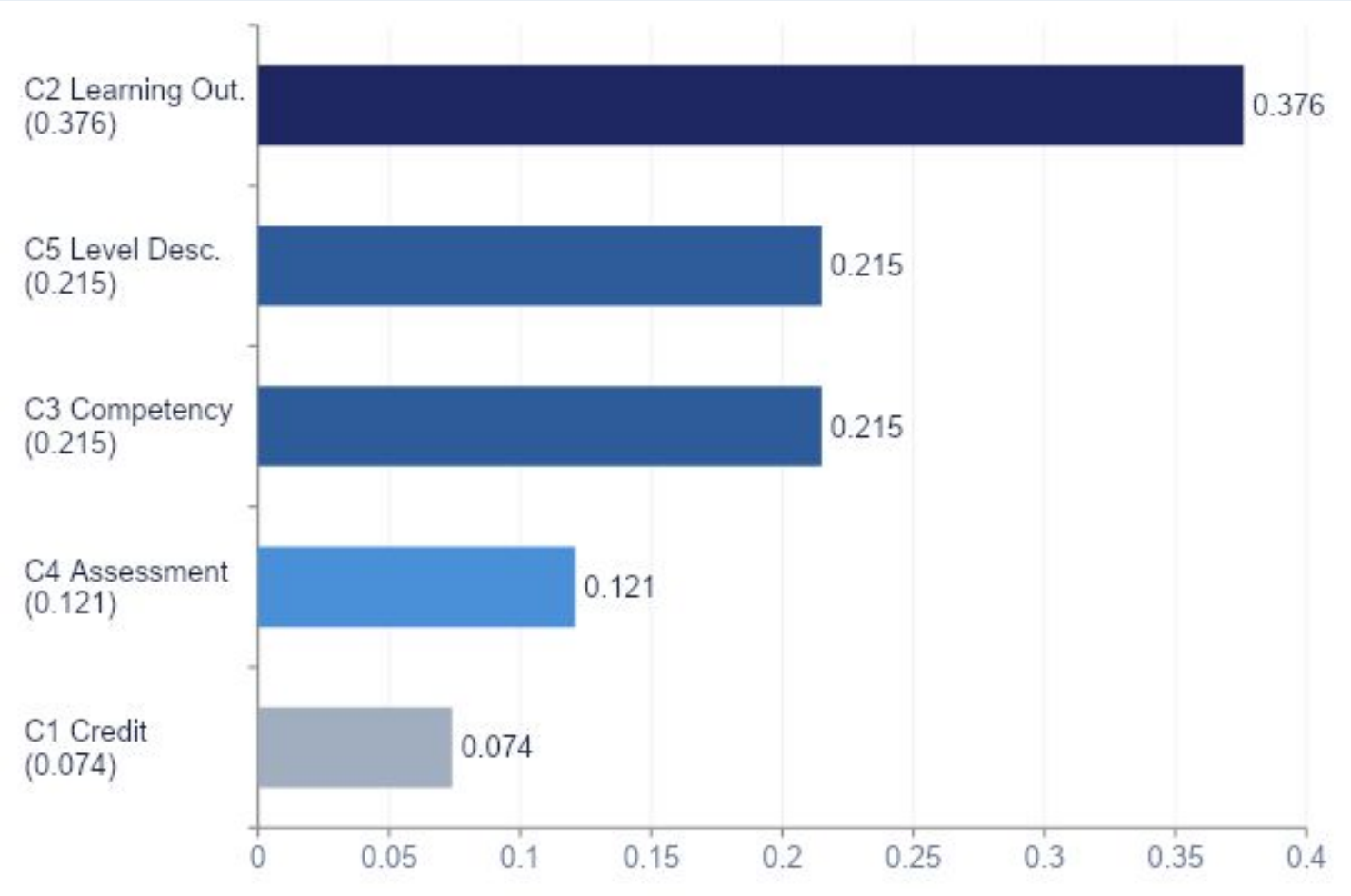
λmax = 5.033
Principal Eigenvalue

CI = 0.0083
Consistency Index

CR = 0.0074 ✓
Consistency Ratio (< 0.10 threshold)

Derived AHP Criterion Weights

Principal eigenvector method — independently verified



C2 0.376 (#1)

Learning outcomes = primary currency of qualification equivalence under outcome-based KNQF

C3 0.215 (#2=)

Competency standards — links to TVETA occupational standards and CUE minimum standards

C5 0.215 (#2=)

Level descriptors — primary bridging mechanism between sub-frameworks and KNQF levels

C4 0.121 (#4)

Assessment structure — reflects rigour but varies by sector norm

C1 0.074 (#5)

Credit volume alone does not capture learning equivalence; informs CATS but must not dominate

The Harmonisation Coefficient (HC) Formula

Constrained linear optimisation minimising weighted structural deviation

$$HC(s) = 1 - [1 / C(n\square , 2)] \times \Sigma_{i<\square} \Sigma\square \ w\square \times |S(i,k) - S(j,k)| / 100$$

where $C(n\square , 2) = n\square(n\square-1)/2$ is the number of unique pairwise comparisons

Minimisation Objective

Minimise $D = \Sigma\square \Sigma_{i<\square} \Sigma\square \ w\square \times |S(i,k) - S(j,k)| / 100$

Subject to Constraints:

- $HC(s) \geq \theta = 0.75$ (minimum coherence threshold)
- $S(i,k) \geq S\_min(k)$ (sector-integrity floor per criterion)
- $\Delta C_1 \leq \pm 15$ credits (TVETA CATS framework tolerance)

$\theta = 0.75$: Author-proposed benchmark informed by CEDEFOP (2017) and SADCQF implementation reports (Tuck, 2007) — not a formally adopted external standard. $HC \in [0.0, 1.0]$

Criterion Scores S(i,k) and Weighted Composite Scores

ICC inter-rater reliability 0.87–0.94 (subsample n=4)

Code	Qualification	Lvl	C1 (0.074)	C2 (0.376)	C3 (0.215)	C4 (0.121)	C5 (0.215)	WS(i)
Q8	KCPE	3	45	58	40	55	55	52.16
Q1	KCSE	4	72	**75★**	44	70	68	66.08
Q2	KNEC Cert. Business	4	60	42	**84★**	56	45	54.73
Q3	TVETA Dip. Elec. Eng.	5	75	64	88	68	72	72.16
Q4	KNEC HND ICT	6	82	58	85	74	65	69.00
Q5	BCom (University)	7	82	84	80	82	85	82.97
Q6	BSc Elec. Engineering	8	86	88	86	84	89	87.15
Q7	MBA (University)	9	84	91	88	86	92	89.45

★ = higher value in L4 interface pair | Yellow shading = L4 profile inversion (KCSE high C2/low C3 vs KNEC Cert. low C2/high C3) | WS = Σ w□ · S(i,k)

Critical Finding: Profile Inversion at KNQF Level 4

Paradigmatic architectural incompatibility — CBC vs TVETA competency approach

Q1 — KCSE (Level 4, Basic Ed.)		Q2 — KNEC Cert. Business (Level 4, TVET)
C1 Credit	72	C1 Credit 60
C2 Learning Outcomes	75 ↑ HIGH	C2 Learning Outcomes 42 ↓ LOW
C3 Competency Stds	44 ↓ LOW	C3 Competency Stds 84 ↑ HIGH
C4 Assessment	70	C4 Assessment 56
C5 Level Descriptors	68	C5 Level Descriptors 45

HC 0.715 < θ

C2 gap: 33 pts | C3 gap: 40 pts (opposite direction) | C2+C3 account for 73.7% of total cross-sector deviation

Individual Pairwise Harmonisation Coefficients — All Pairs

Full transparency and independent verification; coherence threshold θ = 0.75

Q(i)	Q(j)	HC Value	Context	C2 wt-dev	C3 wt-dev	Status
Q8	Q1	0.862	Basic Ed. L3/L4	0.064	0.009	Above θ ✓
Q1	Q2	**0.715**	BasicEd→TVET L4	**0.124** ★	0.086	**BELOW θ ✗ CRITICAL**
Q2	Q3	0.825	TVET L4–L5	0.083	0.009	Above θ ✓
Q3	Q4	0.944	TVET L5–L6	0.023	0.006	Above θ ✓
Q2	Q4	0.857	TVET L4–L6	0.060	0.002	Above θ ✓
Q4	Q5	0.839	TVET→HE L6/7	**0.098** ★★	0.011	Above θ; LO gap HIGH
Q5	Q6	0.958	HE L7–L8	0.015	0.013	Above θ ✓
Q5	Q7	0.935	HE L7–L9	0.026	0.017	Above θ ✓
Q6	Q7	0.974	HE L8–L9	0.011	0.004	Above θ ✓

HE intra mean = (0.958+0.935+0.974)/3 = 0.956 | TVET intra mean = (0.825+0.944+0.857)/3 = 0.875 | wt-dev = w□×Δ/100

Sector-Level Harmonisation Coefficients — Summary (Objective 2)

Only one interface falls below the proposed θ = 0.75 coherence threshold

0.862

Basic Education
(intra HC)

0.875

TVET
(intra HC mean)

0.956

Higher Education
(intra HC mean)

⚠ CROSS-SECTOR: Basic Ed → TVET (L4)

HC = 0.715

BELOW θ = 0.75 | CRITICAL | Only sub-threshold interface

C2 wt-dev=0.124 + C3 wt-dev=0.086 = 73.7% of total deviation

⚡ CROSS-SECTOR: TVET → Higher Ed (L6/7)

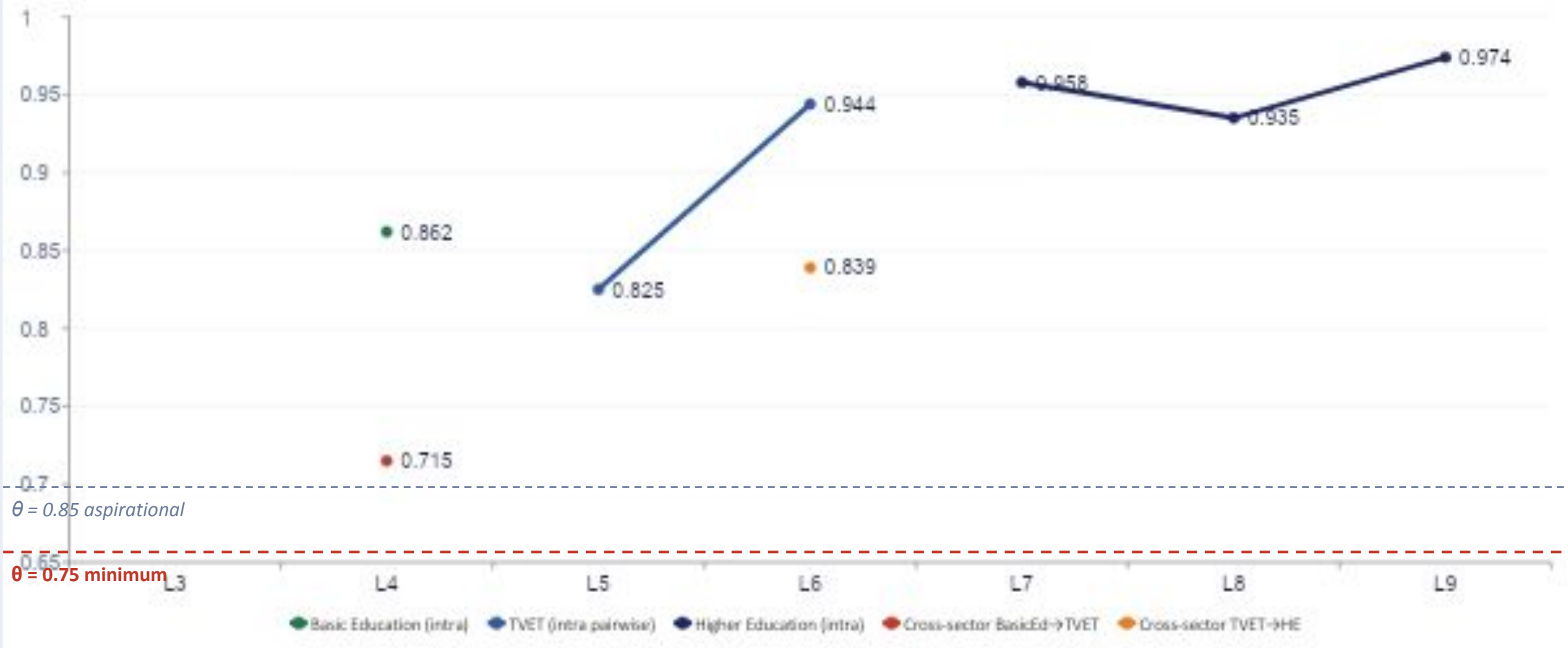
HC = 0.839

Above θ — but LARGEST C2 gap in dataset

C2 wt-dev = 0.098 — second highest priority reform target for learner mobility

Harmonisation Coefficients Across KNQF Levels — 2025 Baseline

Red diamond at L4 = only sub-threshold cross-sector interface; Higher Education consistently strong



Sensitivity Analysis — Three Alternative Weighting Scenarios (Objective 3A)

Most important finding: credits-dominant weighting produces a dangerous false positive at L4

Criterion	Baseline AHP	Scenario A: LO Dominant	Scenario B: Equal Weights	Scenario C: Credits Dominant
C1 – Credit	0.074	0.080	0.200	**0.450 ▲ elevated**
C2 – Learning Out.	**0.376 ★**	**0.500 ★★**	0.200	0.180 ▼
C3 – Competency	0.215	0.215	0.200	0.150
C4 – Assessment	0.121	0.090	0.200	0.110
C5 – Level Desc.	0.215	0.115	0.200	0.110
L4 Cross-Sector HC	**0.715 ✗**	0.700 ✗	0.756 ✓	**0.786 ⚠ FALSE POSITIVE**
L6/7 Cross-Sector HC	0.839 ✓	0.829 ✓	0.882 ✓	0.915 ✓ (inflated)

⚠ **KEY WARNING: Scenario C (credits-dominant, w_C1=0.450) inflates L4 HC from 0.715 to 0.786 — passing θ=0.75 despite the 33-point C2 learning outcome gap being fully unresolved. A CATS based primarily on credit volume will systematically approve transfers not supported by genuine structural equivalence.**

Three Targeted Policy Reforms — Projection Parameters

Structured annual criterion score increments applied from 2026

R1

HIGH

CBC–TVET Level 4 Learning Outcome Alignment

Timeline: 2026–2027 | Parameter: Q2 C2 +8 pts; Q2 C5 +6 pts (annual increment)

Bridges CBC outcome language with TVETA competency standards language at L4

R2

MEDIUM

Standardised Credit Equivalency Protocol

Timeline: 2026 | Parameter: Q4 C1 +6 pts; Q4 C5 +5 pts

Harmonises TVET HND credit conventions with adjacent HE credit norms at L6/7 interface

R3

HIGH

Mandatory Learning Outcome Mapping

Timeline: 2026–2028 | Parameter: Q4 C2 +12 pts (over 3 years)

HND awarding bodies at L6 submit learning outcome crosswalk to university entry outcomes as KNQA registration condition

All projections assume linear annual reform trajectories and no deterioration in existing scores — see Limitations (Slide 26)

Projected HC Trajectories Under Structured Policy Intervention (2025–2030)

System cross-sector average exceeds aspirational threshold θ = 0.85 by 2030

Sector / Metric	2025 Baseline	2026	2027	2028	2029	2030 Target
Basic Education (intra HC)	0.862	0.870	0.878	0.887	0.896	**0.916 ✓**
TVET (intra HC)	0.875	0.888	0.900	0.913	0.924	**0.938 ✓**
Higher Education (intra HC)	0.956	0.961	0.965	0.970	0.975	**0.980 ✓**
Cross-sector L4 HC	**0.715 ✗**	0.731 ✗	0.748 ✗	0.765 ✓	0.782 ✓	**0.810 ✓**
Cross-sector L6/7 HC	0.839	0.853	0.865	0.880	0.893	**0.903 ✓**
System cross-sector average	**0.777**	0.792	0.807	0.823	0.838	**0.857 ✓ > θ=0.85**

⚠️ ***A one-year delay in Reform R1 keeps the L4 interface below θ=0.75 through all of 2027 and shifts the system-wide 2030 target to 2031–2032.***

HC Projection Chart: 2025–2030 Under Structured Policy Reforms

System cross-sector HC crosses θ=0.85 aspirational threshold by 2030

Discussion 1: Nature of Misalignment — A Profile Inversion, Not a Gap

Confirms Allais (2010) theoretical argument on outcome-based NQF coherence

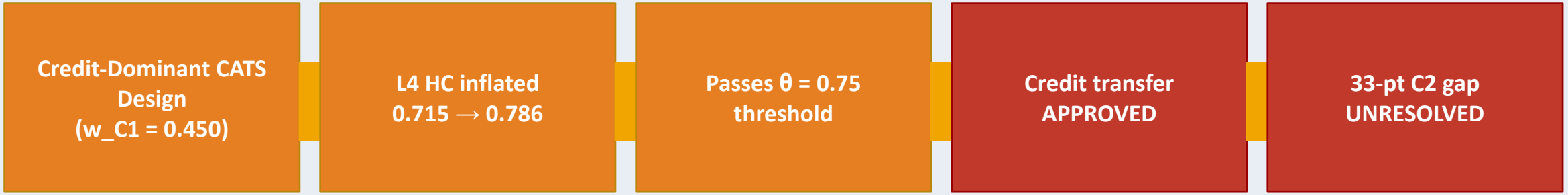
> The dominant influence of Learning Outcome Descriptors (C2, w=0.376) confirms Allais's (2010) argument: outcome-based qualification frameworks are only as coherent as the operational precision of their outcome statements.
>
> *Consistent with World Bank (2021) Kenya Human Capital Project: TVET quality assurance and articulation is the most significant bottleneck in Kenya's education-to-labour pipeline*

The L4 misalignment is paradigmatic — an architectural incompatibility:

- KCSE (Basic Education): Scores HIGH on C2 (outcome language, cognitive levels) — reflects CBC philosophy; scores LOW on C3 (occupational competency)
- KNEC Certificate (TVET): Scores LOW on C2 (outcome precision) — reflects occupational competency tradition; scores HIGH on C3
- This is not a quantitative discrepancy but an architectural incompatibility between CBC outcome philosophy and TVETA occupational competency approach
- Cannot be resolved by credit transfer protocols alone — requires deliberate alignment of the underlying qualification design frameworks
- Policy implication: the Q2 C2 score of 42 marks KNEC Certificate-level TVET qualifications as the weakest single link in the harmonisation chain

Discussion 2: The False Positive Risk of Credit-Dominant CATS

Sensitivity analysis provides the technical case against credit-volume-primary CATS designs



Why This Matters for KNQF Governance

- A credits-dominant CATS will systematically approve credit transfers not supported by genuine structural equivalence — masking the CBC-TVET architectural incompatibility
- The model provides the technical basis for a multi-criteria CATS eligibility protocol; C1 weight should not exceed 10–15% (consistent with AHP-derived w=0.074)
- Consistent with AQRF alignment position of EAC (2015): learning outcomes are the primary comparability anchor for regional credit transfer
- Regulators using aggregate or credit-only comparators cannot detect the profile inversions that the HC formula is specifically designed to reveal

Discussion 3: Kenya's Positive Trajectory & Coordinative Barriers

Strong institutional capacity; institutional barrier is coordinative, not technical

Positive Signs

- Intra-sector coherence is already strong: Higher Education 0.956, TVET 0.875, Basic Education 0.862
- The system requires targeted reform, not wholesale redesign — only one interface is sub-threshold
- KNQA's cross-cutting authority under the KNQF Act positions it uniquely to convene cross-institutional reform
- HC model provides the KNQA with measurable, time-bounded targets — converting qualitative aspiration to quantitative accountability
- With R1–R3 implemented from 2026, system-wide HC reaches θ=0.85 by 2030 — Kenya positioned as first EAC country with quantitative NQF harmonisation instrument

Institutional Barriers

- KICD and TVETA operate under different regulatory philosophies with no existing cross-institutional outcome alignment working group
- CBC transition is still maturing; outcome descriptor language at Level 4 remains in development
- KNQA accreditation review cycles have not previously required cross-sector HC scoring as a condition of registration
- Basic education credits (KCPE/KCSE) lack official KNQF values — researcher-estimated figures at the model's foundation
- Projection assumes linear reform pathways; political/administrative delays will extend timelines (see Limitations)

Key Findings — Summary of Three Objectives

All three objectives fully met with independently verified, quantified results

F1

Model Validated (Obj. 1)

- AHP weights internally consistent: CR = 0.0074 (< 0.10)
- C2 Learning Outcomes dominant (w=0.376) — 80.6% combined weight with C3+C5
- ICC inter-rater reliability: 0.87–0.94 (subsample n=4)
- First mathematically formalised optimisation instrument for KNQF harmonisation benchmarking

F2

HC Values Computed (Obj. 2)

- Intra-sector: Basic Ed 0.862; TVET 0.875; Higher Ed 0.956
- Only sub-threshold interface: BasicEd→TVET L4 (HC=0.715)
- C2+C3 account for 73.7% of total cross-sector deviation at L4
- TVET→HE L6/7 (HC=0.839): above threshold but largest C2 gap — highest-consequence reform target

F3

Sensitivity & Projections (Obj. 3)

- Credits-dominant scenario inflates L4 HC to 0.786 — dangerous false positive masking structural deficit
- Three targeted reforms can raise system cross-sector HC from 0.777 (2025) to 0.857 (2030)
- Competency match (Reform 1) is highest-impact intervention
- One-year delay in R1 shifts 2030 target to 2031–2032

Limitations — Explicitly Acknowledged

Academic transparency and intellectual honesty about model boundaries

1 **Sample Scope** — *High priority*

Purposive sample of 8 qualifications limits generalisability. A census-level study of all 1,200+ KNQF-registered qualifications is required for system-wide robust estimates.

2 **ICC Coverage** — *Recommended*

Inter-rater reliability (ICC 0.87–0.94) established for a subsample of 4 of the 8 qualifications. Extending ICC reliability to all 8 sampled units is a recommended refinement.

3 **Linear Projection Assumption** — *High priority*

Projection trajectories to 2030 assume linear reform pathways. Qualification reform is typically non-linear and subject to political delays. Future iterations should employ system dynamics modelling (Sterman, 2000).

4 **Threshold Specification (θ)** — *Recommended*

The proposed coherence threshold θ=0.75 is author-derived (informed by CEDEFOP 2017 and Tuck 2007) — not a formally adopted external standard. Empirical validation by KNQA through a census-level study is required.

5 **Basic Education Credit Estimates** — *High priority*

KCPE (~40) and KCSE (~84) credit equivalents are researcher-constructed approximations using KNQA volume-of-learning formula. No official KNQF credit values exist for these qualifications. KNQA should commission a formal volume-of-learning study.

Policy Recommendations (1–3) — Immediate Actions

Direct translations of model findings into regulatory action

R1

Immediate

Reform CATS to Incorporate Multi-Criteria HC Eligibility Scoring

KNQA should revise CATS eligibility to require criterion-level alignment on C1–C5 with minimum HC of θ=0.75 between sending and receiving qualifications. Credit volume (C1) must not exceed 10–15% of composite score (consistent with AHP-derived w=0.074). The HC formula and scoring rubric developed in this study provide an immediately deployable CATS evaluation instrument.

R2

Immediate (Time-Critical)

Convene CBC–TVET Level 4 Outcome Alignment Working Group

KNQA should convene KICD and TVETA in a joint working group to develop harmonised Level 4 learning outcome descriptors bridging CBC's outcome language and TVETA's competency standards language. Quantitative target: +15 points on Q2's C2 score raises HC above θ=0.75. Achievable in 18–24 months with ministerial-level coordination. A one-year delay extends sub-threshold status through 2027 — this recommendation is time-critical.

R3

Immediate

Institutionalise HC as a Regulatory Benchmarking Instrument

KNQA should adopt the HC model as a periodic benchmarking instrument in the qualification registration and review cycle. All qualifications applying for cross-sector recognition must submit C1–C5 criterion scores. Minimum HC of θ=0.75 is the eligibility floor for cross-sector recognition. AHP-derived weights serve as default for 2026–2028 cycle, subject to re-elicitation every five years.

Policy Recommendations (4–6) — Medium-Term & Foundation Actions

Phased implementation for sustained system improvement

R4

Year 2–3

Mandate Learning Outcome Mapping for KNQA Registration Renewal

KNQA should require TVET HND awarding bodies at Level 6 to submit a learning outcome crosswalk mapping HND exit outcomes to cognate university entry outcomes as a condition of registration renewal. HC model projects Reform 3 raises L6/7 interface HC from 0.839 to 0.903 by 2030. Phase implementation: STEM disciplines 2026–2027, business and professional disciplines 2027–2028.

R5

Year 3–5

Align KNQF Harmonisation Reporting with EAC-AQRF

With a projected system HC of 0.857 by 2030, Kenya would exceed θ=0.85 and be positioned as the first EAC country with a quantitative, replicable NQF harmonisation instrument. KNQA should prepare an AQRF alignment report using HC values as the quantitative evidence base and propose the HC methodology for regional adoption through the EAC Regional Qualifications Framework Technical Committee.

R6

Foundation

Commission Official Credit Equivalents for Basic Education Qualifications

KCPE (~40) and KCSE (~84) credit equivalents are researcher-derived estimates not verifiable from any official KNQA, KICD, or KNEC register. This is a data quality gap at the model's foundation. KNQA should formally commission a volume-of-learning study to assign official KNQF credit equivalents to all basic education exit qualifications — a prerequisite for rigorous harmonisation benchmarking at the Basic Education–TVET boundary.

Study Contributions — Four Original Contributions

Methodological and empirical advances in NQF governance analytics

🔬 C1: First Mathematically Formalised Optimisation Model

No previous study has formalised qualification harmonisation as a constrained linear programming problem with AHP-derived weights and independently verified HC values for Kenya's KNQF. Extends the MCDA-optimisation hybrid architecture (Mardani et al., 2015) to NQF alignment.

📊 C2: Correct Methodological Distinction of Data Strands

Clear and consistent separation of secondary documentary data (C1–C5 criterion scores) from primary expert-elicited data (AHP weights via structured elicitation). Sets methodological standard for future KNQF empirical research.

🎯 C3: First Quantitative Harmonisation Audit of Kenya's Qualification System

The first HC-based assessment of structural alignment across all three KNQF sub-frameworks using verified documentary data from official regulatory bodies across 2015–2025.

✅ C4: Individual-Level HC Summary Enabling Independent Verification

Full pairwise HC disclosure (Table 6a) enables independent verification and replication — a methodological standard for policy-facing NQF research not previously established in African NQF literature.

Conclusion

Kenya's qualification system is structurally coherent within each sub-framework but harbours a critical cross-sector misalignment at the Basic Education–TVET Level 4 interface (HC = 0.715). This misalignment is paradigmatic, not quantitative — it arises from the structural incompatibility between CBC learning outcome orientation and TVETA occupational competency approach. The HC model provides KNQA with the mathematical infrastructure to govern this alignment with transparency and precision.

0.715

Critical L4 interface HC
(below θ=0.75)

0.857

Achievable 2030 system
cross-sector HC

R1–R3

Three reforms from 2026
deliver aspirational target

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Conference: Quality Assurance & Relevance | Sub-theme: Standardisation & Harmonisation Across Sub-Frameworks

Thank you — Questions welcome

REPUBLIC OF KENYA

KENYA NATIONAL QUALIFICATIONS AUTHORITY

A Descriptive Analysis of the Role of Quality Assurance Mechanisms on the Transformation of TVET Systems in Kenya

Theme; ***"Strengthening Qualifications Frameworks and Skills Development for Sustainable Growth."***

Sub-Theme: Quality Assurance and Relevance of Qualifications

By:

Dennis Makori Baraka Nyangoto/Charline Jeptepkeny Cheruiyot

Rift Valley National Polytechnic

1st National Qualifications Conference 2026

12th – 14th May 2026 | Emara-Ole Sereni

Introduction and Problem Statement

- Despite the growing emphasis on Technical Vocational Education and Training as a means of addressing unemployment and skill gaps, challenges persist in ensuring the quality and relevance of its programs
- QA mechanisms transform Technical and Vocational Education and Training systems by ensuring that they maintain high standards of education and training.
- This Enables TVET graduates to be competent, employable, and capable of driving industrial and economic growth in line with Kenya's Vision 2030.

Cont'

- **While QA frameworks exist, their implementation effectiveness and systemic impact on teaching, learning, assessment, and graduate employability are not fully understood.**
- **This study addresses that gap by descriptively analyzing how QA mechanisms shape TVET transformation.**
- **The study provided insights into strategies and QA mechanisms that contribute to high quality, relevance and effectiveness of TVET education and training in Kenya.**

OBJECTIVES

1. To determine the quality assurance mechanisms that are used in TVET System in Kenya.
2. To assess the effectiveness of quality assurance mechanism in Kenya
3. To establish the Role of quality assurance mechanisms in the transformation of TVET systems

Hypothesis

- **H_a: Monitoring and evaluation is the quality assurance mechanisms that is mostly used in TVET systems in Kenya**
- **H_a: Clear policy and regulatory framework is the most effective quality assurance mechanism in TVET system in Kenya**
- **H_a: Quality assurance mechanisms play a great role in Alignment of TVET systems with National Development Goals in Kenya.**

MEASUREMENT OF VARIABLES

1. Quality assurance mechanisms
2. Effectiveness of quality assurance mechanism
3. Role of quality assurance mechanisms

- Questionnaires
- Interviews
- Focused group discussions

SCOPE OF STUDY

- The study was carried out in Kenya's Technical and Vocational Education and Training (TVET) Sector
- They included, National polytechnics and Technical Training Institutes, Vocational Training Centers and County Polytechnics.
- Moreover it encompassed Technical Vocational Education and Training Authority (TVETA) and Ministry of education that oversee the quality and standards of TVET institutions and programs in Kenya.

LITERATURE REVIEW

- **Technical and Vocational Education and Training Plays a critical role in equipping individuals with skills and Knowledge necessary to thrive in today's dynamic market (Manubag et al., 2023).**
- **The transformation of TVET is linked to the integration of QA through the enactment of the TVET Act of 2013 and the establishment TVETA authority (Raby et al., 2023).**
- **QA frameworks ensure relevance, efficiency, and credibility of training programs (UNESCO, 2018; Oketch, 2017).**

Gaps From Literature Review

- Limited Kenya-specific empirical studies on quality assurance impact on TVET system
- Lack of longitudinal evidence on transformation processes
- Data and monitoring weaknesses
- Contribution to knowledge.

Theoretical Framework

The Study integrates Total Quality Management (Deming, 1986; Oakland, 2014), Systems Theory (Bertalanffy, 1968), and Human Capital Theory (Becker, 1964; Schultz, 1961).

Conceptual Frame Work

INDEPENDENT VARIABLE

Quality Assurance Mechanisms

- Regularly Updating Curriculum
- Access To Modern Infrastructure, Equipment, And Facilities
- Collaboration Between TVET Institutions And Industry Stakeholders
- Assessment And Certification
- Monitoring And Evaluation
- The Policy And Regulatory

Intervening Variables

- Government Policies and Support
- Availability of Funding
- Industry Partnerships and Collaboration
- Stakeholder Engagement and
- Participation
- Quality of Teaching Staff
- Infrastructure and Facilities
- Regulatory Framework

DEPENDENT VARIABLE

Transformations of TVET Systems

- Improvement in Curriculum Relevance
- Enhanced Teaching and Learning Quality
- Upgraded Infrastructure and Facilities
- Strengthened Industry Partnerships
- Credible Assessment and Certification Processes
- Effective Monitoring and Evaluation Mechanisms
- Alignment with National Development Goals

METHODOLOGY

Unit analysis	❖ **TVET Institutions and systems**
Research design	❖ **Descriptive Survey**
Sample size	❖ **900 Respondents**
Sampling design	❖ **Stratified sampling**
	❖ **Within-Institution /Proportionate sampling**
	❖ **Purposive sampling**
Methods of data collection	❖ **Focused group discussions**
	❖ **Interviews**
	❖ **Questionnaires**
Methods of data analysis	❖ **Descriptive statistics**
	❖ **Likert Scale**
	❖ **Thematic analysis**
	❖ **Triangulation**
Methods of data presentation	❖ **Tables**
	❖ **Textual, statistical**
	❖ **Visual/Graphical**

RESULTS AND DISCUSSION
(I) Questionnaire Return Rate

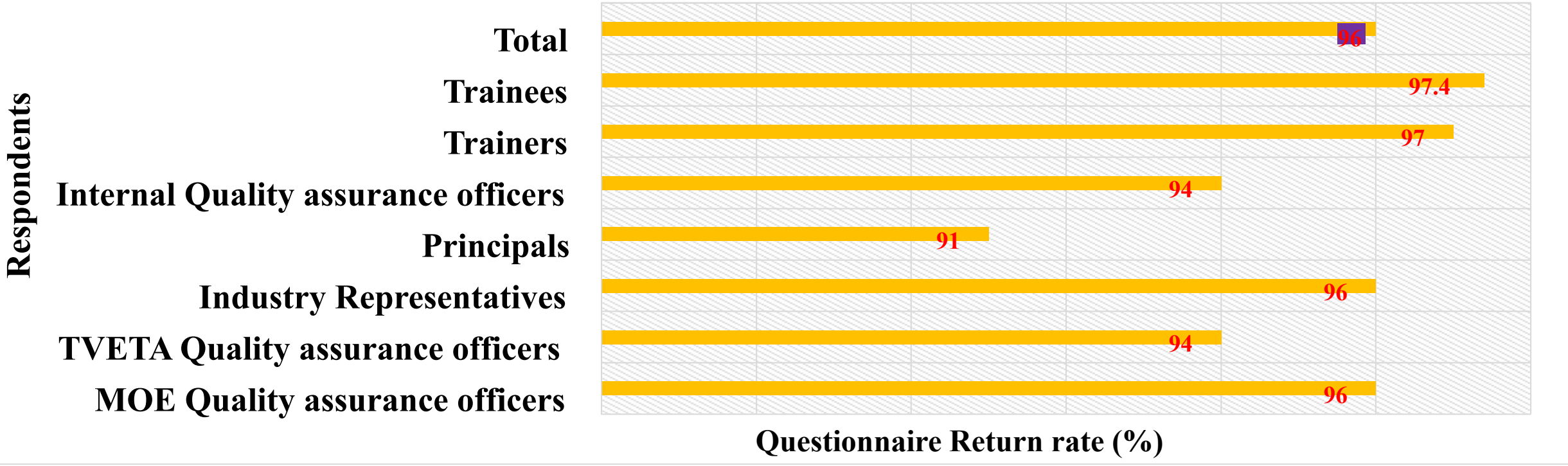

Figure 2: Questionnaire Return Rate(%)

- The questionnaire return rate was 96% and was excellent for statistical inference and conformed to the findings of Mugenda and Mugenda (2003) that a response of 70 percent and above is sufficient for data analysis and reporting.

(II) Background Information
a) Age distribution of the Respondents

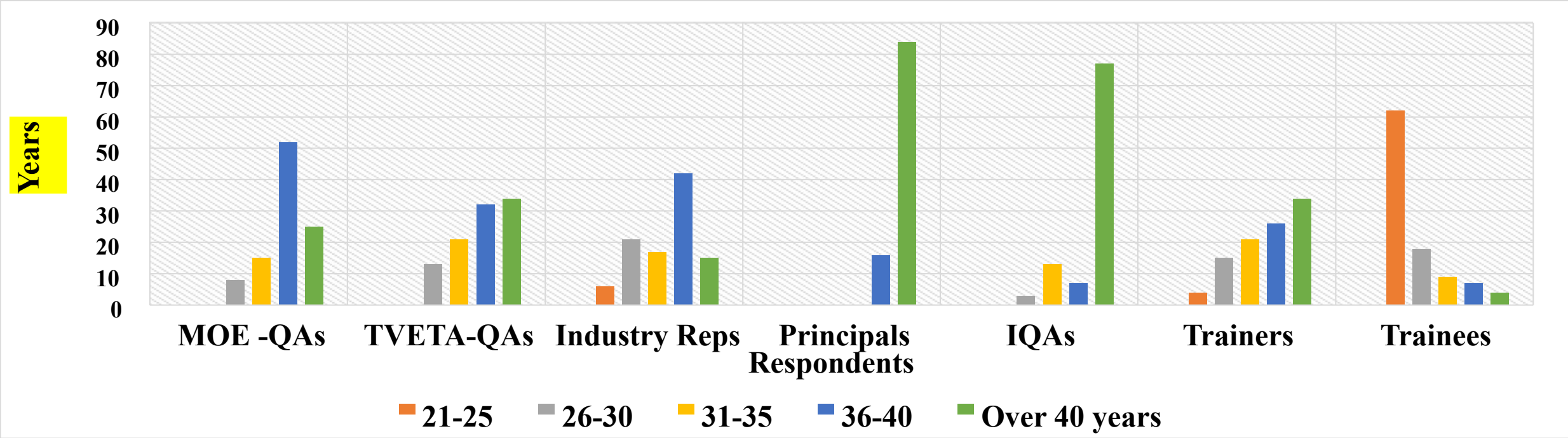

Figure.3: Age distribution of respondents

- Majority of the respondents were in the age bracket of 36-40 years and over 40 years.
- This dominant groups were very vital in the survey as they were more informed on current issues concerning quality assurance mechanisms in TVET systems in Kenya as they added depth and richness to the data by tapping into their experience, expertise, and awareness of current issues (Uandara, 2023).
- Based on the data, the various age groups in the populations were fairly represented.

(b) Gender distribution of respondents

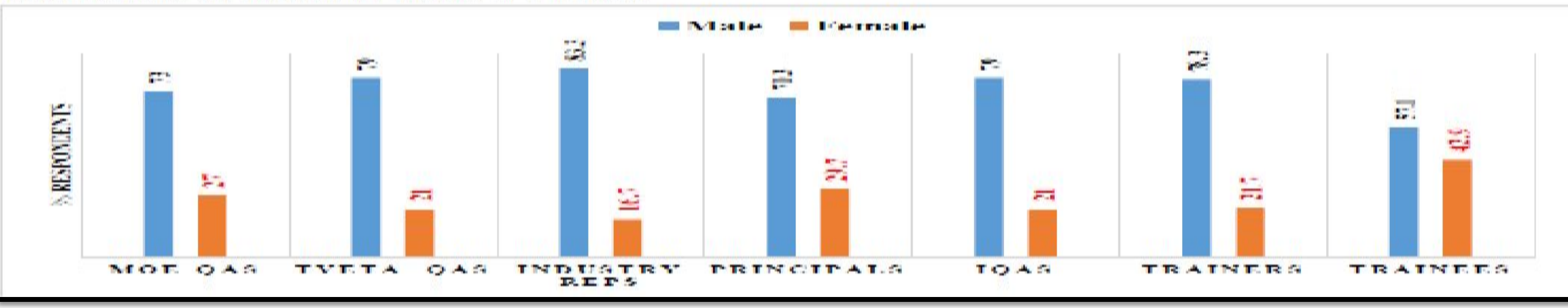

Figure 4: Age distribution of respondents

- The results obtained showed the male dominance in the TVET system in Kenya.
- This was as a result of traditional gender roles that are prevalent in Kenyan societies and access to TVET education has never been equal amongst male and female (Bray-Collins et.al,2022).

(c) Highest Level Of Education Attained by Respondents

Highest level of education(%)	MOE quality assurance officers	TVETA Quality assurance officers	Industry Representatives	Principals	Internal quality assurance officers	Trainers	Trainees
Secondary education	0	0	0	0	0	0	83
Diploma	15	4	35	0	5	21	12
BED	58	73	58	78	81	70	5
PGDE	27	21	6	22	14	9	0

- A greater portion of respondents had bachelor's degree as the highest level of education.
- This demonstrated the ability of the respondents to provide valid and consistent information on the role of quality assurance mechanisms in the transformation of TVET systems.

(d) Geographical Distribution of Respondents

Distribution (%)	MOE Quality Assurance Officers	TVETA Quality Assurance Officers	Industry Representatives	Principals	Internal Quality Assurance Officers	Trainers	Trainees	Mean
Nairobi	21	26	31	8	9	26	21	20
Central	17	13	21	25	20	13	20	18
Eastern	10	15	10	13	10	10	10	11
Western	15	17	8	18	24	15	14	16
Coast	13	9	13	8	5	14	9	10
N. Eastern	8	6	4	5	4	8	5	6
Rift-Valley	17	14	13	23	28	12	21	18

- Nairobi region had the highest number of respondents(20%) while North- Eastern region with 6% only had the least number of respondents.

- This was a reflection of disparities in population density, infrastructure, economic opportunities, security concerns, and cultural factors between TVET system regions (Kenya National Bureau of Statistics [KNBS], 2019; Mount Kenya Times, 2023; National Academies Press, 2015).

(e) Length of service of Respondents.

Length of service (%)	MOE quality assurance officers	TVETA Quality assurance officers	Industry Representatives	Principals	Internal quality assurance officers	Trainers	Mean
Less than 1 year	6	2	6	17	11	5	8
1-5 years	20	19	37	49	54	26	34
6-10 years	31	57	43	25	26	38	37
Over 10 years	42	21	13	7	10	31	21

- The findings indicated that majority of the respondents (37%) had worked in their current position and institution for between 6-10 years while only 8% of the respondents had been in service in their position for less than one year.
- This showed that the respondents had experience and knowledge to give reliable and consistent information on the quality assurance mechanisms in TVET system (Mugenda & Mugenda, 2003; Orodho, 2009).

OBJECTIVE ONE: Determination of the Quality Assurance Mechanisms that are Used in TVET System in Kenya.

Statement on the quality assurance Mechanisms used in the TVET sector in Kenya	Disagree (%)	Neutral (%)	Agree (%)
The TVET curriculum is regularly updated to align with industry needs and technological advancements	23	15	62
TVET instructors receive adequate training and professional development opportunities to enhance their teaching skills	25	22	53
TVET institutions have access to modern infrastructure, equipment, and facilities to support practical training	28	34	38
There is effective collaboration between TVET institutions and industry stakeholders to ensure the relevance of training programs.	24	38	38
Assessment and certification processes in the TVET sector are robust and credible, reflecting student learning outcomes accurately	26	34	40
Monitoring and evaluation mechanisms assess the effectiveness of TVET programs and identify areas for improvement.	13	16	71
The policy and regulatory framework governing TVET adequately supports quality assurance measures	27	9	65

- The findings revealed that the majority of respondents (71%) identified monitoring and evaluation mechanisms as the most commonly implemented quality assurance strategy within Kenya's TVET institutions.
- Conversely, limited access to modern infrastructure and weak institutional–industry collaboration were reported as the least utilized mechanisms (TVET Authority, 2020; Republic of Kenya, 2019; UNESCO-UNEVOC, 2021).

OBJECTIVE TWO: Determination of Effectiveness Of Quality Assurance Mechanism in Kenya

Types of quality assurance mechanisms in TVET systems in Kenya	Not Effective (%)	Somewhat Effective (%)	Moderately Effective (%)	Very Effective (%)	Extremely Effective (%)
Accreditation of TVET institutions	3	13	12	29	42
Regular curriculum review and updating	2	44	11	13	30
Continuous professional development for TVET instructors	7	9	30	26	27
Industry engagement and partnerships	8	17	41	13	22
Robust monitoring and evaluation mechanisms	3	4	19	30	44
Clear policy and regulatory frameworks	4	7	10	33	46

- A large proportion of respondents identified policy and regulatory frameworks, monitoring and evaluation, and institutional accreditation as the most effective mechanisms ensuring quality in TVET systems.
- However, mechanisms such as industry collaboration, instructor professional development, and curriculum review were viewed as only moderately or somewhat effective (Republic of Kenya, 2019; TVET Authority, 2020; UNESCO-UNEVOC, 2021; World Bank, 2020)

OBJECTIVE THREE: Assessing the Role of Quality Assurance Mechanisms in the Transformation of TVET System

Transformation of TVET Systems by Quality Assurance	Not at all (%)	Slightly (%)	Moderately (%)	Significantly (%)	Completely (%)
Improvement in Curriculum Relevance	2	20	22	22	34
Enhanced Teaching and Learning Quality	5	15	22	22	36
Upgraded Infrastructure and Facilities	8	16	32	33	11
Strengthened Industry Partnerships	6	22	34	25	13
Credible Assessment and Certification Processes	1	10	30	22	36
Effective Monitoring and Evaluation Mechanisms	6	10	22	29	33
Alignment with National Development Goals	1	6	27	22	44

- As indicated in the results above , most respondents agreed that quality assurance mechanisms have been instrumental in transforming Kenya's TVET system by aligning programs with national development goals, enhancing curriculum relevance, improving assessment credibility, and strengthening monitoring and evaluation processes (Republic of Kenya, 2019; TVET Authority, 2020; UNESCO-UNEVOC, 2021; World Bank, 2020; African Union, 2018).

Conclusion

- The study concluded that quality assurance mechanisms are vital in transforming Kenya's TVET system by improving the relevance, effectiveness, and credibility of training programs.
- Monitoring and evaluation, policy frameworks, and institutional accreditation emerged as the most effective mechanisms, while industry collaboration and modern infrastructure were least utilized.
- The findings also showed that these mechanisms have enhanced curriculum relevance, teaching quality, and alignment with national development goals.
- Overall, strengthening comprehensive quality assurance frameworks will further promote sustainable growth, employability, and competitiveness in Kenya's TVET sector.

Recommendations

- The study recommends that the government and TVET Authority strengthen quality assurance frameworks by enforcing clear policies, robust monitoring, and evaluation systems.
- Greater investment in modern infrastructure, equipment, and continuous professional development for instructors is essential to enhance training quality and relevance.
- Stronger collaboration between TVET institutions and industry should be promoted to align training with labor market demands.
- Further research should focus on regional comparisons, long-term impacts, and the role of digital technologies in improving quality assurance in Kenya's TVET system.

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Q & A

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Strengthening Quality Assurance to Enhance the Relevance of Qualifications in Digital-Green Transitions

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Introduction

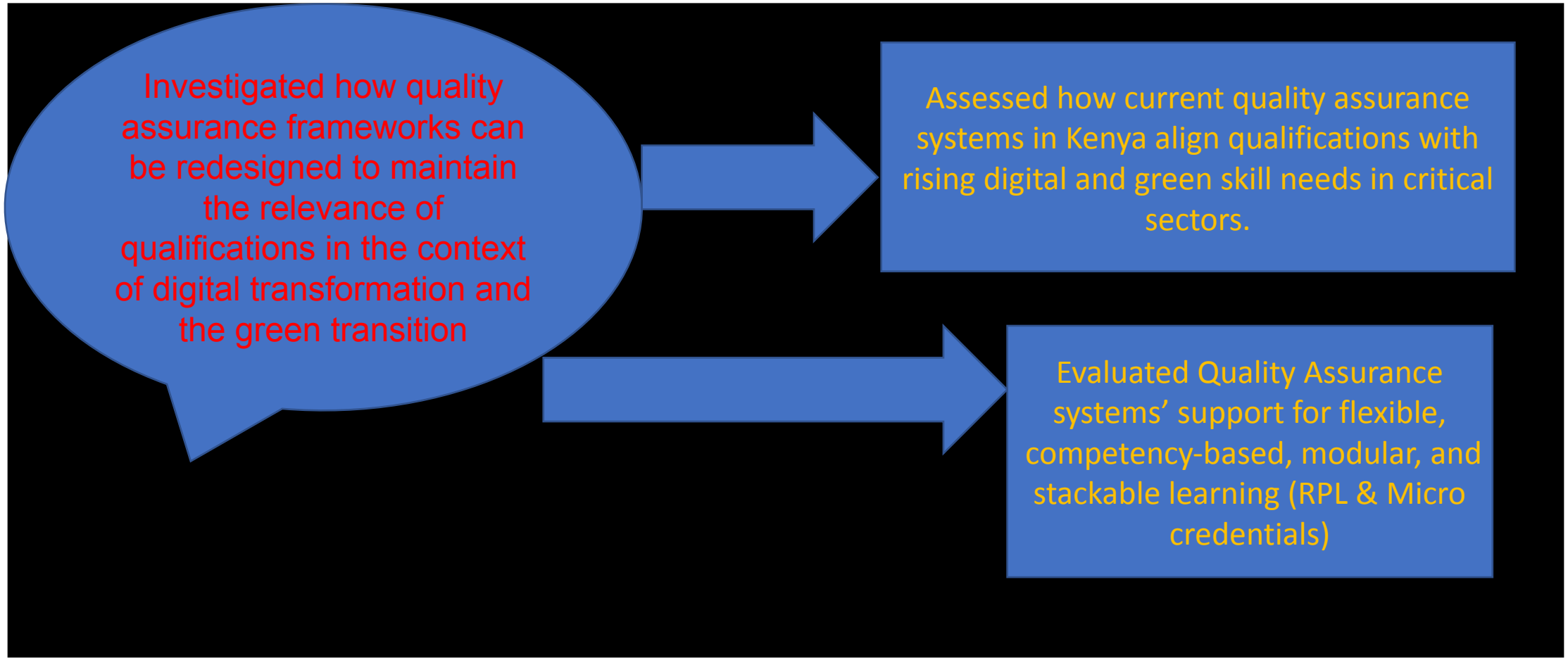
The world of work is changing rapidly due to digital transformation and the shift towards greener economies.

- Skills demand is shifting to digital green hybrids
- Current Quality Assurance and training models are misaligned
- Quality Assurance reform priorities to improve relevance and mobility

Problem Statement

- Existing quality assurance processes remain rigid and slow to respond to rapidly evolving industry needs.
- Institutional processes such as accreditation and curriculum approval are often slow, and some institutions still rely on traditional teaching models.
- Limited clarity on how micro-credentials should be defined and quality assured.
- Lack of clear rules, agreed standards, and strong collaboration between institutions.

Objectives


Investigated how quality assurance frameworks can be redesigned to maintain the relevance of qualifications in the context of digital transformation and the green transition
Assessed how current quality assurance systems in Kenya align qualifications with rising digital and green skill needs in critical sectors.
Evaluated Quality Assurance systems' support for flexible, competency-based, modular, and stackable learning (RPL & Micro credentials)

Methodology

A desk review was conducted on policy documents, reports, and frameworks related to QA, CBET, micro-credentials, and RPL.

A structured document analysis method was used to examine issues such as accreditation timelines, the flexibility of training programmes, the integration of RPL, and the use of digital credentials

A rapid desk review of online job postings was conducted, which helped to highlight the growing demand for hybrid skills in Kenya's labour market and provided evidence of gaps between training outcomes and employer needs

Methodology

The study used purposive and convenience sampling methods.

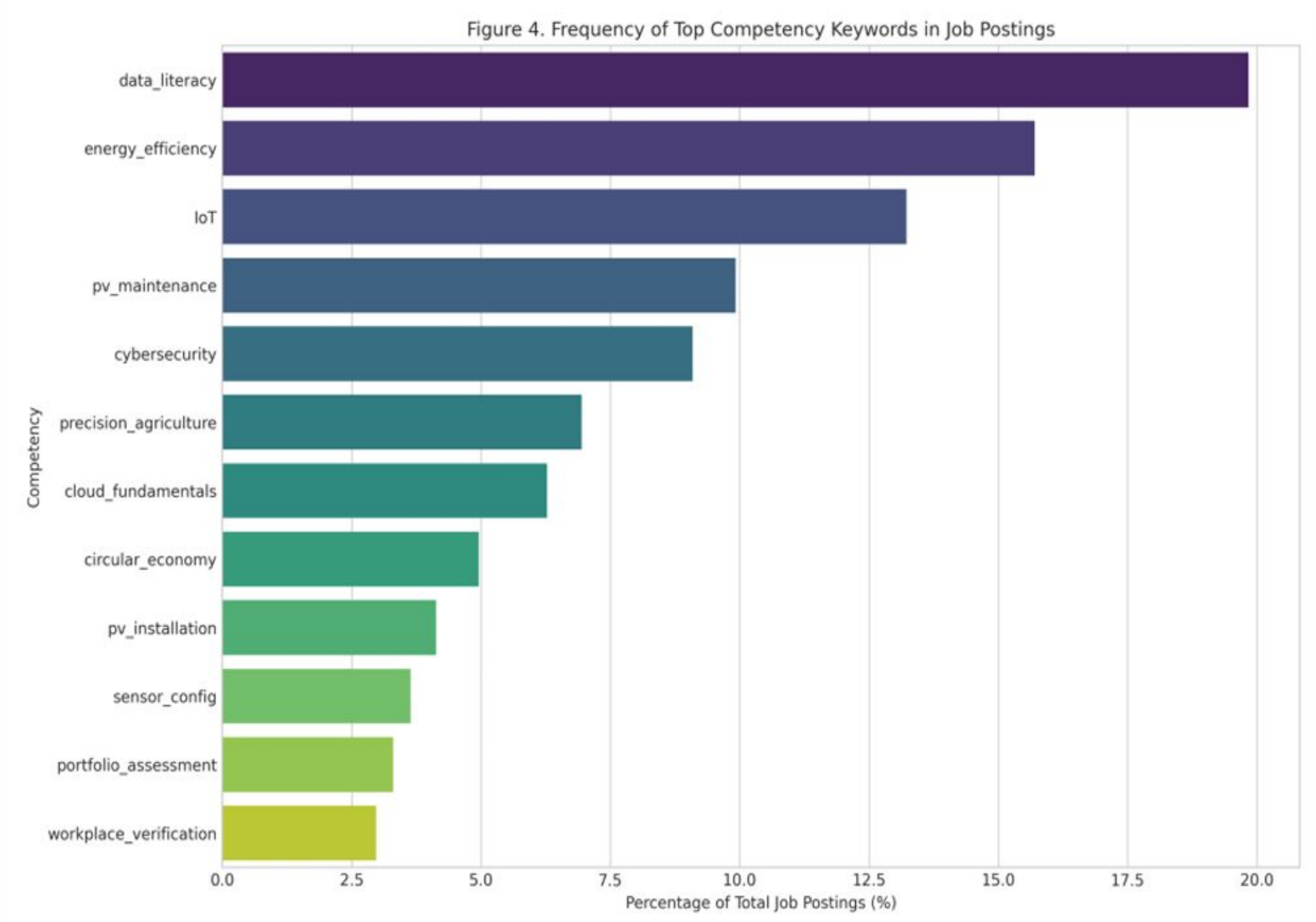
- Purposive sampling was applied to select key documents involved in Kenya's TVET and KNQA systems.
- Convenience sampling was used, where access to data was based on availability, especially for policy documents and job market data that could be accessed within the study timeline

Findings (Aligning qualifications with digital-green skills need)

Competency cluster	Category	Frequency rank
Data literacy / data analysis	Digital	1
Energy efficiency / sustainability practices	Green	2
IoT / remote monitoring	Digital	3
PV system installation / maintenance	Green	4
Cybersecurity awareness	Digital	5
Precision agriculture / sensor use	Green	6
Cloud fundamentals	Digital	7
Circular economy / waste reduction	Green	8

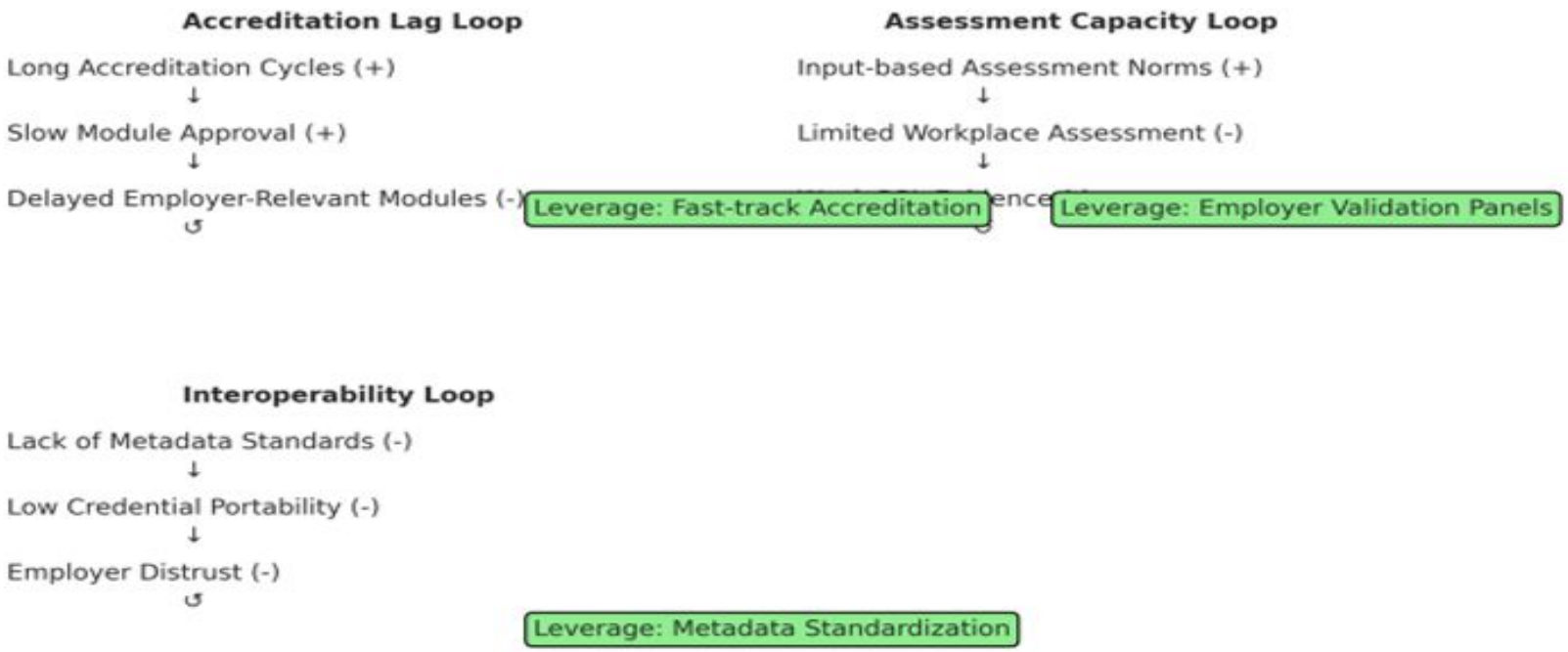
The table highlights how digital and green competencies are increasingly interdependent, showing that the digital–green transition relies on a blended skillset where data, connectivity, sustainability, and technical green capabilities reinforce one another.

Findings (Online job postings)



Findings (QA Systems)

Figure 3. Causal Loop Diagram: QA System Bottlenecks and Leverage Points



Summary of findings

- More effort is needed to fully apply competency-based QA approaches, integrate micro-credentials and Recognition of Prior Learning (RPL) into formal systems, strengthen digital methods for verifying qualifications, and improve coordination among institutions and stakeholders.
- There is significant demand for hybrid skills in Kenya's labour market
- QA systems are still slow and not fully aligned with competency-based approaches
- Persistent systemic constraints that limit the full operationalisation of the KNQF

Conclusion

- Micro-credentials are not yet fully integrated into credit accumulation and transfer (CAT) systems, and RPL remains inconsistently implemented
- There is a need for strong QA frameworks to fully support Kenya's digital-green transition
- Kenya's regulatory timelines are misaligned with the rapid evolution of labour-market needs, particularly in the digital-green transition.
- There is still limited clarity on how micro-credentials should be defined and quality assured.

Reccomendations

Enablers for KNQF Alignment and Quality Assurance

- Accreditation reforms
- Competency-Based Assessment
- Micro-credentials and RPL
- Employee-Led Validation
- Digital Verification Standards

Recommendations

- Revising quality assurance standards to formally recognize micro-credentials and RPL evidence
- Adoption of competency-based QA criteria that support modular and stackable learning pathways
- Establishment of employer-led validation panels within accreditation cycles to improve responsiveness
- Integration of digital verification mechanisms and metadata standards to facilitate the portability of micro-credentials across qualification frameworks.
- Employers and industry stakeholders should play a stronger role in validating qualifications.
- Strengthen digital systems for verifying and sharing qualifications.

Future Research

- Collect quantitative data through surveys and interviews for Key informants, focus group discussions, and other stakeholders to validate the data from the desk review.

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Strengthening Quality Assurance for Relevant Qualifications in Kenya
A Decade of Transformation Toward Lifelong Learning and Employability

Presenters:

1.Beatrice Kirui

2.Abraham Korir

3.Agnes mitheko

Institution: Rift Valley National Polytechnic

1st National Qualifications Conference 2026

12th – 14th May 2026 | Emara-Ole Sereni

background study 1

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Worldwide Context

Market Demand: The demand for competency-based, job-ready skills continues to increase globally, while the value of theoretical knowledge in the workplace is decreasing.

Curriculum Gap: The outcome of traditional curricula is typically less relevant to the real world than the outcomes demanded by the marketplace.

International Pressure: The global community is pressuring education systems to produce graduates with measurable competencies – not just paper certificates.

Bottom Line: The world is moving from what you know to what you can do

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Background of the study 2(kenya context)

Policy	Purpose
ey Reforms	
Kenya National Qualifications Framework (KNQF)	Establish and align qualifications across different education levels
Competency Based Education & Training (CBET)	Shift from content coverage to gaining practical, job-ready competencies
Recognition of Prior Learning (RPL)	Allow workers to gain formal qualifications for skills acquired outside formal education

Role of Quality Assurance in Achieving Reform Goals
The Core Challenge

- Without robust Quality Assurance (QA) mechanisms, even well-designed reforms risk failure.
- Qualifications may lose credibility if competency claims are not verifiable.
- Learners could acquire certificates that do not reflect actual competencies – undermining trust in the system.
- Focus Areas of This Study
- Quality – Establishing reliable QA frameworks for CBET and RPL under KNQF.
- Inclusion – Ensuring QA systems accommodate diverse learners, including those in informal sectors.
- Employability – Linking verified competencies directly to labor market success

Problem statement

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- Despite a decade of reforms, significant implementation challenges persist
- Inconsistent application of quality assurance (QA) policies across institutions
- Variations in quality standards among different regulatory agencies
- Limited and uneven industry participation in training and assessment
- Mismatch between qualifications and labour market needs
- Recognition of Prior Learning (RPL) underutilized
- Limited institutional capacity development (skills, resources, infrastructure)
- Weak monitoring and evaluation systems affecting performance assessment

General objective

- To analyze progress in quality assurance and relevance of qualifications in Kenya (2016-2026)

Specific objectives

1. Determine current status of QA measures .

2. Assess alignment between qualifications and labor market.

3. Identify challenges in QA and relevance.

Justification of the study

- Policy Need, CBE implementation (Grade 10-12) and RPL underway; mid-course corrections needed
- Labour Market Requirement: 800,000+ young Kenyans join workforce annually; low-quality qualifications waste resources
- Regional Influence:Kenya is signatory to EAC and AfCFTA; qualifications framework has regional importance
- Critical Insight: Without timely QA strengthening, Kenya risks producing a generation of graduates with certificates but no competencies.

Significance of the study

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This research is relevant for:

- **Policy Makers (KNQA, TVETA):** Provides evidence for strategic adjustments.
- **QA Personnel & Educators:** Offers practical lessons to enhance internal QA systems.
- **Employers:** Highlights the role of credible QA in building trust in qualifications.
- **Researchers:** Contributes to the African discourse on QA as a driver of lifelong learning and economic growth.

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Knowledge gap

- No **longitudinal perspective** on Kenya's QA transformation.
- Little **empirical data** on QA consistency across public vs. Private, formal vs. non-formal institutions.
- Lack of studies linking **QA practices directly to graduate employment outcomes**.
- Sparse exploration of **technology-enabled QA** (e.g., digital dashboards).
- Detailed analysis of industry engagement in assessment

Literature review

- **Progress & Persistent Gaps**

Achievements:

- KNQF (2014) established KNQA
- CBET curriculum guidelines (2017)
- National RPL Policy (2022)
- TVET Act (2013) that established TVETA
- National Education Sector strategic plan 2023-2027

Remaining Challenges:

- Inconsistent QA policy implementation (Oboko et al., 2019)
- Limited stakeholder engagement (Karanja & Mburu, 2021)
- Inadequate QA staff capacity building (Njeru, 2022)

Lieratture review (case studies)MathengeTTI

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- First RPL Graduation in Kenya (December 2025)
- Graduands certified 61 students
- Artisans from housing project 39
- Trades included Construction, mechanics, carpentry, metal work, agriculture

Strategic Partnerships:

- State Department for TVET (RPL Delivery Unit)
- State Department for Housing
- Affordable Housing Programme contractors

- Quality Assurance Implication: Rigorous competency-based assessments + industry partnerships = Relevant qualifications

Case study 2(University of Nairobi)

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- RPL Practitioner Training (July 2025)
- Programme: 5-day RPL Practitioner Level 2 Training
- Participants: APVOTIK members + professionals from various sectors

Training Content:

- Advanced RPL assessment skills
- Candidate counseling
- Verification of prior learning
- KNQA standards alignment
- RPL Management Information Systems

- Key Quote:
- "A vital step in strengthening Kenya's national qualifications framework" – Prof. Ann Aseey, Lead Trainer

Research methodology

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- **Design:** Qualitative Policy Analysis.
- **Scope:** Kenya's education sector (TVET, universities, non-formal centers).
- **Timeframe:** 2016 – 2024.
- **Sampling:** Purposive selection of:
  - 4 key national policy documents (e.g., KNQF Act, CBET guidelines).
  - 4 institutional QA self-assessment reports.
- **Analysis:** Thematic analysis using NVivo 12 (Braun & Clarke's 6 phases).

Key Findings

Success Indicator	Evidence
Accreditation Coverage	80% of TVET institutions accredited (KNQA report, 2023).
Public Confidence	67% of employers trust CBET graduates' skills (survey, n=200).
RPL Pilots	Completed in 5 counties for informal sector workers.
National QA Database	KNQA online portal tracks registered qualifications

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Gaps

- Three factors explain the gap between policy and practice:
- **Resource Constraints:** Lack of dedicated QA officers, monitoring budgets, and digital tools.
- **Change Fatigue:** Rapid successive reforms have overwhelmed trainers.
- **Weak Accountability Loops:** QA findings rarely lead to sanctions or rewards.
- ➡ **Industry Engagement is low** because employers see no immediate returns; partnership remains voluntary without formal incentives.

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Conclusions

- **Progress is Real:** Kenya has established a comprehensive QA architecture (KNQF, CBET, KNQA, RPL policy).
- **Effectiveness is Uneven:** Accreditation has improved, but implementation is inconsistent.
- **Key Gaps Remain:** Weak industry participation, low RPL uptake, minimal technology use.
- **The Journey is Incomplete:** Sustained commitment and targeted institutional development are critical for a mature, lifelong learning-oriented QA system.

Recommendation

For	Key Actions
KNQA	Mandate annual QA audits with public scorecards; develop a national digital QA dashboard.
Training Institutions	Establish dedicated QA units; link trainer evaluation to QA outcomes.
Industry/Employers	Create formal industry QA committees; offer tax incentives for active participation.
RPL	Train & accredit 500+ assessors within two years; subsidize fees for informal workers.
Technology	Pilot a **blockchain-based credentialing system** for transparency & portability.

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- *"Strengthening internal QA systems, enhancing M&E, and fostering authentic industry partnerships are not merely beneficial – they are essential for credible, responsive, and globally competitive qualifications."*

- THANKYOU

BAYESIAN RELIABILITY MODEL FOR

Recognition of Prior Learning

A Hierarchical Probabilistic Framework for
RPL Assessment Quality Assurance under the KNQF

Saina Philiph Kipkosgei

Academic Officer, Sensei Institute of Technology | PhD Candidate, University of Eldoret

Conference Theme: Quality Assurance and Relevance • Sub-theme: Quality Assurance in RPL Processes

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ROADMAP

Presentation Overview

01 **Introduction & Context**

RPL in Kenya, the KNQF, and the reliability challenge

02 **Research Problem & Objectives**

Gap in probabilistic quality benchmarks

03 **Theoretical Framework**

Bayesian vs classical approaches to reliability

04 **Methodology**

Data, hierarchical model, MCMC estimation

05 **Results**

Variance components, ICC, reliability coefficients

06 **Discussion & Implications**

Cluster heterogeneity, equity dimensions

07 **Policy Recommendations**

KNQA benchmarks and monitoring framework

INTRODUCTION

What is Recognition of Prior Learning?

RPL evaluates competencies acquired through informal experience, workplace practice, self-directed learning, and community-based knowledge — outside traditional classrooms.

Heterogeneous Evidence

A decade of site experience, frontline clinical practice, or self-taught digital skills cannot be reduced to a single test score.

Reliability Challenge

Ensuring equally competent candidates receive consistent judgements regardless of assessor, institution, or sector.

Social Equity Imperative

RPL candidates are often from populations excluded from formal credentials — marginalised workers, rural communities, informal economy.

"...competencies accumulated through informal experience cannot be evaluated with standardised tests without substantial loss of validity." — Harris (2000)

CONTEXT

RPL under Kenya's National Qualifications Framework

10
KNQF Levels

12,400+
RPL Applications (2016–2023)

8,457
Successful Candidates

68.2%
National Pass Rate

The KNQF (Act No. 22 of 2014) maps competencies from basic literacy through doctoral level. RPL is an explicit pathway for recognition of informal and non-formal learning at any KNQF level.

Dimension	KNQF Position
Governing Body	Kenya National Qualifications Authority (KNQA)
Legal Basis	KNQF Act No. 22 of 2014; TVET Act No. 29 of 2013
Accredited Institutions	47 institutions across 10 occupational sectors (by 2023)
RPL Definition	Measuring and adjudicating learning from formal, non-formal, or informal sources against qualification requirements

PROBLEM STATEMENT

The Core Reliability Problem in RPL

Between 8% and 24% of RPL outcome variance is attributable to which assessor a candidate encountered — not to the candidate's actual competency.

No Probabilistic Benchmarks

Regulators cannot quantify confidence in reliability estimates

Unquantified Assessor Variance

Inconsistency is identified anecdotally, not statistically

No Predictive Tools

No models predict candidate progression probabilities

Small Sample Sensitivity

Classical methods fail with small RPL panel datasets

Missing Data Patterns

Not all candidates are assessed by all assessors

KNQA's Own Diagnosis

'Assessor variability remains unquantified and therefore unmanaged' — KNQA (2019)

RESEARCH OBJECTIVES

Objective 1 | Variance Partitioning

Construct a Bayesian hierarchical model that partitions RPL assessment outcome variance into assessor-level, candidate-level, and residual components across occupational clusters.

Objective 2 | Reliability Benchmarks

Derive posterior reliability coefficients and credible intervals for assessor consistency, providing statistically defensible quality benchmarks.

Objective 3 | Predictive Validity

Estimate predictive probabilities of candidate progression as a function of latent competency scores, generating a probabilistic RPL outcome prediction tool.

Objective 4 | High-Variance Contexts

Identify occupational clusters where assessor inconsistency poses the greatest threat to RPL reliability and make targeted QA recommendations.

LITERATURE REVIEW

Approaches to RPL Reliability Estimation

Classical Test Theory (CTT)

Reliability = true score variance / total variance
Cannot handle hierarchical data; sensitive to sample size

Generalisability Theory (G-Theory)

Decomposes variance into multiple facets (assessors, occasions, tasks)
Frequentist — struggles with small samples & missing data

Bayesian Hierarchical Models

Parameters as probability distributions, not point estimates
Handles small samples, missing data, and unbalanced designs
Yields credible intervals directly actionable for governance

This study represents the FIRST application of Bayesian hierarchical modelling to RPL reliability within an African national qualifications framework context.

THEORETICAL FRAMEWORK

Why Bayesian Methods for RPL Reliability?

1

Hierarchical Structure

Candidates nested within assessors, within institutions, within clusters — naturally modelled by Bayesian hierarchical models that partition variance appropriately across levels (Gelman et al., 2014).

2

Small Sample Robustness

RPL assessor panels and niche occupational clusters have limited data. Bayesian partial pooling stabilises estimates where classical methods fail.

3

Credible Intervals for Governance

Posterior distributions yield credible intervals with natural probabilistic meaning:
'95% probability the true parameter lies in this range' — directly actionable for regulatory decision-making.

4

Incorporates Prior Knowledge

Historical assessment variance from institutional QA systems can be formally encoded in prior distributions, making full use of accumulated knowledge.

METHODOLOGY

Data Sources and Sampling Strategy

1,890
Candidate Records

97
Assessors

33
Institutions

6
Occupational Clusters

Data Period: 2016–2025 • Source: Kenya National Qualifications Authority (data sharing agreement KNQA/RES/2024/017) • All data fully anonymised

Occupational Cluster	Institutions	Assessors	Candidates
Construction & Civil Engineering	7	21	438
ICT and Digital Services	6	18	362
Healthcare & Allied Health	5	15	291
Agriculture & Agri-processing	6	17	319
Business & Financial Services	5	14	266
Hospitality & Tourism	4	12	214

Bayesian Hierarchical Model Specification

Model Equations

$$y_{ij} \sim \text{Bernoulli}(p_{ij})$$

$$\text{logit}(p_{ij}) = \alpha + \theta_i + u_j$$

$$\theta_i \sim \text{Normal}(0, \sigma^2_{\text{candidate}}) \quad \text{[latent competency]}$$

$$u_j \sim \text{Normal}(0, \sigma^2_{\text{assessor}}) \quad \text{[assessor effect]}$$

$$\alpha \sim \text{Normal}(\text{logit}(0.682), 0.15^2) \quad \text{[grand mean]}$$

$$\sigma_{\text{candidate}} \sim \text{HalfNormal}(0, 0.5)$$

$$\sigma_{\text{assessor}} \sim \text{HalfNormal}(0, 0.5)$$

y_{ij}

Binary outcome: pass(1) or refer/fail(0) for candidate i by assessor j

θ_i

Latent true competency — the quantity RPL is designed to measure

u_j

Assessor random effect — systematic leniency or severity bias

α

Grand mean centred on KNQA national pass rate of 68.2%

METHODOLOGY

Prior Distribution Specification

Priors are weakly to moderately informative, following Gelman et al. (2014). Historical KNQA data provides principled grounding.

Parameter	Prior Distribution	Justification
Grand mean (α)	Normal(0.68, 0.08^2)	KNQA national RPL pass rate 2016–2023: 68.2%
Assessor variance (σ^2_assessor)	InvGamma(2.5, 0.05)	Weakly informative; consistent with QA literature
Assessor random effect (u_j)	Normal(0, σ^2_assessor)	Uninformative; variance estimated from data
Candidate competency (θ_i)	Normal(μ + u_j, σ^2_e)	Hierarchical; assessor-nested structure
Residual variance (σ^2_e)	InvGamma(3.0, 0.10)	Weakly informative; bounded below
Progression threshold (τ)	Normal(0.60, 0.03^2)	KNQF minimum competency threshold: 60%

The grand mean prior directly encodes KNQA institutional knowledge — a key advantage over classical methods.

METHODOLOGY

Posterior Estimation via MCMC

Implementation

Stan probabilistic programming language (Carpenter et al., 2017) via RStan in R 4.3.1. Hamiltonian Monte Carlo (HMC) — preferred for complex posterior geometries.

Sampling Design

4 independent chains | 2,000 warm-up iterations + 4,000 sampling iterations per chain
= 16,000 post-warm-up samples per parameter

Why HMC over Gibbs?

Superior efficiency in high-dimensional parameter spaces; more reliable exploration of complex posterior geometries (Betancourt, 2017)

Non-Centred Parameterisation

Applied to random effects to improve sampling efficiency and eliminate divergent transitions in the hierarchical structure

Model Diagnostics Checklist

- Gelman-Rubin $\hat{R} < 1.01$ for all parameters (convergence)
- Effective Sample Size (ESS) > 400 for all parameters
- Posterior predictive checks: Bayesian p-values between 0.41–0.57 (no systematic misfit)
- Leave-one-out cross-validation (LOO-CV) for model comparison

METHODOLOGY

Reliability Coefficient and ICC Derivation

Posterior Reliability Coefficient (ρ)

$$\rho = \sigma^2_{candidate} / (\sigma^2_{candidate} + \sigma^2_{assessor} + \sigma^2_{e})$$

Assessor-Level ICC

$$ICC_{assessor} = \sigma^2_{assessor} / (\sigma^2_{assessor} + \sigma^2_{candidate} + \sigma^2_{e})$$

High ρ (→1)

Candidate latent competency drives outcomes — desired state

High ICC_assessor

Assessor identity explains outcome variance — quality risk

Posterior Distribution

Not a point estimate — a full probability distribution with credible intervals

RESULTS

MCMC Convergence and Model Diagnostics

All models achieved satisfactory convergence. No divergent transitions detected after non-centred parameterisations.

R̂ Range

1.000–1.008

All < 1.01 threshold

ESS Range

1,840–4,210

All > 400 threshold

Bayesian p-values

0.41–0.57

No systematic misfit

Divergent Transitions

0

After non-centred reparameterisation

LOO-CV Model Comparison: Full hierarchical model outperformed assessor-only model (ΔELPD = −38.4, SE = 6.2) and null model (ΔELPD = −214.7, SE = 18.9)

RESULTS

Assessor-Level ICC by Occupational Cluster

Posterior variance components and assessor intra-class correlation with 95% highest posterior density credible intervals (16,000 MCMC samples).

Occupational Cluster	ICC	σ^2_assessor	σ^2_candidate	95% Credible Interval
Construction & Civil Engineering	0.14	0.031	0.189	[0.009, 0.061]
ICT and Digital Services	0.09	0.018	0.181	[0.005, 0.038]
Healthcare & Allied Health	**0.22**	0.057	0.203	[0.028, 0.094]
Agriculture & Agri-processing	0.11	0.024	0.193	[0.007, 0.047]
Business & Financial Services	0.08	0.016	0.178	[0.004, 0.034]
Hospitality & Tourism	**0.19**	0.048	0.206	[0.021, 0.082]
Pooled (all clusters)	0.13	0.027	0.191	[0.011, 0.052]

⚠️ RED = ICC > 0.20 — substantial assessor-level bias threshold (Cicchetti, 1994). Priority QA intervention required.

RESULTS

Assessor ICC Across Clusters — Visual Comparison

RESULTS

Posterior Reliability Coefficients & Predictive Validity

Pooled posterior reliability coefficient ρ = 0.81 — broadly 'good' by international psychometric benchmarks (Cicchetti, 1994; Koo & Mae, 2016).

Occupational Cluster	ρ	95% CI	P(pass | competent)	P(fail | not competent)
Construction & Civil Engineering	**0.81**	[0.76, 0.86]	0.87	0.83
ICT and Digital Services	**0.86**	[0.82, 0.90]	0.91	0.88
Healthcare & Allied Health	**0.73**	[0.67, 0.79]	0.80	0.76
Agriculture & Agri-processing	**0.84**	[0.79, 0.88]	0.89	0.85
Business & Financial Services	**0.87**	[0.83, 0.91]	0.92	0.89
Hospitality & Tourism	**0.76**	[0.70, 0.82]	0.83	0.79
Pooled (all clusters)	**0.81**	[0.78, 0.85]	0.87	0.83

P(pass | competent): probability a genuinely competent candidate ($\theta_i > \tau = 0.60$) receives a pass. P(fail | not competent): probability non-competent candidate receives refer/fail.

RESULTS

Error Rates — The Equity Dimension

13%

Competent candidates incorrectly referred/failed (POOLED)

17%

Non-competent candidates incorrectly passed (POOLED)

20%

Healthcare false-negative rate (highest cluster)

Why This Matters for Equity

- RPL candidates are disproportionately drawn from populations without access to formal education — women in the informal economy, rural agricultural workers, historically excluded communities.
- A 13% systematic error rate in identifying competent candidates as incompetent is not a technical abstraction — it represents a failure to recognise the legitimate competencies of economically marginalised individuals.
- The Bayesian framework makes this error rate precisely estimable and directly actionable — a decisive advantage over classical reliability methods.

RESULTS

Individual Assessor-Level Posterior Estimates

15 / 97
Assessors with Credible Systematic Bias ($u_j \neq 0$)

9
Consistent Leniency (positive u_j)

6
Consistent Severity (negative u_j)

Most extreme effects:

Most Lenient Assessor

$u_j = +0.48$ log-odds
95% CI: [0.21, 0.76]

Equivalent to a +12 percentage point shift in pass probability for an average-competency candidate

Most Severe Assessor

$u_j = -0.41$ log-odds
95% CI: [−0.68, −0.15]

Equivalent to a −10 percentage point shift in pass probability for an average-competency candidate

11 of 15 biased assessors were from healthcare and hospitality clusters — consistent with elevated cluster ICC values.

DISCUSSION

Interpreting Cluster-Level Heterogeneity

Why do healthcare and hospitality show higher assessor ICC?

Relational Competencies (Healthcare, Hospitality)

These sectors require assessment of care quality, client interaction, professional conduct, and attitudinal competencies — inherently more subjective and less amenable to standardised portfolio evidence than technical skills.

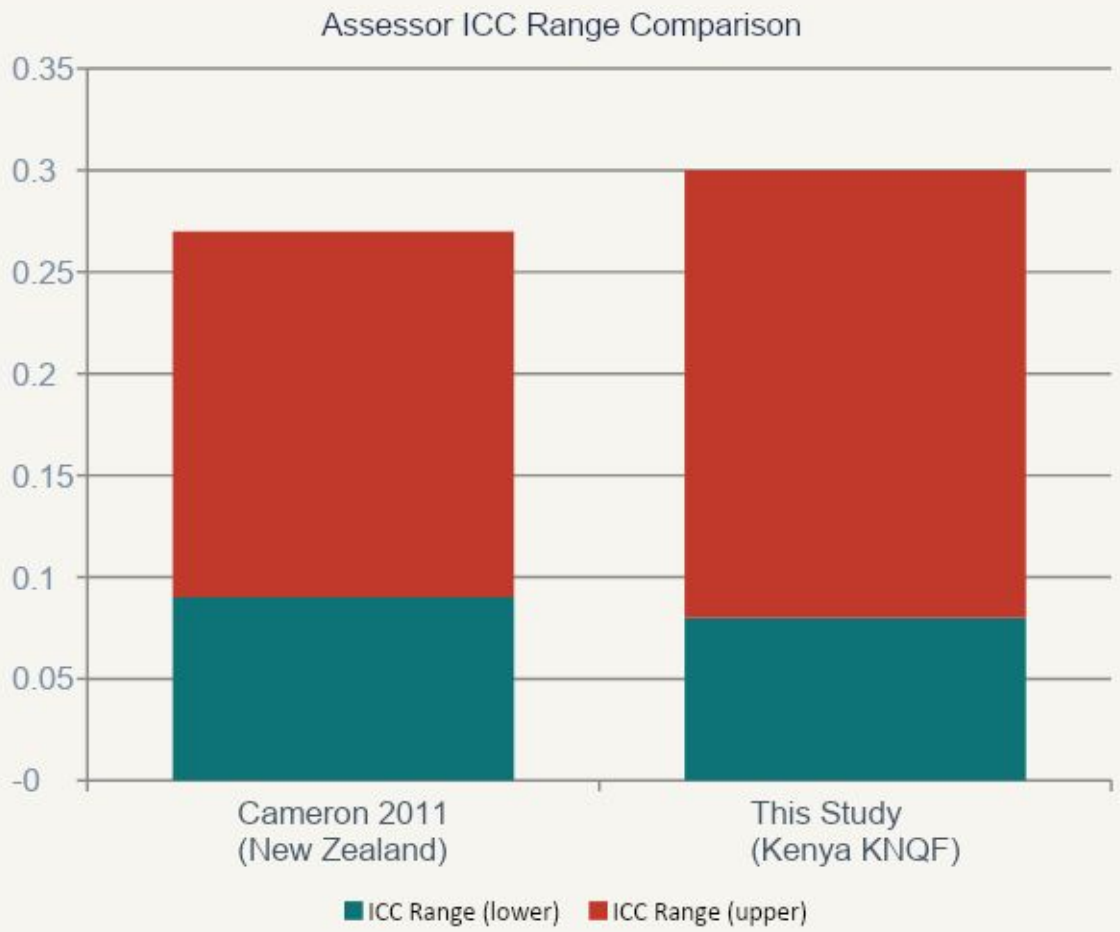
Technical Competencies (ICT, Business)

Competencies in ICT (software skills, coding, system administration) and business services (accounting, process management) can be demonstrated through concrete, verifiable portfolio artefacts — enabling more consistent assessor judgements.

Consistent with Cameron (2011) — New Zealand and Wheelahan et al. (2012) — multi-country studies on RPL reliability variation across competency domains.

DISCUSSION

International Comparison



Kenya's KNQF RPL system is neither unusually reliable nor unusually unreliable — it is typical of competency-based RPL systems globally.

DISCUSSION

Advantages over Classical and G-Theory Approaches

Feature	Classical / G-Theory	Bayesian Hierarchical (This Study)
Classical G-Theory	Single ICC point estimate	**Full posterior distribution with credible interval**
Classical G-Theory	Average inconsistency across all assessors	**Individual assessor posterior — direction, magnitude, and uncertainty**
Classical G-Theory	Sensitive to small samples	**Partial pooling stabilises estimates with limited panel data**
Classical G-Theory	Cannot incorporate historical data formally	**Prior distributions formalise institutional knowledge**
Classical G-Theory	Point estimate reliability — no predictive tool	**Posterior predictive probabilities of candidate progression**
Classical Moderation	10–15% sample — may miss systematic bias	**Full-data Bayesian pooling detects assessor effects more reliably**

Establishing Probabilistic Reliability Benchmarks in KNQF Policy

$\rho \geq 0.75$	**Reliability Threshold** Required for continued institutional accreditation across all occupational clusters
$ICC \leq 0.20$	**ICC Ceiling** Assessor-level ICC must not exceed this in any cluster without a formal remediation plan
u_j CI excludes 0	**Bias Detection** Institutions with assessors showing credible systematic bias must implement targeted calibration within 2 assessment cycles

Benchmarks derived from Cicchetti (1994) and Koo & Mae (2016) and calibrated against study results.

POLICY RECOMMENDATIONS

Targeted QA Investments and Monitoring Infrastructure

Priority Sector Interventions (Healthcare & Hospitality)	Mandatory annual assessor calibration workshops with benchmark portfolios Double-blind assessment for KNQF Level 4+ RPL applications Structured observation protocols for relational/attitudinal competencies Partner with Nursing Council of Kenya, Tourism Regulatory Authority
KNQA Monitoring Infrastructure	Invest in standardised digital record-keeping across accredited institutions Dedicated RPL Data Analyst role in KNQA Quality Assurance Directorate Annual Bayesian reliability updates replacing ad hoc moderation Public-facing reliability reporting dashboard for institutions, candidates, employers
Regional & International Exchange	Framework directly transferable to Uganda (UNEB) and Tanzania (NECTA) Share findings through EAC Regional Qualifications Framework Technical Committee Model for operationalising EAC-RQF mutual recognition quality standards

CONCLUSION

From Averages to Probability — A New Framework for RPL Quality Assurance

ρ = 0.81 (Pooled)	Good reliability overall — comparable to international competency-based RPL systems
Healthcare: ρ=0.73, ICC=0.22	Highest priority cluster for QA intervention — substantial assessor-level bias
15 Assessors Flagged	Credible systematic bias identified — operationally actionable for calibration
13% False-Negative Rate	Competent candidates incorrectly failed — equity imperative for KNQA action

"RPL is, at its best, a mechanism for educational justice. The Bayesian framework provides the KNQA with statistical tools to pursue that imperative with rigour, transparency, and the probabilistic honesty that the complexity of RPL assessment requires."

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