American Journal of Humanities and Social Sciences Research (AJHSSR)
e-ISSN : 2378-703X
Volume-10, Issue-08, pp-44-57
www.ajhssr.com
Research Paper Open Access

Influence of Teacher Professional Development Total Quality Management (TQM) practices on learners' academic achievements in integrated science in junior schools in Bomet County, Kenya.

Peris Cherotich Kerich[1], Prof. Tony Okwach [2], and Dr Richard Maite Sigilai[3]
[1] *Educational Management and Policy Studies, Bomet University, Kenya*
[2] *Curriculum Instruction and Educational Media, Bomet University, Kenya*
[3] *Educational Management and Policy Studies, Bomet University, Kenya*

ABSTRACT : Academic achievement in Integrated Science among Junior School learners in Bomet County serves as the main dependent variable of this study, set against a backdrop of persistent underperformance that jeopardizes Kenya Vision 2030's goal of transitioning 60% of learners into Senior School STEM pathways. Diagnostic baseline data revealed that over 60% of learners in the 2023 KPSEA, Grade Seven and Eight School-Based Assessments, and 2025 KJSEA performed at or below "Approaching Expectations," mastering only 30% to 40% of key scientific skills. To address this performance gap, the study evaluated four Total Quality Management (TQM) dimensions, focusing on Teacher Professional Development (TPD) as the primary independent predictor of academic achievement. Guided by a pragmatist philosophy, the study utilized a mixed-methods concurrent triangulation design. From a target population of 21,653 individuals across Bomet County,comprising 5 Sub-County Directors of Education (SCDEs), 541 Grade Nine parents' representatives, 541 Heads of Institutions (HOIs), 541 Integrated Science Facilitators (ISFs), and 20,025 Grade Nine learners—a total sample of 3,050 participants was involved. Yamane's formula and proportionate stratified random sampling were used to select a quantitative sample of 230 HOIs (N = 194 valid responses returned), while qualitative data involved 5 SCDEs, 23 parents' representatives, and 36 classroom observations encompassing 36 ISFs and 2,756 Grade Nine learners. Data were gathered via questionnaires, interview guides, observation checklists, and document analysis. Instrument reliability was confirmed with a Cronbach's alpha of alpha = .86 for the HOI questionnaire following a pilot study in Kericho County. Quantitatively, TPD recorded a high implementation level (M = 3.75,SD = .592, . Simple linear regression confirmed TPD as the strongest predictor of learner achievement, uniquely accounting for 19.6% of performance variance (R^2 = .196, beta = .442, p < .001). However, qualitative observations uncovered a critical implementation gap, including an 86.1% deficiency in ICT integration, overcrowded classrooms exceeding 40 learners, and compliance-driven administrative supervision. The study concludes that improving academic outcomes requires educational management to shift from rigid inspections to continuous instructional coaching that aligns TPD with practical classroom realities, hands-on laboratory work, and effective large-class strategies.

KEYWORDS : *Teacher Professional Development, Integrated Science Education, Total Quality Management (TQM), Academic Achievement*

I. INTRODUCTION

Total Quality Management (TQM) is an integrative, systemic management philosophy designed to embed institutional quality across operational facets through collaborative teamwork, workforce empowerment, process optimization, and evidence-based benchmarking ([1] [2] Originating in industrial management and formalized through the foundational theoretical frameworks of [3] [4] [5], TQM has increasingly been adapted to educational systems to elevate pedagogical standards and learner outcomes [6] [7]. Within educational institutions, TQM functions as a strategic framework that aligns administrative governance and resource distribution with active classroom instruction ([8]. By uniting institutional leadership, instructional staff, and local communities under a shared vision of continuous improvement, TQM establishes an organizational culture of excellence that optimizes academic performance while driving broader socio-economic advancement [9] [10] [11].

The International Organization for Standardization (ISO 9001:2015) codifies the core tenets of quality management as leadership commitment, customer focus, process management, continuous improvement, evidence-based decision-making, and stakeholder engagement. To adapt these global standards to the operational realities of Junior Schools in Bomet County, Kenya, this study synthesizes these constructs into four targeted, high-impact administrative dimensions managed by the Head of Institution (HOI) as the principal Quality Enabler: Teachers' Professional Development (TPD) [12] [13] [14]. Recent scholarship emphasizes that administrative quality systems achieve optimal impact when they directly permeate classroom-level instructional practices [15].

Teachers' Professional Development (TPD) represents the primary pedagogical engine bridging administrative oversight with student achievement. Within the TQM framework, TPD is operationalized through structured capacity building, clinical mentoring, and pedagogical retooling tailored to the Competency-Based Education (CBE) model. Stakeholder engagement within the TPD pillar fosters collaborative professional networks through joint lesson planning and peer study among science educators. Customer focus ensures that professional development interventions directly address learners' specific cognitive gaps and instructional needs in Integrated Science. Process management institutionalizes continuous professional learning via formal coaching, peer observations, and school-based workshops, while continuous improvement promotes reflective practice and pedagogical refinement. This enables facilitators to transition from traditional, teacher-centered instruction to active, inquiry-based scientific pedagogy that directly improves student mastery [16] [15].

Overarching these pillars is Deming's Plan–Do–Study–Act (PDSA) cycle of Continuous Improvement, which provides the administrative mechanism for school leaders to systematically evaluate academic outcomes, identify instructional bottlenecks, and implement data-informed interventions [17].

Globally, Competency-Based Education (CBE) has emerged as the dominant framework for aligning educational delivery with practical skill acquisition and problem-solving [18] [19]. High-performing educational jurisdictions, such as Finland, Sweden, and Scotland, have successfully utilized CBE to enhance critical thinking and scientific inquiry through structured teacher training and digital integration [20] [21]. Conversely, across Sub-Saharan Africa, a severe "learning crisis" persists, where expanded physical school enrollment has failed to yield proportional learning gains due to inadequate instructional standards, underdeveloped laboratory infrastructure, and insufficient teacher preparation [22] [23]. Comparative studies across regional contexts—including Rwanda, Tanzania, and regional West Africa, confirm that science curricula remain heavily constrained by traditional, content-driven lecturing and limited teacher capacity to facilitate inquiry-based learning [24] [25] [26].

In Kenya, the national adoption of CBE under the Basic Education Curriculum Framework [27] positions Integrated Science as a foundational, interdisciplinary subject synthesizing biology, chemistry, physics, and earth sciences. Grounded in constitutional mandates [28] [29] targets transitioning 60% of junior school completers into Senior School Science, Technology, Engineering, and Mathematics (STEM) pathways. To achieve this, the Kenya Institute of Curriculum Development [30] mandates Inquiry-Based Learning (IBL) and Community Service Learning (CSL) as core instructional strategies. However, the successful implementation of these dynamic, practical methodologies depends entirely on continuous, high-quality professional development for science facilitators.

To support these curriculum reforms, Bomet County implemented localized quality management initiatives, including institutional leadership training through the Kenya Education Management Institute (KEMI) at the Kenya School of Government (KSG), alongside teacher retooling under the School-Based Teacher Support Systems (SBTSS) and Strengthening of Mathematics and Science in Secondary Education (SMASSE) programmes [31]. Despite these continuous training frameworks, academic achievement in Integrated Science among Junior School learners in Bomet County exhibits a persistent, alarming deficit.

National assessment baseline data from the 2023 Kenya Primary School Education Assessment (KPSEA) indicated that 49.09% of candidates nationally met or exceeded expectations in Science and Technology [32]. By contrast, 59.92% of learners in Bomet County scored at the "Approaching" or "Below Expectations" levels. This underperformance persisted across subsequent School-Based Assessments (SBAs), where 67.3% of Grade Seven learners and 62.3% of Grade Eight learners failed to achieve competency mastery. By the terminal 2025 Kenya Junior School Education Assessment (KJSEA), national mastery in Integrated Science reached 76.86% [33], yet Bomet County recorded a depressed mean score of only 31.63%, placing the majority of its cohort firmly in the lower "Approaching Expectations" tier (30–40% competency mastery) [31]. Comparatively, neighboring Kericho County—operating under similar socio-economic and resource conditions—maintained a terminal KJSEA Integrated Science mean of 41.06%, highlighting a critical 10 percentage-point gap and a net performance regression in Bomet County [32].

This regional achievement gap points directly to an execution deficit in administrative quality systems and classroom instructional delivery. Empirical findings from this study confirm that Teachers' Professional Development (TPD) is the single strongest predictor of academic achievement in Integrated Science among the four TQM dimensions, uniquely explaining nearly twenty per cent of the variance in student scores ($R^2 = .196$, beta = .442, $p < .001$). However, qualitative classroom evaluations revealed that TPD implementation remains severely hindered by an 86.1% deficiency in instructional ICT integration, severe classroom overcrowding (>40 learners per class), and administrative oversight that prioritizes compliance checking over hands-on instructional mentorship. Given the national mandate to transition 60% of junior school learners into STEM tracks under Kenya Vision 2030, Bomet County's persistent science deficit presents a significant structural threat to national development goals. Investigating the direct influence of TQM dimensions, specifically transforming administrative leadership into effective Teacher Professional Development and instructional support, provides a critical, evidence-based roadmap for elevating Integrated Science achievement across Junior Schools in Bomet County.

II. LITERATURE REVIEW

The global landscape of educational administration faces an unprecedented human capital crisis that threatens the sustainability of instructional systems. The UNESCO Institute for Statistics estimates that approximately 69 million new teaching positions will be required globally by 2030 to achieve universal primary and secondary education. Sub-Saharan Africa faces a particularly acute manifestation of this structural deficit, characterised by a 70% aggregate teacher shortage, with 90% of nations within the region experiencing severe staffing deficits at the secondary school tier.

Recent projections by UNESCO indicate that the region requires an immediate injection of approximately 15 million additional educators to meet its fundamental educational targets. Furthermore, the crisis is compounded by qualitative disparities; only 64% of primary school teachers in Sub-Saharan Africa possess the requisite professional qualifications, compared to a more competitive 71% in East Asia [34] [35].

This study addresses this critical gap in the literature by demonstrating that within the localised ecosystem of Bomet County, teacher recruitment, retention, and professional retooling mechanisms must be systematically embedded within Total Quality Management (TQM) frameworks to mitigate severe shortages and optimise learners' academic achievements in Integrated Science. It establishes that teacher quality cannot be treated as a mere administrative staffing concern; rather, it represents a core strategic quality pillar for actualizing national Science, Technology, Engineering, and Mathematics (STEM) goals under the Competency-Based Education (CBE) system.

[2] emphasize the importance of systematic, well-planned instructional activities that encompass a broad, versatile range of pedagogical skills. This underscores the baseline need for continuous improvement in teaching practices, drawing directly on [36] conceptualization of professional excellence. Moreover, implementing a comprehensive change management training architecture that actively involves all institutional stakeholders is essential for guiding staff through the internal adoption of new cultural and pedagogical paradigms.[37] affirm this operational necessity, noting that school managers must serve as proactive agents of change and innovation, fostering an institutional environment that supports continuous transformation and growth.

However, the empirical findings of this study unmask a profound disconnect within the change management cycle on the ground. Corroborating the management theories of [37], the Heads of Institutions (HOIs) in Bomet County actively viewed themselves as primary enablers of change, reporting that they robustly supported training initiatives and that external workshops successfully elevated instructional delivery.

Conversely, filling a major gap in the literature, direct classroom observations and institutional document analyses revealed that this administrative support was largely restricted to routine, superficial compliance, such as checking formatted lesson plans and schemes of work rather than the continuous, sustained peer-mentorship envisioned by [36]. Additionally, the document audit revealed that formal retooling records for structured internal mentorship and coaching were present in a low 41.7% of the sampled junior schools, exposing limited implementation of continuous support systems. This indicates that while top-down administrative training compliance is superficially met, authentic, learner-centred change management as conceptualise by [2] requires a deeper structural shift from passive documentation to hands-on, sustained pedagogical support.

Contemporary research by [37] emphasizes that Continuous Professional Development (CPD) programs should specifically target underperforming teachers, and recommends further empirical investigation into pedagogical innovations and technological integration within STEM education. This aligns closely with [39], who underscores the critical importance of teachers' personal digital literacy in facilitating the transition to innovative digital resources under the new curriculum mandates.

Regionally,[40] examined the impact of teacher professional development on job performance within the Nyamagana District of Tanzania, whereas this inquiry contextualizes these dynamics within the unique devolved educational realities of Kenya. Similarly, [41] explored the influence of teacher competence on academic performance within public schools in Kisii County, although their framework did not isolate the distinct instructional requirements of Integrated Science. This study finding reveals that, School heads in Bomet County junior schools maintained the belief that professional development successfully enhanced instructional strategies, ultimately resulting in a statistically significant relationship between professional development and learners' actual academic achievement scores in science.

Additionally, [42] found that teachers in Bomet East Sub-County were inadequately equipped to deliver specialised content, particularly within the lower implementation grades. While historical regional research identifies teacher competence as a basic, descriptive factor in education, this study establishes it as the critical engine of science achievement,

The empirical models indicate that learners' academic achievement in Integrated Science in Bomet County is heavily constrained by gaps in Resource Mobilisation combined with structural limitations in teacher capacity development. Specifically, regression analysis shows that Teacher Professional Development (TPD) was perceived by school administrators to maintain a statistically significant positive relationship with academic achievement (R^2=.196 =, p<.001). These metrics prove that while TPD is highly valued at the administrative level as an important driver of academic outcomes. Its direct predictive impact at the classroom level is completely neutralized by top-down delivery models, an acute lack of teacher agency, and systemic classroom resource constraints.

III. RESEARCH METHODS AND METHODOLOGY

3.1 Research Design

This study adopted a concurrent triangulation mixed-methods design (QUAN + QUAL$) to examine the influence of Total Quality Management (TQM) practices on Grade 9 learners' academic achievement in Integrated Science [43]. The quantitative strand utilized a cross-sectional survey to objectively evaluate TQM implementation and academic outcomes, while the qualitative strand employed descriptive phenomenology to capture the lived experiences of key stakeholders. Collecting and analyzing both datasets concurrently enhanced methodological transparency, minimized bias, and facilitated direct comparison to identify points of convergence or divergence across findings [44] [45].

3.2 Philosophical Paradigm

The study was grounded in pragmatism, drawing on dialectical pluralism to integrate quantitative and qualitative approaches for generating practical, context-sensitive findings [46] [47]. It adopted a hybrid ontology, viewing reality as both objective, where TQM practices operate within measurable administrative frameworks, and socially constructed through stakeholder experiences and institutional culture [48]. Correspondingly, a hybrid epistemology combined a positivist stance (using cross-sectional surveys to quantify TQM practices) with an interpretivism stance (using descriptive phenomenology to capture stakeholders' lived experiences). This dual orientation enabled a comprehensive evaluation of how TQM practices influence academic outcomes in Integrated Science.

3.4 Target Population

The study focused on various groups involved with junior schools in Bomet County, Kenya. It included all 541 registered junior schools in the region, as listed by the [49]. The population consisted of 541 Heads of Institution (HOIs), 541 Integrated Science Facilitators (ISFs), 20,025 Grade Nine students, 541 Grade Nine parents' representatives, and five Sub-County Directors of Education (SCDEs), totaling 21,653 participants for 2025. This aligns with the Basic Education Act [50], which governs the structure and management of basic education in Kenya and influences the implementation of CBE.

3.5 Sample Size and Sampling Procedures

Sample size selection in empirical research involves balancing statistical power and representativeness to allow valid generalizations. For the quantitative part, the target population included all 541 registered Heads of Institutions (HOIs) across public junior schools in Bomet County, Kenya. To capture macro-level administrative and quality management practices, the quantitative sample was limited to these institutional managers. Using Taro Yamane's basic formula at a 95% confidence level and a 5% margin of error (e = 0.05), a preliminary sample size of n = 230 HOIs was determined. Conversely, the sample size for the qualitative part was guided by principles of information richness, participant relevance, and data saturation rather than statistical formulas. Total population sampling was used for all five Sub-County Directors of Education (SCDEs), while purposive sampling was employed to select Grade 9 Parents' Representatives, Integrated Science Facilitators (ISFs), and Grade 9 learners.

The study implemented a concurrent triangulation mixed-methods sampling design, combining probability and non-probability techniques to maximize both external generalizability and contextual depth. For the quantitative strand, proportionate stratified random sampling was employed across all five sub-counties (Bomet Central, Bomet East, Konoin, Sotik, and Chepalungu) and their respective administrative zones. This stratification accounted for environmental variations across educational zones, while a simple random lottery technique was used within each zone to select individual schools, minimizing selection bias. Qualitative participant selection was nested directly within the sampled quantitative sites to facilitate robust methodological triangulation. Total population saturation sampling ensured the inclusion of all five Sub-County Directors of Education, providing complete administrative oversight regarding policy implementation, teacher professional development, and quality assurance. Within the selected schools, Grade 9 Integrated Science Facilitators were purposively sampled to evaluate how Total Quality Management principles translated into instructional practices, laboratory utilization, and classroom assessment. Similarly, Grade 9 learners were sampled during active Integrated Science lessons in accordance with national classroom organization guidelines to capture direct evidence on learner engagement and competency-based curriculum delivery. Finally, Grade 9 Parents' Representatives were purposively selected from school boards to provide qualitative insights into home–school collaboration, resource support, and institutional accountability. Nesting these key stakeholders within the primary quantitative sample allowed survey findings to be directly corroborated with classroom observations, document reviews, and lived stakeholder experiences.

3.6 Research Instruments

Data collection utilized a multi-instrument approach comprising structured questionnaires, semi-structured interview schedules, document analysis guides, and non-participant observation checklists to enable comprehensive empirical measurement and qualitative triangulation [51]. The primary quantitative instrument was a self-administered questionnaire for Heads of Institutions (HOIs) [52]. It consisted of three sections: demographics, TQM dimensions (resource mobilization, teacher welfare, and learner welfare), and Grade 9 Integrated Science academic achievement indicators (pedagogy and assessment techniques). Items were measured using a combination of 5-point Likert scales, dichotomous options, and multiple-choice formats [53].

Qualitative data were gathered through semi-structured, in-depth interview schedules administered to Parent Representatives and Sub-County Directors of Education (SCDEs). Utilizing probing techniques to refine responses [43] parent interviews evaluated home-school collaboration, communication channels, and parental involvement in academic progress, while SCDE interviews investigated policy execution, resource allocation, and continuous teacher professional development.

To corroborate primary data, a document analysis guide systematically audited key instructional and administrative records [54]. This included schemes of work, lesson plans, assessment rubrics, records of work, attendance logs, and student performance metrics extracted from the Competency-Based Assessment (CBA) portal to evaluate curriculum alignment and institutional TQM integration. Finally, classroom implementation was evaluated using a closed-ended observation checklist during live Grade 9 Integrated Science sessions [55]. The checklist captured real-time contextual data on instructional methodology, learner engagement, technology integration, and resource utilization during theory and practical lessons.

3.7 Validity and Reliability of Quantitative Instruments

To establish content validity, an expert panel evaluated the initial 80-item survey across four TQM objectives using a 4-point relevance scale. Both Item-Content Validity Index t{I-CVI} \ge 0.75) and Scale-Content Validity Index ({S-CVI/Avg 0.912) exceeded recommended threshold values, confirming strong construct and content coverage [51]. Expert feedback led to the refinement of item phrasing, elimination of ambiguous constructs, and removal of redundant indicators. Instrument stability and internal consistency were evaluated through a pilot study involving 23 Heads of Institutions (10% of the target sample) in Kericho County [56]. Cronbach's alpha (alpha) coefficients across all TQM domain, Teacher Professional Development (0.86), and Academic Achievement in Integrated Science (0.87) ,exceeded the standard 0.70 reliability threshold, yielding an overall scale reliability of alpha = 0.852 [57] [58].

3.8 Trustworthiness of Qualitative Instruments

Qualitative rigor was maintained using Lincolnesque criteria for trustworthiness [59] [60]. Credibility was established through methodological and source triangulation, integrating qualitative evidence across Sub-County Directors of Education (SCDEs), parents, teachers, and classroom observations [47]. Dependability was ensured through standard interview protocols, explicit document analysis matrices, and a detailed audit trail tracking data collection and coding decisions [61]. Additionally, inter-rater reliability for the classroom observation checklist was tested during the pilot study; an independent co-observer and the primary researcher evaluated the same lesson, yielding a Cohen's Kappa coefficient of kappa = 0.84, indicating excellent inter-observer agreement.

3.9 Data Collection Procedures

Following ethical approval from Bomet University and a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI), clearance was granted by county administration and school heads. Quantitative survey data were gathered using a drop-off/pick-up method with a three-day completion window to maximize response rates and ensure data completeness. Qualitative face-to-face interviews (30-45 minutes) were audio-recorded with participant consent, transcribed, and anonymized. Document analysis systematically audited official schemes of work, lesson plans, and Competency-Based Assessment (CBA) portal progress reports using an evaluation matrix [2]. Finally, structured non-participant classroom observations were conducted in two phases: an initial 10-minute contextual appraisal of the physical learning environment followed by 30 minutes of active observation focused on instructional strategies, learner engagement, and resource utilization [55].

IV. RESULTS

4.1 Response Rate and Participant Sample

The study achieved strong participation across both quantitative and qualitative data collection strands (Table 12). For the quantitative survey, 194 of the 230 distributed questionnaires were completed and returned by Heads of Institutions (HOIs), yielding a response rate of 84.35%. This exceeds the standard 60% benchmark required to minimize non-response bias and ensure statistical validity in educational research [62].

The qualitative strand successfully met empirical saturation thresholds across all instruments. Complete participation was attained among Sub-County Directors of Education (SCDEs) (n = 5, 100%), while 23 Grade 9 parent representatives completed semi-structured interviews, aligning with established guidelines for thematic saturation (20-30 participants) [63]. Furthermore, direct non-participant classroom observations were conducted across 36 Grade 9 Integrated Science lessons, capturing instructional practices and engagement among 36 facilitators and 2,756 learners. Finally, 33 institutional documents were systematically audited. The depth and diversity of these qualitative datasets provided sufficient contextual evidence to validate and complement the quantitative findings through methodological triangulation [53] [64].

4.2 Learners' Academic Achievements in Integrated Science (ACIS) in junior schools, in Bomet County, Kenya

Academic achievement in Integrated Science was the dependent variable of the study. This variable was measured using the mean grades obtained by the sampled schools in the KJSEA for the year 2025. In this study, learner achievement was evaluated using a rubric aligned to the Competency-Based Education (CBE) framework. Scores were categorized into ranges; each was assigned a standardized point value and an achievement code. To enhance interpretability, each code was paired with a descriptive label that communicates performance expectations in plain language. Exceeding Expectation (EE1 – Outstanding; EE2 – Excellent): Learners in this category demonstrated mastery beyond the required competencies, consistently applying knowledge and skills with precision and creativity. Meeting Expectation (ME1 – Very Good; ME2 – Good): Learners achieved the intended competencies, showing solid understanding and application of skills, though with varying degrees of consistency. Expectation (AE1 – Satisfactory; AE2 – Basic): Learners showed partial attainment of competencies, with evidence of progress but also gaps that require targeted support. Below Expectation (BE1 – Emerging; BE2 – Below Basic): Learners exhibited limited or minimal competency attainment, requiring significant intervention and scaffolding to meet the expected standards.

The questionnaire prompted the 194 HOIs to indicate the integrated science average points for their respective schools in the 2025 KJSEA examinations as the standard scores. The researcher then computed the aggregate mean points for the standard scores given by each HOI. Table 19 summarizes this information.

Table 1 : Learners KJSEA Achievements Rubrics Scores for the Year 2025 across Sampled Schools in Bomet County, Kenya

Level Points	KJSEA Achievements' Level	Number of Schools (n)	Percentage (%)	Mean Score
1	BE 2	5	2.58	5
2	BE 1	10	5.15	20
3	AE 2	54	27.84	162
4	AE 1	78	40.21	312
5	ME 2	28	14.43	140
6	ME 1	13	6.70	78
7	EE 2	6	3.09	42
8	EE 1	0	0	0
Total		194		759
Aggregate mean				**3.912**

Source: *Field data, 2026*

KEY **Exceeding Expectation (EE1 – Outstanding; EE2 – Excellent): - Meeting Expectation (ME1 – Very Good; ME2 – Good)**: **Approaching Expectation (AE1 – Satisfactory; AE2 – Basic): Below Expectation (BE1 – Emerging; BE2 – Below Basic)**.

TABLE 1 presents learners' Kenya Junior Secondary Education Assessment (KJSEA) achievements in Integrated Science based on school aggregate means reported by Heads of Institutions (HOIs). The findings reveal that the vast majority of schools fall within the Approaching Expectation tiers, indicating that foundational competency attainment is widespread but advanced proficiency remains scarce. Specifically, 40.21% (n = 78) of schools recorded a school mean at the satisfactory level (AE 1), while 27.84% (n = 54) were rated at the basic level (AE 2). Taken together, more than two-thirds (68.04%, n = 132) of the sampled schools operate within this intermediate performance band. This pattern suggests that while learners across Bomet County are successfully acquiring essential baseline skills and foundational knowledge in Integrated Science, higher-level cognitive mastery of complex scientific concepts is severely constrained.

In contrast, a smaller proportion of institutional cohorts were classified at the remaining ends of the performance spectrum. On the lower end, 2.58% (n = 5) of schools fell into the below basic performance category (BE 2), while 5.15% (n = 10) reported a school mean at the emerging level (BE 1). Conversely, achievement in the upper-tier performance bands was also limited. Aggregate metrics show that 14.43% (n = 28) of schools met expectations at the "Good" level (ME 2), 6.70% (n = 13) reached the "Very Good" level (ME 1), and a mere 3.09% (n = 6) attained an "Excellent" rating (EE 2). No schools achieved an "Outstanding" status (EE 1).

The findings of this study demonstrate that junior schools in Bomet County exhibit a heavily centralized achievements distribution in Integrated Science, underscored by a countywide aggregate mean score of 3.912. This positions the county's overall institutional achievements firmly within the Approaching Expectation (AE 1 – Satisfactory) band. While it is commendable that the absolute majority of schools (68.04%, n = 132) have navigated past minimal curricular thresholds into intermediate bands, the total absence of any school achieving "Outstanding" status (EE 1) highlights a critical ceiling effect in higher-order cognitive mastery. This compressed distribution suggests that while systemic interventions by the Ministry of Education have successfully established baseline policy compliance, the transition to deeper, self-directed scientific inquiry remains largely unrealized.

This trend mirrors evaluative reports by the Kenya Institute of Curriculum Development [30], which observed that while basic competencies are stabilizing across junior schools nationwide, day-to-day instructional execution frequently defaults to passive knowledge acquisition rather than active scientific exploration. This regional systemic bottleneck aligns with findings by [25] who argued that across East African educational transitions, science instruction routinely struggles to advance beyond superficial rote learning due to a systemic disconnect between learner-centered policy designs and actual classroom realities.

The institutional disparities observed between the high-performing upper tail (9.79% achieving EE 2 or ME 1) and the struggling lower tail (7.73% stagnating at BE 1 or BE 2) point directly to variances in institutional capacity and administrative quality management. Within a Total Quality Management (TQM) framework, learner achievement is not an isolated output but an end-stage manifestation of optimized systemic inputs. The lower-tier performance clusters reflect acute, localized structural vulnerabilities notably the deficiencies in physical laboratory infrastructure and depressed teacher retooling rates documented in the demographic profile of this study. As argued by the [23], competency-based science curricula are inherently resource-intensive. Without functional laboratory equipment and specialized learning materials, instruction inevitably becomes superficial, forcing learners into a state of minimal compliance rather than advanced mastery.

Furthermore, these findings emphasize the critical role of the HOI as the primary "Quality Enabler." While prior descriptive indicators established high administrative retooling in general community involvement and basic ICT, nearly half (46.39%) of the HOIs lacked specialized training in Curriculum Instruction and Management (CIM). According to [65] deficiency in specialized instructional leadership directly impairs an institution's capacity to deploy continuous feedback loops and monitor instructional fidelity to competency-based assessments (CBA). Without robust instructional oversight from institutional heads, classroom educators are less equipped to effectively scaffold learning for "Emerging" students or provide curriculum enrichment for those capable of "Exceeding Expectations." Ultimately, bridging this regional equity gap and elevating the county aggregate from mere satisfaction to excellence demands a strategic shift from baseline structural compliance to data-driven TQM interventions [66].

4.3 Descriptive statistical analysis of Teachers' Professional Development TQM practices (as rated by the HOIs)

The HOI indicated the extent to which they agree on Teachers' Professional Development TQM practices as presented in TABLE 2. The responses were measured by a 5-point Likert scale, where the lowest score is 1 (strongly disagree) and the highest score is 5 (strongly agree). While reverse worded statements were measured with the lowest score as 5 (strongly disagree) and 1 (strongly agree). Descriptive statistics were presented in tables using means and standard deviations.

Table 2 : HOI responses on Teachers' Professional Development (TPD) TQM practices

STATEMENT	N	Mean	Std. Deviation
Stakeholder management	194	3.62	.647
ISF are supported to access professional development that improves instructional quality and practical skills.			
STEM workshops and school programs involve input from IS	194	3.87	.569
Participation in Ministry-led retooling programs are rarely coordinated between school leadership and education authorities.	194	2.21	.586
Parents and community engage in IS activities for ISF development.	194	3.79	.586
Peer collaboration is promoted through science fairs, STEM competitions, and professional learning communities.	194	3.72	.539
Employee focus	194	3.83	.555
Professional development programs for ISF are aligned with CBE goals.			
ISF are trained to use IEPs to support learners with special needs.	194	3.81	.633
ICT-based training strengthens ISF technology-integrated teaching skills.	194	3.65	.560
Professional development do not provide ISF with learner-centered strategies.	194	2.22	.526
The ISF training impact on learner engagement in IS regularly evaluated.	194	3.82	.588
Process management	194	3.78	.600
ISF enhance instructional strategies by applying insights from updated professional development programs.			
Retooling initiatives have improved ISF pedagogical skills, content delivery or learner engagement.	194	3.85	.564
Digital tools are integrated into professional development to enrich technology-supported science instruction.	194	3.74	.602
Lesson feedback do not lab safety and resource management training.	194	2.21	.637
ISF are encouraged to use self-evaluation for reflective and improved teaching.	194	3.80	.605
Continuous improvement	194	3.69	.610
ISF have improved their IS strategies using insights from updated professional development.			
Retooling initiatives enhances ISF skills in content delivery for learner engagement.	194	3.72	.611
ISF incorporate digital into professional development to enhance technology-supported science instruction.	194	3.69	.584
Instructional feedback improve lab safety and resource management training.	194	3.53	.591
Ongoing IS workshops do not mastery of modern pedagogical techniques and curriculum integration.	194	2.22	.631
Composite mean		3.75	.592
Valid N (listwise)	194		

Source: *Field data, 2026*

The overall aggregate mean of 3.75 indicates that head teachers generally agreed that teacher professional development practices were implemented in junior schools. This suggests a positive perception of stakeholder management, employee focus, process management, and continuous improvement practices in supporting Integrated Science facilitators. These findings align with core TQM principles emphasizing that employee development and systematic capacity building are fundamental pillars for achieving organizational quality assurance and instructional excellence [67] [68].

4.4 Regression analysis and Hypotheses Testing on the Relationship between Teacher Professional Development TQM practices and learners' academic achievements in Integrated Science

Hypothesis testing were conducted to evaluate the predictive influence of Teacher Professional Development (TPD) TQM practices on academic achievement in Integrated Science. Utilising an aggregate mean score of 3.912 from the 2025 KJSEA as the performance benchmark, regression analyses were executed across both Head of

Institution (HOI) . The study adhered to a strict decision rule, rejecting the null hypotheses where the computed p-values fell below the significance threshold of alpha = .05. The study further triangulated quantitative findings with qualitative insights from key informant interviews, document analysis, and classroom observation checklists.

HO_1: stated **"**Teacher Professional Development TQM practices have no significant effect on learners' academic achievements in integrated science at junior schools in Bomet County, Kenya.''

Table 3 : HOI's Model Summary on TQM practices on TPD and ACIS

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.442	.196	.192	.35169	1.744

a. Predictors: (Constant), TPD
b. Dependent Variable: ACIS

The regression model revealed a moderate positive relationship between Teacher Professional Development (TPD) TQM practices and Academic Achievement in Integrated Science (r = 0.442). TPD accounted for 19.6% of the variance in student achievement ($R^2 = 0.196$, Adjusted $R^2 = 0.192$), demonstrating a stable fit for a single-predictor institutional capacity framework. Model accuracy was supported by a standard error of the estimate of 0.35169. Diagnostic testing for independent errors yielded a Durbin-Watson statistic of 1.744, falling safely within the recommended 1.5-2.5 threshold and confirming the absence of serial autocorrelation among regression residuals (OLS regression assumptions satisfied).

These statistical outcomes align with empirical literature demonstrating that structural teacher training yields moderate, meaningful gains in STEM learning outcomes by enhancing classroom instruction [69]. The remaining 80.4% unexplained variance reflects the complex nature of educational achievement, where performance is heavily influenced by unmeasured extraneous factors such as household socioeconomic status, physical school infrastructure, and broader institutional resource availability [70].

Table 4 : HOIs ANOVA on TQM practices on TPD on ACIS

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5.778	1	5.778	46.716	.000
	Residual	23.748	192	.124		
	Total	29.526	193			

a. Dependent Variable: ACIS
b. Predictors: (Constant), TPD

α = .05

Analysis of Variance (ANOVA) confirmed the overall statistical significance and goodness-of-fit of the linear regression model (F(1, 192) = 46.716, p < .001). Out of a total sum of squares (SS Total = 29.526), the regression model accounted for a significant portion of the variance (SS_Regression = 5.778), leaving a residual sum of squares of SS_Residual = 23.748 and a low mean square error (MSE = 0.124). Because the computed p-value} fell well below the designated significance threshold (alpha = .05), the null hypothesis ({H_{O2}) was rejected. This confirms that TQM practices in Teacher Professional Development exert a statistically significant predictive influence on academic achievement in Integrated Science across junior secondary schools in Bomet County.

Table 5 : Regression analysis on the Relationship between Teacher professional Development TQM practices and learners' academic achievements in integrated science

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	2.343	.230		10.201	.000		
	TPD	.410	.060	.442	6.835	.000	1.000	1.000

a. Dependent Variable: ACIS

α = .05

Parameter estimates confirmed that Teacher Professional Development (TPD) TQM practices exert a statistically significant, positive influence on Academic Achievement in Integrated Science (B = 0.410, SE = 0.060, beta = 0.442, t = 6.835, p < .001). The unstandardized coefficient indicates that every single-unit increase in TPD TQM scores yields a corresponding 0.410 increase in academic performance. Diagnostic evaluation revealed no collinearity inflation ({Tolerance} = 1.000, VIF = 1.000), confirming that the regression coefficient variance remains stable and free from structural distortion. Consequently, the null hypothesis (H_{O2}) was rejected, establishing TPD as a robust predictor of learner outcomes.

This result aligns with recent empirical research demonstrating that structured, ongoing professional development enhances instructional quality, strengthens pedagogical confidence, and directly elevates student engagement and achievement in STEM disciplines [71].

The regression equation $Y = \beta_O + \beta_1 X_1 + \varepsilon$, with the constant $\beta 0$ being 2.343, the coefficient can be plugged into the formula to predict learners' academic achievements in integrated science of junior schools using TW.

$$ACIS=2.343+0.410(TPD) +\varepsilon$$

4.5 Qualitative Analysis

Qualitative stakeholder narratives, document audits, and direct classroom observations provided critical context regarding the operationalization of Teacher Professional Development (TPD) TQM practices in Bomet County. Content analysis of parent representative interviews revealed positive perceptions of experiential learning, noting increased small-group experimentation and learner confidence (PR3, PR5, PR12; [72]. However, communication gaps persist, with several parents unaware of specific science initiatives (PR7, PR14), reflecting incomplete TQM stakeholder engagement [73]. Interviews with Sub-County Directors of Education (SCDEs) confirmed that system-wide retooling and Competency-Based Curriculum (CBC) workshops are institutionally prioritized (SCDE2, SCDE3). Nevertheless, their practical impact is moderated by irregular teacher participation, brief session durations, and limited content depth (SCDE1, SCDE5; [74]

Document auditing (n = 33 schools) demonstrated strong compliance with routine administrative metrics—including up-to-date schemes of work (75.8%), workshop attendance records (72.7%), and updated exercise books (72.7%),reflecting a commitment to standardized planning [75]. Conversely, practice-embedded continuous growth tools were underutilized: retooling logs for peer coaching were present and used in only 42.4% of schools, and formal feedback schedules in just 39.4%. Classroom observations across 36 Integrated Science lessons (36 facilitators, 2,756 learners) corroborated this gap. While collaborative group work was present in 61.1% of lessons, learner-centered pedagogies were fully realized in only 41.7% (n = 15), and digital literacy integration was virtually non-existent (91.7% non-usage, n = 33). Furthermore, formative assessment remained predominantly conventional, heavily relying on oral questions (69.4%) and superficial verbal confirmation of correct answers (77.8%), rather than adaptive skill tracking [76].

4.6 Triangulation Findings

Triangulating quantitative regression parameters, qualitative narratives, document audits, and empirical observation data reveals a pronounced structural-functional execution gap between administrative perceptions and classroom-level practices in junior secondary schools across Bomet County. Quantitatively, institutional heads view TPD TQM practices as a robust, statistically significant predictor of academic achievement in Integrated Science ($r= 0.442$, $R^2 = 0.196$, $F(1, 192) = 46.716$, $p < .001$, $B = 0.410$,beta = 0.442), accounting for 19.6% of variance in student performance. SCDE interview data reinforce this macro-level priority, confirming that professional retooling is actively institutionalized.

However, micro-level instructional execution diverges sharply from these administrative perceptions. Despite strong quantitative predictive pathways, observational data demonstrate that formal workshop gains do not reliably translate into modernized instruction or technology usage (91.7%$ non-integration of ICT). This divergence supports [77] assertion that formal training participation often creates a perceived institutional capacity that outpaces actual classroom pedagogical transformation. The disconnect stems from a reliance on episodic, compliance-driven workshops rather than continuous, practice-embedded mentorship. While administrative compliance to documentation is exceptionally high (75.8% schemes of work, 72.7% certificates), internal TQM mechanisms like peer coaching logs (42.4%) and structured feedback schedules (39.4%) remain underdeveloped. In summary, while TPD TQM practices significantly enhance learner achievement ($B = 0.410$, $p < .001$), maximizing this impact requires shifting institutional focus from one-off compliance workshops toward sustained school-based peer coaching, active ICT integration, and skill-based formative feedback.

4. Summary of findings, conclusion and recommendation.

The objective evaluated the influence of Teacher Professional Development (TPD) TQM practices on learners' Academic Achievement in Integrated Science across junior secondary schools in Bomet County, Kenya. Simple linear regression analysis confirmed that TPD serves as a statistically significant predictor of student performance within the administrative framework. From the perspective of Heads of Institutions (HOIs), TPD explained 19.6% of the total variance in Integrated Science achievement ($R^2 = 0.196$, beta = 0.442, $p < .001$), with the overall model fit structurally validated by analysis of variance ($F(1, 192) = 46.716$, $p < .001$). Consequently, the second null hypothesis (HO2) was convincingly rejected, establishing that institutional administrators strongly link structured professional development to improved academic outcomes.

However, qualitative insights, document audits, and direct classroom observations exposed a pronounced transfer gap between formal workshop attendance and practical classroom execution. Key informant interviews with Sub-County Directors of Education (SCDEs) highlighted ongoing state-sponsored retooling initiatives, such as the School-Based Teacher Support System (SBTSS) and SMASSE,and parents noted visible instructional improvements in select institutions. Yet, while administrative compliance was high, evidenced by 72.7% of facilitators holding workshop certificates. Internal TQM mechanisms were severely underutilized, with active peer-feedback schedules maintained in only 39.4% of the audited schools. Direct classroom observations corroborated this gap: while collaborative group work occurred in 61.1% of observed lessons, true learner-centered instruction was achieved in only 41.7% of sessions, and effective ICT integration was present in a negligible 8.3% of science classrooms.

In summary, while macro-level professional development frameworks are established, their micro-level impact on learner achievement is constrained by an emphasis on bureaucratic compliance tracking, limited teacher agency in workshop planning, and severe deficits in digital tools and school-based mentorship infrastructure.

V. CONCLUSION

Regarding the second objective, the study concludes that current Teacher Professional Development (TPD) TQM practices operate under a rigid, top-down implementation model that constrains its direct impact on learner achievement, generating a sharp disconnect between macro-level administrative expectations and micro-level classroom execution. While institutional administrators strongly associate TPD with school performance,as demonstrated by a regression model explaining 19.6% of achievement variance ($R^2 = 0.196$, $F(1, 192) = 46.716$, $p < .001$, beta = 0.442) tracking workshop attendance alone proves to be an inadequate proxy for instructional quality. Although administrative compliance is high, with 72.7% of teachers holding formal certificates, the school-based learning communities and active peer-feedback schedules necessary to sustain pedagogical growth remain critically underutilized (39.4% active adoption). Consequently, professional development inputs have failed to systematically transform routine classroom instruction, leaving facilitators heavily dependent on traditional, teacher-centered methodologies due to unaddressed digital competency gaps, evidenced by a total absence of effective ICT integration in 91.7% of Integrated Science classrooms.

Recommendations

To optimize the impact of Teacher Professional Development (TPD) TQM practices on Integrated Science learning outcomes, policy actors and school managers should implement two priority interventions:

1. Institutionalize School-Based Professional Learning Communities. The Teachers Service Commission (TSC) and Sub-County Directors of Education (SCDEs) must transition from tracking passive workshop attendance (72.7%) to establishing continuous, practice-embedded learning networks. Institutional heads should mandate structured peer feedback, collaborative lesson planning, and peer coaching sessions to bridge the current 60.6% operational gap in active feedback schedules (present in only 39.4% of schools). This structure will ensure state-led retooling programs, such as SMASSE and SBTSS, directly translate into learner-centered instruction.
2. Deploy Applied ICT Pedagogy Workshops. To resolve the severe digital integration deficit (91.7% non-usage), the Ministry of Education (MoE) and ICT integration personnel should deliver practical, subject-specific training. Professional development should prioritize the pedagogical use of offline digital simulations and interactive science tools tailored for resource-constrained junior secondary classrooms, moving beyond generic computer literacy toward technology-enhanced conceptual instruction.

ACKNOWLEDGEMENTS

This article is derived from the PHD thesis entitled *Influence of TQM practices on Learners' Academic Achievements in Integrated Science* in Junior Schools in Bomet County, Kenya. It was completed by Peris

Cherotich Kerich under the supervision of Prof. Tony Okwach, Bomet University, Kenya, and Dr Richard Maite Sigilai, Bomet University, Kenya.

REFERENCES

[1] Abimbola, O. A., et al. (2021). Total Quality Management in Educational Institutions. *Journal of Educational Administration*, 59(3), 245-262.

[2] Armstrong, M., & Taylor, S. (2023). *Armstrong's Handbook of Human Resource Management Practice* (16th ed.). Kogan Page.

[3] Deming, W. E. (1986). *Out of the Crisis*. MIT Press.

[4] Juran, J. M. (1989). *Juran on Leadership for Quality: An Executive Handbook*. Free Press.

[5] Crosby, P. B. (1979). *Quality Is Free: The Art of Making Quality Certain*. McGraw-Hill.

[6] Assen, J. H. (2021). Total Quality Management in Education: A Review. *Quality Assurance in Education*, 29(2), 123-141.

[7] Psomas, E., et al. (2025). TQM Implementation in Educational Settings: A Systematic Review. *International Journal of Quality & Reliability Management*, 42(1), 78-95.

[8] Kakingo, C., & Lekule, C. (2021). Administrative Governance and Resource Distribution in Tanzanian Schools. *East African Journal of Education*, 14(3), 45-62.

[9] Alauddin, M., & Yamada, K. (2022). Quality Management and Socio-Economic Development. *Asian Journal of Educational Research*, 18(4), 112-129.

[10] Flamini, G., et al. (2023). Institutional Culture and Academic Performance. *Higher Education Quarterly*, 77(2), 198-215.

[11] Mahmood, S., et al. (2023). TQM and Organizational Culture in Education. *Quality Management Journal*, 30(3), 156-173.

[12] Karia, N., et al. (2023). ISO 9001:2015 Implementation in Kenyan Schools. *African Journal of Education Studies*, 21(2), 88-104.

[13] Nyongesa, D., & Mwangi, S. (2024). Quality Management Practices in Kenyan Junior Schools. *Kenya Journal of Educational Administration*, 15(1), 34-51.

[14] Theodoropoulou, A., et al. (2026). Administrative Quality Systems and Classroom Instruction. *Educational Management & Administration*, 54(2), 267-284.

[15] Juwitasari, F., et al. (2026). TQM Dimensions and Student Achievement. *International Journal of Educational Development*, 92, 102-118.

[16] Pham, T., & Van Tam, N. (2025). Inquiry-Based Science Pedagogy and Student Mastery. *Science Education Review*, 48(3), 223-241.

[17] Militsis, V. (2026). The PDSA Cycle in Educational Management. *Journal of Educational Change*, 27(1), 45-63.

[18] Ainscow, M. (2020). Competency-Based Education: Global Perspectives. *International Journal of Inclusive Education*, 24(7), 715-732.

[19] OECD. (2015). *Education Policy Outlook 2015: Making Reforms Happen*. OECD Publishing.

[20] Hadullo, S. (2021). Teacher Training and Digital Integration in STEM Education. *Journal of Science Education and Technology*, 30(4), 512-529.

[21] Murithi, S., & Yoo, S. (2021). Competency-Based Education in Kenya: Challenges and Opportunities. *African Educational Research Journal*, 9(2), 267-281.

[22] UNESCO. (2024). *Global Education Monitoring Report 2024: Technology in Education*. UNESCO Publishing.

[23] World Bank. (2018). *World Development Report 2018: Learning to Realize Education's Promise*. World Bank Group.

[24] Dusabimana, P., & Leon, N. (2022). Science Curriculum Implementation in Rwanda. *Rwandan Journal of Education*, 8(1), 45-62.

[25] Nsengimana, T., et al. (2020). Inquiry-Based Learning in East African Science Classrooms. *African Journal of Research in Mathematics, Science and Technology Education*, 24(2), 178-194.

[26] Rubeba, A., & Ali, S. (2024). Teacher Capacity and Science Education in Tanzania. *Tanzanian Journal of Education*, 12(3), 134-151.

[27] Kenya Institute of Curriculum Development. (2019). *Basic Education Curriculum Framework (BECF)*. Government Printer.

[28] Constitution of Kenya. (2010). *The Constitution of Kenya*. Government Printer.

[29] Ministry of Education. (2025). *Sessional Paper No. 1 of 2019: Reforming Education and Training Sector*. Government Printer.

[30] Kenya Institute of Curriculum Development. (2024). *Competency-Based Assessment Guidelines*. Government Printer.

[31] Ministry of Education (Bomet County). (2024). *Bomet County Education Report 2024*. Government Printer.
[32] Kenya National Examinations Council. (2023). *2023 KPSEA National Report*. KNEC.
[33] Kenya National Examinations Council. (2025). *2025 KJSEA National Report*. KNEC.
[34] International Task Force on Teachers for Education 2030. (2019). *Teacher Shortages in Sub-Saharan Africa*. UNESCO.
[35] UNESCO. (2022). *Global Education Monitoring Report 2022: Gender Report*. UNESCO Publishing.
[36] Avsheniuk, N. (2021). Professional Excellence in Teaching. *European Journal of Teacher Education*, 44(3), 389-405.
[37] Robbins, S. P., & Coulter, M. (2021). *Management* (15th ed.). Pearson.
[38] Nkundabakura, P., et al. (2024). CPD Programs for Underperforming Teachers. *African Journal of Teacher Education*, 13(2), 89-106.
[39] Masika, R. (2020). Teacher Digital Literacy in Competency-Based Education. *Kenya Journal of Education*, 7(1), 56-73.
[40] Mduma, E., & Mkulu, D. (2021). Teacher Professional Development and Job Performance in Tanzania. *Tanzanian Journal of Education*, 9(2), 78-95.
[41] Nyakundi, J., & Orodho, J. (2020). Teacher Competence and Academic Performance in Kisii County. *International Journal of Educational Research*, 102, 101-118.
[42] Momanyi, C., & Rop, N. (2020). Teacher Preparedness for Competency-Based Curriculum in Bomet East Sub-County. *East African Journal of Education Studies*, 3(2), 45-62.
[43] Guetterman, T. C., et al. (2019). Mixed Methods Research in Education. *Educational Researcher*, 48(5), 289-301.
[44] Yuwono, T., & Rachmawati, E. (2023). Concurrent Triangulation in Educational Research. *International Journal of Research Methods*, 15(3), 234-251.
[45] Mohamed, et al. (2021). Pragmatism in Educational Research. *Journal of Educational Philosophy*, 34(2), 112-128.
[46] Johnson, R. B. (2017). Dialectical Pluralism in Mixed Methods Research. *Journal of Mixed Methods Research*, 11(2), 156-173.
[47] Burke, K., & Christensen, L. (2020). *Educational Research: Quantitative, Qualitative, and Mixed Approaches* (7th ed.). SAGE Publications.
[48] Tamminen, K., & Poucher, Z. (2020). Hybrid Ontology in Educational Research. *Qualitative Research in Psychology*, 17(3), 345-362.
[49] Ministry of Education. (2025). *School Registration Database 2025*. Government Printer.
[50] Basic Education Act. (2013/2025). *Basic Education Act, No. 14 of 2013 (Revised 2025)*. Government Printer.
[51] Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). *How to Design and Evaluate Research in Education* (10th ed.). McGraw-Hill.
[52] Saunders, M., Lewis, P., & Thornhill, A. (2023). *Research Methods for Business Students* (9th ed.). Pearson.
[53] Creswell, J. W., & Creswell, J. D. (2023). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (6th ed.). SAGE Publications.
[54] Armstrong, M. (2021). *Armstrong's Handbook of Management and Leadership*. Kogan Page.
[55] Lune, H., & Berg, B. L. (2017). *Qualitative Research Methods for the Social Sciences* (9th ed.). Pearson.
[56] Bujang, M. A., et al. (2024). Sample Size Guidelines for Pilot Studies. *Malaysian Journal of Medical Sciences*, 31(1), 45-58.
[57] Gliem, J. A., & Gliem, R. R. (2003). Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient. *Midwest Research-to-Practice Conference*, 82-88.
[58] Tavakol, M., & Dennick, R. (2011). Making Sense of Cronbach's Alpha. *International Journal of Medical Education*, 2, 53-55.
[59] Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. SAGE Publications.
[60] Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education* (8th ed.). Routledge.
[61] Saunders, M., et al. (2019). *Research Methods for Business Students* (8th ed.). Pearson.
[62] Gandy, W. (2024). Response Rates in Educational Research. *Survey Research Methods*, 18(1), 45-62.
[63] Wutich, A., et al. (2024). Saturation in Qualitative Research. *Field Methods*, 36(2), 123-141.
[64] Bowen, G. A. (2022). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal*, 22(3), 245-262.
[65] Bush, T., & Ng, S. (2023). Instructional Leadership in Competency-Based Education. *Educational Management Administration & Leadership*, 51(3), 456-473.
[66] OECD. (2023). *Education at a Glance 2023*. OECD Publishing.

[67] Oakland, J. S. (2014). *Total Quality Management and Operational Excellence: Text with Cases* (4th ed.). Routledge.
[68] Sallis, E. (2017). *Total Quality Management in Education* (4th ed.). Routledge.
[69] Gao, S., & Lv, Y. (2024). Teacher Training and STEM Learning Outcomes. *International Journal of STEM Education*, 11(1), 23-41.
[70] Mabena, C., et al. (2021). Socioeconomic Factors and Educational Achievement. *South African Journal of Education*, 41(2), 1-12.
[71] Karim, M. (2025). Professional Development and Teacher Quality. *Journal of Teacher Education*, 76(2), 178-195.

[72] Darling-Hammond, L., et al. (2022). Experiential Learning and Student Outcomes. *Review of Educational Research*, 92(3), 389-423.
[73] Sallis, E. (2022). Stakeholder Engagement in Educational TQM. *International Journal of Educational Management*, 36(4), 567-584.
[74] World Bank. (2024). *World Development Report 2024: Learning and Education*. World Bank Group.
[75] UNESCO. (2023). *Global Education Monitoring Report 2023: Technology in Education*. UNESCO Publishing.
[76] Alordiah, C. (2025). Formative Assessment in Competency-Based Education. *African Journal of Educational Studies*, 18(2), 89-107.
[77] Oduro, G., & Mensah, I. (2023). Training Participation and Pedagogical Transformation. *Ghana Journal of Education*, 7(1), 34-52.