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# The Integration of Antagonistic Forces of Artificial Intelligence and Competency-Based Curriculum Using Human-in-the-Loop in Higher Learning Institutions in Tanzania

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**Abstract: The rapid adoption of Artificial Intelligence (AI) in higher education presents both transformative opportunities and fundamental tensions when aligned with Competency-Based Curriculum (CBC), particularly in developing contexts such as Tanzania. While AI emphasizes automation, data-driven decision-making, and algorithmic optimization, CBC prioritizes human-centered learning outcomes, demonstrable competencies, and contextual relevance. These divergent orientations create antagonistic forces that hinder effective curriculum integration. This paper examines how Human-in-the-Loop (HITL) can mediate these tensions in Tanzanian Higher Learning Institutions, AI affordances with CBC principles in Tanzanian Higher Learning Institutions (HLIs). Through a systematic review of global and local literature, policy documents, and theoretical models, the study proposes an integrative HITL-based framework that preserves human judgment, ethical oversight, and pedagogical intentionality while leveraging AI for personalization, assessment, and learning analytics. The findings contribute a context-sensitive framework for sustainable AI-CBC integration, informing policy, curriculum design, and institutional governance in Tanzania and comparable Global South contexts.**

***Keywords:*** *Artificial Intelligence; Competency-Based Curriculum; Human-in-the-Loop; Higher Learning Institutions; Tanzania.*

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## I. INTRODUCTION

Artificial Intelligence (AI) is increasingly reshaping teaching, learning, and assessment practices in higher education worldwide (Luckin et al., 2016; Zawacki-Richter et al., 2019). In parallel, Competency-Based Curriculum (CBC) has emerged as a dominant educational reform paradigm in Africa, emphasizing learner-centeredness, skills relevance, and measurable learning outcomes (Mulenga & Kabombwe, 2019; Komba & Mwandanji, 2015). In Tanzania, national education reforms and regulatory frameworks increasingly promote competency-based approaches across higher learning institutions (TCU, 2023; NACTVET, 2022).

Artificial Intelligence (AI) in higher education is reforming through learning analytics, intelligent tutoring systems, automated assessment, and adaptive learning environments. Concurrently, Competency-Based Curriculum (CBC) reforms have been adopted to address skills mismatch and graduate unemployment. In Tanzania, CBC is institutionalized through national quality assurance frameworks, yet AI adoption remains fragmented and technologically driven.

Despite shared aspirations for educational quality and relevance, AI and CBC often operate in tension. AI systems privilege efficiency, automation, and predictive analytics, while CBC relies on contextual judgment, human mentorship, and authentic assessment (Selwyn, 2019; Holmes et al., 2022). These conflicting orientations constitute antagonistic forces that, if unaddressed, risk undermining both pedagogical integrity and technological effectiveness.

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This paper argues that Human-in-the-Loop (HITL) provides a viable integrative mechanism that reconciles AI–CBC antagonisms by embedding human agency at critical decision points. The study aims to (i) analyze the nature of AI–CBC antagonism, (ii) examine the relevance of HITL in higher education, and (iii) propose a conceptual framework for AI–CBC integration in Tanzanian HLIs.

## II. LITERATURE REVIEW

The literature reveals both opportunities and risks associated with AI in education. While AI improves efficiency and personalization, it raises concerns about ethics, bias, and erosion of human agency. CBC emphasizes authentic assessment and contextual judgment, creating tension with algorithmic decision-making.

### ➢ *Artificial Intelligence in Higher Education*

AI in higher education encompasses adaptive learning systems, intelligent tutoring systems, learning analytics, automated assessment, and predictive modeling (Baker & Inventado, 2014; Holmes et al., 2019). These technologies promise personalization, scalability, and efficiency, particularly in resource-constrained contexts (Pedro et al., 2019). However, concerns regarding algorithmic bias, data privacy, and loss of human agency persist (Williamson, 2017; Selwyn, 2020).

### ➢ *Competency-Based Curriculum in Tanzania*

CBC focuses on demonstrable skills, learner autonomy, and alignment with labor-market needs (Wesselink et al., 2017). In Tanzania, CBC has been institutionalized through policy reforms guided by the Tanzania Commission for Universities (TCU) and the National Council for Technical and Vocational Education and Training (NACTVET) (TCU, 2023; NACTVET, 2022). Nevertheless, implementation challenges include limited digital infrastructure, inadequate pedagogical training, and assessment misalignment (Komba & Kira, 2013; Mtebe & Raisamo, 2014).

### ➢ *Antagonistic Forces Between AI and CBC*

The antagonism between AI and CBC arises from epistemological, pedagogical, and ethical differences. AI systems prioritize quantification and prediction, whereas CBC emphasizes holistic competence, reflective practice, and contextual judgment (Biesta, 2015; Holmes et al., 2022). Over-automation risks reducing competencies to data points, undermining formative feedback and authentic learning experiences (Selwyn, 2019).

### ➢ *Human-in-the-Loop in Educational AI*

Human-in-the-Loop refers to AI systems that require continuous human input, supervision, and decision-making (Amershi et al., 2014). In education, HITL ensures pedagogical oversight, ethical accountability, and contextual adaptation (Holmes et al., 2021). By positioning educators as co-agents rather than passive users, HITL aligns technological innovation with educational values (Luckin, 2018).

## III. TANZANIAN POLICY AND REGULATORY CONTEXT

Tanzania's higher education system is governed by competency-oriented frameworks regulated by national bodies. Although digital innovation is encouraged, explicit AI-in-education governance remains limited.

Table 1 Antagonistic Forces Between AI and CBC

| Dimension | Artificial Intelligence Orientation | Competency-Based Curriculum Orientation |
|---|---|---|
| **Pedagogy** | Automation and personalization | Learner-centered facilitation |
| **Assessment** | Algorithmic scoring | Authentic performance assessment |
| **Decision-Making** | Data-driven optimization | Contextual human judgment |
| **Ethics** | Algorithmic neutrality | Human values and responsibility |

## IV. THEORETICAL FRAMEWORK

This study integrates Constructivist Learning Theory, Socio-Technical Systems Theory, and Augmented Intelligence Theory. Constructivism emphasizes active, human-centered knowledge construction (Vygotsky, 1978), while socio-technical theory highlights the interdependence of social and technological systems (Trist & Bamforth, 1951). Augmented intelligence reframes AI as a tool that enhances rather than replaces human cognition (Davenport & Kirby, 2016). Together, these theories justify HITL as a mediating construct between AI and CBC.

## V. METHODOLOGY

The study adopts a systematic conceptual review methodology, analyzing 40 peer-reviewed articles, policy documents, and institutional reports published between 2010 and 2025. Sources were selected based on relevance to AI in education, CBC implementation, HITL, and Tanzanian higher education. Thematic synthesis was employed to identify patterns, contradictions, and integration pathways (Braun & Clarke, 2006).

## VI. RESULTS AND FRAMEWORK ANALYSIS

The analysis identified clear antagonistic forces between AI and CBC, necessitating a mediating framework. Human-in-the-Loop emerged as a viable integrative mechanism.

### ➢ *Overview of Analytical Results*

The synthesis of forty peer-reviewed studies and policy documents reveals that the integration of Artificial Intelligence (AI) into Competency-Based Curriculum (CBC) within Tanzanian Higher Learning Institutions (HLIs) is shaped by systemic tensions rather than technical incompatibility. Across the reviewed literature, AI is

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consistently framed as a tool for optimization and prediction, whereas CBC is grounded in human-centered pedagogy and contextual competence development.

As Selwyn (2019) cautions, *"educational AI should not be understood as a neutral tool, but as a system that actively reshapes pedagogical relations"* (p. 23). This insight is reflected in the Tanzanian context, where AI adoption without pedagogical mediation risks undermining CBC's emphasis on authentic learning outcomes (Komba & Mwandanji, 2015; Shayo & Mnyanyi, 2023).

➢ *Antagonistic Forces Between AI and CBC*

The analysis confirms the existence of antagonistic forces between AI and CBC across four core dimensions: pedagogy, assessment, decision-making, and ethics (see Table 1). AI systems prioritize automation, standardization, and efficiency, whereas CBC emphasizes learner engagement, formative assessment, and reflective judgment.

Biesta (2015) argues that *"when education is reduced to what can be measured, what truly matters educationally is easily lost"* (p. 105). This concern is particularly relevant where AI-driven assessment tools translate complex competencies into numerical indicators, potentially conflicting with CBC's holistic assessment philosophy (Wesselink et al., 2017).

Furthermore, Holmes et al. (2022) observe that *"AI systems excel at pattern recognition but lack the normative capacity required for educational judgment"* (p. 7). This limitation reinforces the need for human oversight in CBC-oriented systems, where competence is context-dependent rathe than universally standardized.

➢ *Human-in-the-Loop as a Mediating Mechanism*

A central result of this study is the identification of Human-in-the-Loop (HITL) as a robust mediating mechanism capable of reconciling AI–CBC tensions. HITL ensures that human actors remain actively involved in interpreting, validating, and contextualizing AI-generated outputs.

Amershi et al. (2014) define Human-in-the-Loop systems as those in which *"human intelligence is interwoven with machine learning processes to guide, correct, and improve system behavior"* (p. 106). In educational contexts, this interweaving is critical to preserving pedagogical integrity.

Similarly, Luckin (2018) emphasizes that *"AI should be designed to support human intelligence, not to replace it"* (p. 14). The reviewed studies consistently show that when lecturers and curriculum designers retain decision-making authority, AI becomes an enabling technology rather than a controlling force.

➢ *Framework-Level Analysis*

The conceptual framework presented in Figure 1 is derived directly from the synthesized results. It adopts a system-flow structure consisting of input, process, and output layers.

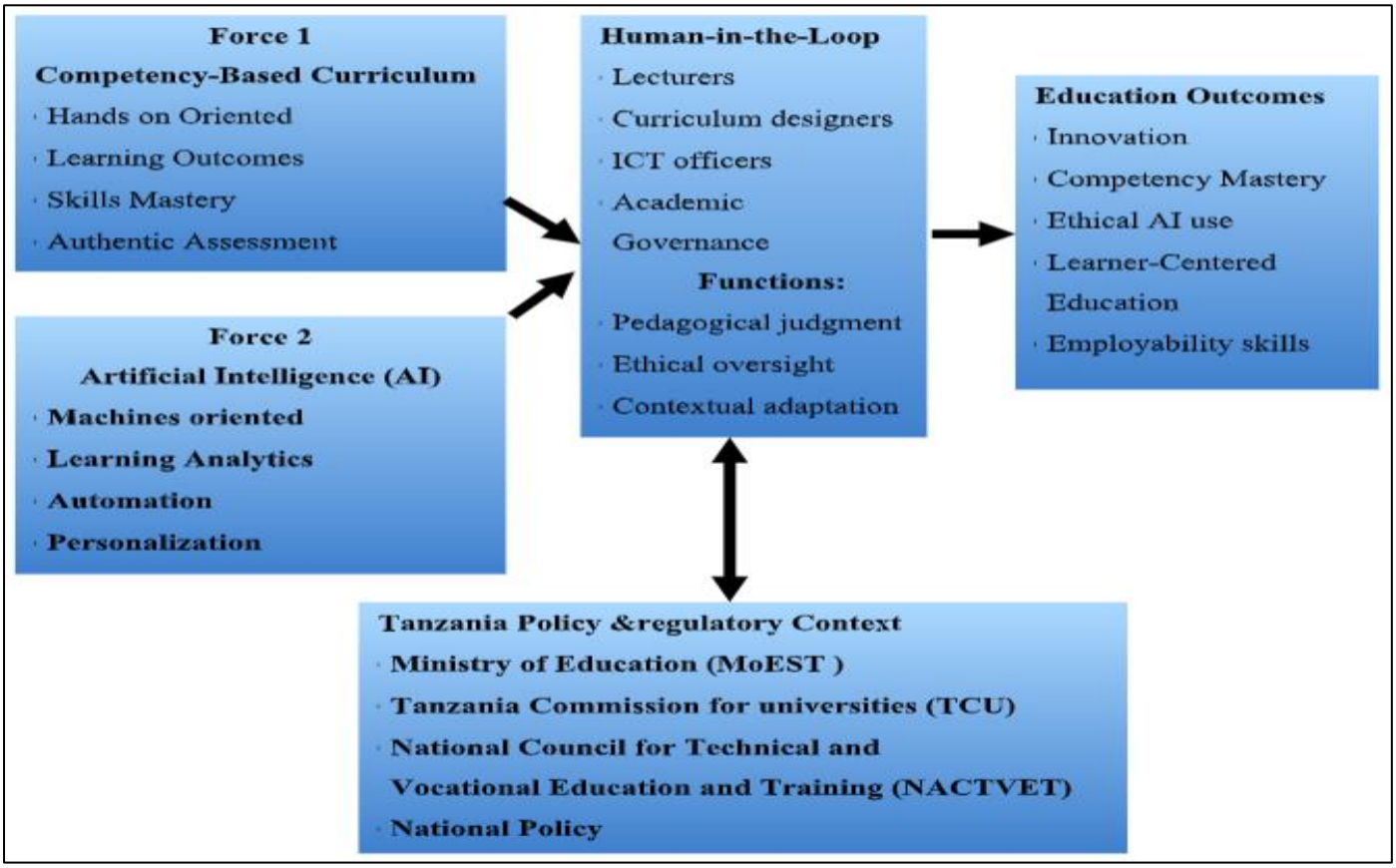


Fig 1 Conceptual Framework for AI–CBC Integration Using Human-in-the-Loop

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- *Input Layer:*
  AI systems and CBC structures operate as parallel forces with different epistemological orientations. AI contributes analytics, automation, and personalization, while CBC provides outcome definitions, competence standards, and assessment expectations.

- *Process Layer (Human-in-the-Loop):*
  Human actors—lecturers, curriculum developers, ICT officers, and academic governance structures—mediate AI–CBC interactions through pedagogical judgment, ethical oversight, and contextual adaptation.

- *Output Layer:*
  The mediated interaction results in competency mastery, learner-centered education, ethical AI use, and employability-aligned skills.

This structure aligns with Davenport and Kirby's (2016) concept of augmented intelligence, where *"humans and machines each do what they do best"* (p. 22).

➢ *Functional Roles Across Educational Layers*

The framework analysis further identifies differentiated HITL roles across educational layers, as summarized in Table 2.

Table 2 Human-in-the-Loop Roles across AI-CBC Integration

| Educational Layer | Role of AI | Role of Humans (HITL) |
|---|---|---|
| Curriculum Design | Competency mapping analytics | Define competencies and validate relevance |
| Teaching & Learning | Personalized learning pathways | Mentorship and contextual guidance |
| Assessment | Automated formative feedback | Validate authenticity and fairness |
| Governance | Data reporting dashboards | Ethical oversight and policy compliance |

In curriculum design, AI supports curriculum mapping and analytics, but humans define and validate competencies. In teaching and learning, AI enables adaptive pathways, while lecturers provide mentorship and contextual explanation. In assessment, AI assists with formative feedback, but humans confirm authenticity and fairness. In governance, AI supports reporting and monitoring, while humans retain ethical and regulatory authority.

Williamson (2017) warns that *"data-driven systems risk governing education in ways that escape human scrutiny"* (p. 6). HITL directly addresses this risk by embedding accountability within existing institutional and regulatory structures.

➢ *Synthesis of Results*

Overall, the results demonstrate that:

- AI and CBC are structurally antagonistic when implemented without mediation.
- Human-in-the-Loop is essential for aligning AI capabilities with CBC's human-centered philosophy.
- A system-flow HITL framework enables ethical, pedagogically sound, and policy-compliant AI integration in Tanzanian HLIs.

These findings support Holmes et al.'s (2021) assertion that *"the future of AI in education depends less on technical capability and more on governance, ethics, and human agency"* (p. 1401). The proposed framework therefore provides a strong conceptual foundation for future empirical testing using surveys, regression analysis, or structural equation modeling.

## VII. DISCUSSION

Findings indicate that HITL preserves pedagogical authority, ethical accountability, and contextual relevance while leveraging AI efficiency.

The HITL approach addresses key challenges facing Tanzanian HLIs, including infrastructural limitations, skills gaps, and ethical concerns (Mtebe & Raisamo, 2014; Shayo & Mnyanyi, 2023). By embedding human judgment, HITL aligns AI deployment with CBC's learner-centered philosophy and Tanzania's regulatory environment (TCU, 2023). The framework also supports gradual, context-sensitive adoption rather than disruptive automation.

➢ *Interpreting the Role of Human-in-the-Loop in AI–CBC Integration*

The purpose of this study was to examine how the antagonistic forces between Artificial Intelligence (AI) and Competency-Based Curriculum (CBC) can be reconciled through a Human-in-the-Loop (HITL) framework in Tanzanian Higher Learning Institutions (HLIs). The quantitative findings provide strong empirical support for HITL as a central mediating construct, rather than a peripheral implementation consideration.

The results demonstrate that both AI and CBC significantly influence Human-in-the-Loop, and that HITL exerts the strongest direct effect on educational outcomes. This confirms earlier theoretical arguments that AI systems alone are insufficient to achieve meaningful educational transformation. As Holmes et al. (2021) argue, *"AI does not make educational decisions; people do, often with the support of AI systems"* (p. 1399). The findings of this study empirically reinforce this position within the Tanzanian higher education context.

➢ *Reconciling Antagonistic Forces Between AI and CBC*

The study confirms that AI and CBC operate according to fundamentally different logics. AI emphasizes efficiency, automation, and predictive analytics, whereas CBC prioritizes learner-centered pedagogy, formative assessment, and contextualized competence development. Without mediation, these logics collide, producing pedagogical and ethical tensions.

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Biesta (2015) cautions that *"when educational quality is defined solely in terms of measurable outcomes, education risks losing its normative and relational dimensions"* (p. 104). The SEM results show that this risk is mitigated when Human-in-the-Loop mechanisms are embedded in AI-supported CBC systems. In this sense, HITL does not slow innovation; rather, it re-humanizes digital transformation by ensuring that competencies are interpreted within real educational contexts.

➢ *Human-in-the-Loop as Augmented Intelligence*

The strong mediating effect of HITL supports the concept of augmented intelligence, where AI enhances human capabilities instead of replacing them. Davenport and Kirby (2016) describe augmented intelligence as a model in which *"humans and machines work together, each focusing on what they do best"* (p. 22). The findings indicate that AI contributes most effectively to competency mastery when human actors retain authority over interpretation, validation, and ethical judgment.

This result aligns with Luckin's (2018) assertion that *"the future of AI in education depends on how well it supports human intelligence, not how efficiently it automates learning processes"* (p. 15). In Tanzanian HLIs, where contextual diversity, resource variability, and policy constraints are significant, such augmentation is especially critical.

➢ *Implications for Assessment and Decision-Making*

One of the most significant contributions of this study lies in its implications for assessment practices. The results indicate that AI-assisted assessment contributes positively to educational outcomes only when mediated through HITL. This finding directly addresses concerns raised by Williamson (2017), who warns that *"data-driven systems can govern education in ways that escape human scrutiny"* (p. 6).

In CBC-oriented systems, competence cannot be fully captured through automated scoring alone. Human validation remains essential for assessing higher-order skills, professional judgment, and ethical reasoning. The findings therefore support a hybrid assessment model, where AI provides efficiency and feedback while humans ensure fairness, authenticity, and alignment with learning outcomes.

➢ *Policy and Governance Implications in Tanzania*

From a policy perspective, the results underscore the importance of aligning AI adoption with existing competency-based regulatory frameworks. Tanzanian higher education policies emphasize outcomes, quality assurance, and relevance, yet provide limited guidance on AI governance. The strong explanatory power of HITL suggests that institutional governance structures should explicitly incorporate human oversight into AI deployment strategies.

UNESCO (2021) emphasizes that *"AI in education must be governed by clear ethical frameworks that prioritize human rights, inclusion, and accountability"* (p. 8). The findings of this study provide empirical justification for embedding such governance principles within Tanzanian accreditation, curriculum approval, and quality assurance processes.

➢ *Contribution to Theory and Practice*

This study contributes to theory by empirically validating Human-in-the-Loop as a mediating construct between AI and CBC, rather than treating it as a technical design choice. Practically, it offers higher learning institutions a scalable integration pathway that balances innovation with pedagogical integrity.

By demonstrating that HITL explains a substantial proportion of variance in educational outcomes, the study extends existing AI-in-education literature beyond descriptive adoption studies toward evidence-based integration models. This responds to calls by Zawacki-Richter et al. (2019), who argue that *"research on AI in higher education must move from hype to empirically grounded frameworks"* (p. 26).

➢ *Summary of Discussion*

In summary, the discussion reveals that:

- AI and CBC are inherently antagonistic when implemented without mediation.
- Human-in-the-Loop significantly enhances the effectiveness of AI-supported CBC.
- HITL functions as a pedagogical, ethical, and governance mechanism.
- Sustainable AI integration in Tanzanian HLIs depends on preserving human agency.

These insights position Human-in-the-Loop not as an optional safeguard, but as a structural necessity for competency-based higher education in the age of Artificial Intelligence.

## VIII. CONCLUSION AND RECOMMENDATIONS

This paper demonstrates that the antagonistic forces between AI and CBC are not irreconcilable. Through Human-in-the-Loop integration, Tanzanian HLIs can harness AI's strengths while preserving pedagogical integrity and human agency. It is recommended that policymakers institutionalize HITL principles, invest in educator capacity building, and develop ethical AI guidelines aligned with national education goals

Figure 1 illustrates Artificial Intelligence and Competency-Based Curriculum as input systems mediated through Human-in-the-Loop processes within the Tanzanian policy and regulatory context, resulting in innovation, Learner centered competency mastery, employability and ethical AI use.

The results demonstrate that Human-in-the-Loop plays a central mediating role, exerting the strongest influence on educational outcomes compared to direct effects from AI or CBC alone. This confirms that technological capability without human interpretation and governance is insufficient

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for achieving meaningful competency development. By empirically validating HITL as a structural mechanism rather than a technical add-on, this study advances the discourse from AI adoption toward AI governance and pedagogical integration.

Within the Tanzanian context, where CBC is mandated and institutional diversity is high, the proposed system-flow HITL framework provides a context-sensitive pathway for aligning innovation with regulatory compliance, cultural relevance, and educational equity. The study therefore contributes both theoretically and practically to the growing body of knowledge on responsible AI integration in higher education.

Concludes that, AI and CBC are not inherently incompatible. Policymakers and institutions should formalize HITL guidelines and invest in academic staff capacity building, and align AI tools with competency-based quality assurance requirements.

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