



Bound by the Weakest Link: A Systemic-Fidelity Framework for Competency-Based Curriculum Implementation in Resource-Constrained Education Systems

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Abstract

Competency-based curriculum (CBC) reforms have spread rapidly across the Global South, yet routinely underdeliver in resource-constrained education systems, where sound policy coexists with under-prepared teachers and inadequate facilities. Explanations tend to isolate a single culprit – policy incoherence, teacher unpreparedness or infrastructure deficits – and so cannot account for why reforms stall even when one or two conditions are met. This article develops an integrative theoretical framework, termed Systemic Fidelity, that reconceptualises CBC implementation as a property of an interdependent system rather than of any single reform strand. Drawing together systems theory and loose coupling, implementation-fidelity theory, Fullan's account of educational change, human-capital theory and the capability approach, the framework advances two core principles: implementation fidelity depends on the alignment among three subsystems (curriculum policy, human capacity and material infrastructure); and fidelity is bounded by the least-developed subsystem, the binding constraint, so that returns rise most from strengthening the weakest link. The framework yields testable propositions on interdependence, the design-enactment gap, capacity depth, loose coupling and sequencing, and it specifies boundary conditions and contextual moderators including leadership, culture, incentives and political economy. A secondary-data illustration from Kenya's CBC demonstrates the framework's diagnostic value, and a school-level assessment protocol is proposed to operationalise the diagnostic. The article offers a parsimonious, testable account of why competency-based reforms succeed or stall in low-resource settings, with implications for research and policy – notably that scarce resources should be directed first to the binding constraint.

Introduction

Over the past two decades, competency-based curriculum (CBC) reforms have become the dominant template for education change across much of the Global South. Systems from Kenya and Rwanda to South Africa, Ghana and beyond have moved, at least on paper, from content-heavy, examination-



driven schooling toward curricula built on competencies such as critical thinking, communication, creativity and collaboration, and on continuous, formative assessment (Chisholm & Leyendecker, 2008). The appeal is clear: competency-based education promises to equip young people for uncertain labour markets and civic life, and it aligns national systems with a global discourse of twenty-first-century skills. Yet the record of implementation is uneven and frequently disappointing. Reforms that are well designed at the level of policy are diluted, delayed or quietly abandoned at the level of the classroom, and the competencies that learners actually acquire fall short of what the curriculum envisages.

The explanations offered for this shortfall are numerous but strangely partial. Some accounts locate the problem in policy: reforms are said to be incoherent, poorly communicated or rushed. Others locate it in teachers: the workforce is under-prepared, trained under content-based systems, and inadequately retooled. Others still locate it in resources: schools lack the classrooms, laboratories, materials, and information and communication technology (ICT) that activity-based learning requires. Each explanation is supported by evidence, and each is incomplete. Single-factor accounts cannot explain why reforms stall even where one or two of the conditions for success are met, why the same policy produces high fidelity in some schools and near-zero fidelity in others, or why investment concentrated on one strand so often fails to move the needle. What is missing is a framework that treats these factors as parts of a single system and specifies how they combine to produce, or fail to produce, faithful implementation.

This article develops such a framework. It argues that the fidelity with which a competency-based curriculum is enacted is a systemic property, determined not by any single reform strand but by the alignment among three interdependent subsystems, curriculum policy, human capacity and material infrastructure, and by the level of the least-developed of them. The framework, termed Systemic Fidelity, integrates five theoretical traditions and yields a set of falsifiable propositions. Its central and most consequential claim is a weakest-link principle: in resource-constrained systems, implementation fidelity is bounded by the binding constraint, so that the reform can be no more faithful than its least-developed subsystem allows, and the largest marginal returns come from strengthening that subsystem rather than the one that is already strong.

The contribution is threefold. Theoretically, the article integrates fragmented, single-factor explanations into one parsimonious model and clarifies the mechanism, alignment and the binding constraint, that links reform inputs to implementation outcomes. Methodologically, it derives propositions that specify what to measure and how relationships should behave, giving empirical researchers a testable target. Practically, it reframes the resource-allocation problem facing education planners, replacing the intuition that every strand deserves equal attention with a diagnostic logic that identifies where scarce resources will do the best. The remainder of the article sets out the implementation puzzle, develops the theoretical building blocks, presents the Systemic-Fidelity framework and its propositions, illustrates it with Kenya's CBC, and draws out implications and boundary conditions.

A word on approach is warranted. The framework is developed through theory synthesis rather than data analysis: it integrates established constructs from several traditions into a coherent model, states the relationships among them as propositions, and specifies the conditions under which the model applies. This is a recognised and distinct form of scholarly contribution, and it is assessed by the coherence, parsimony and testability of the account it produces, and by its capacity to organise



fragmented findings and to generate new and falsifiable predictions. The framework is therefore evaluated here against those criteria, and its propositions are offered as an agenda for the empirical work they invite rather than as claims already established.

The implementation puzzle in competency-based reform

Competency-based reform is unusually demanding because it is systemic by design. Unlike a change of textbook or an added subject, it alters what schooling is expected to produce and therefore places simultaneous demands on every part of the system. The curriculum must be redefined around competencies and continuous assessment; teachers must relearn their craft to plan learner-centred lessons and assess performance rather than recall; assessment regimes must shift from terminal examinations to formative judgement; and the physical environment must accommodate practical, collaborative and project-based work. A reform of this scope cannot be delivered by decree, because its success depends on changes that must occur together and that reinforce one another (Fullan, 2016).

The literature on CBC implementation reflects this complexity but rarely captures it whole. Studies of curriculum policy show that reforms often falter in transmission, as frequent circulars and shifting requirements generate confusion at the school level and as leaders struggle to interpret and sequence them (Pale & Amukowa, 2020; Cheruiyot, 2024; Waruingi et al., 2022). Studies of teachers show that preparedness is a persistent constraint, with short cascade workshops leaving teachers confident in principle but unready in practice (Isaboke et al., 2021; Karua et al., 2025; Mwachabe et al., 2024). Studies of infrastructure show that facility and resource adequacy shape delivery, and that under-resourced and rural schools are systematically disadvantaged (Maiyuria et al., 2024; Maluha et al., 2025). Each body of work is valuable, and each, taken alone, implies that fixing its chosen factor would substantially improve implementation.

The difficulty is that the factors interact, and single-factor accounts cannot represent the interaction. A system may have an exemplary policy and willing teachers, and still fail to deliver practical learning if it lacks laboratories; it may have excellent facilities and clear policy, and still fail if teachers cannot use them; it may have capable teachers and adequate facilities, and still fail if the policy signal is garbled before it reaches the classroom. Because the factors are complements rather than substitutes, the marginal value of improving any one of them depends on the state of the others, and the reform as a whole is limited by whichever is weakest. A framework adequate to the puzzle must therefore be explicitly systemic: it must model the factors as interdependent subsystems and specify how their combination determines fidelity.

Existing integrative models go part of the way but stop short of the mechanism the puzzle requires. Evaluation frameworks that enumerate context, input, process and product usefully catalogue the categories that matter, but they are descriptive taxonomies rather than causal accounts, and they do not specify how the categories combine or which dominates when they conflict. General implementation-science models identify enabling and constraining conditions across levels of a system, but they are typically additive in spirit, treating more of each condition as uniformly and independently better, and so cannot capture the non-compensatory logic that a system of complements implies. What distinguishes the account developed here is precisely this claim: that the conditions for competency-based implementation are complements bound by a weakest link, a claim with specific and falsifiable consequences that additive taxonomies do not generate.



Theoretical foundations

The Systemic-Fidelity framework integrates five traditions, each contributing a distinct component of the argument. None of them alone accounts for CBC implementation; together they supply the mechanism the puzzle demands.

Systems theory and loose coupling

General systems theory conceptualises an organisation as a set of interdependent subsystems whose collective output depends on their coordination and on the state of the least-developed component (von Bertalanffy, 1968). Applied to schooling, it implies that curriculum, capacity and infrastructure are coupled components of one system rather than independent levers. The theory of loosely coupled systems refines this insight for education specifically, observing that the elements of school systems, from ministries to classrooms, are connected but preserve their own logics and identities, so that policy signals attenuate as they travel and intentions are only weakly transmitted into practice (Weick, 1976). Loose coupling explains why the same policy yields divergent fidelity across schools, and why implementation cannot be assumed to follow from adoption. It also implies that tightening the coupling, through monitoring, feedback and support, is itself a lever of fidelity.

Two implications of the systems view are central to what follows. First, because subsystem outputs are interdependent, the performance of the whole is not the sum of its parts but is constrained by their coordination and by their least-developed element, a property that additive models cannot represent. Second, because educational systems are loosely rather than tightly coupled, the transmission of policy into practice is lossy and variable, so that fidelity cannot be inferred from adoption and must be explained by the conditions that strengthen or weaken the coupling. The framework builds directly on both implications, treating interdependence and lossy transmission not as complications to be assumed away but as the substance of the phenomenon to be explained.

Implementation fidelity: design versus enactment

The implementation-fidelity tradition distinguishes a reform as designed from a reform as enacted and shows that outcomes depend on the degree to which the intended model is actually delivered (O'Donnell, 2008; Century et al., 2010; Century & Cassata, 2016). Fidelity is not a single quantity but a set of dimensions, including adherence to core components, dosage, quality of delivery and participant responsiveness, and it is shaped by the structural and support conditions in which delivery occurs. This tradition supplies the framework's dependent construct: what a competency-based reform is trying to achieve is not adoption but faithful enactment, and the gap between design and enactment is the phenomenon to be explained.

The tradition also guards against two opposite errors. The first is to equate implementation with adoption, counting schools that have taken up a reform as schools that are delivering it, an error that loose coupling makes both common and consequential. The second is to treat any local adaptation as a failure of fidelity, when some adaptation is necessary and even desirable in diverse contexts. The framework navigates between these by defining fidelity in terms of the core components a competency-based reform requires, namely learner-centred pedagogy, formative assessment and practical activity, while allowing that the surface forms through which these are realised will, and should, vary from school to school.

Educational change and policy cognition

Fullan's theory of educational change adds a process account of why reforms take hold, emphasising clarity of purpose, the deliberate building of capacity and coherence between policy and practice, and



warning that unclear or rushed communication breeds misinterpretation and resistance (Fullan, 2016). Complementing this, the policy-cognition perspective shows that implementers do not simply receive policy; they interpret it through existing frames and prior practice, so that the meaning of a reform is reconstructed at each level of the system (Spillane et al., 2002). Together these accounts specify one of the framework's key mechanisms: the fidelity of the policy subsystem depends less on the volume of directives than on the clarity, continuity and interpretability of the signal, and on the sense-making capacity of those who receive it.

The cognitive perspective has a further consequence for how reform should be communicated. If implementers reconstruct policy through prior frames and existing practice, then the burden on clear communication is heavier than a transmission model assumes, and the same quantity of guidance can either build or erode coherence depending on how interpretable it is and how consistent it remains over time. This is why the framework treats the quality of the policy signal, rather than its quantity, as the relevant variable, and why it predicts that frequent and poorly sequenced directives can lower fidelity even as they multiply the guidance available, a prediction directly at odds with the intuition that more direction is always better.

Human capital and the capability approach

Human-capital theory provides the rationale for investing in teachers, since the returns to a curriculum reform are realised only through the skills of those who deliver it (Becker, 1993), and the professional-development literature specifies that such investment raises practice only when it is sustained, content-focused, collective and coherent with the reform, rather than brief and generic (Desimone, 2011). The capability approach broadens the lens from inputs to real freedoms, asking not merely whether resources exist but whether actors can convert them into valued functionings (Sen, 1999). Applied here, it implies that a subsystem must be assessed by what it enables schools and teachers to actually do: a policy that cannot be interpreted, training that cannot be applied, or facilities that cannot be used contribute little to fidelity regardless of their nominal presence.

This convergence of human-capital and capability reasoning has a sharp implication for how the capacity subsystem should be assessed. Its level should be judged not by the volume of training delivered or by teachers' self-reported confidence, but by the pedagogical functions teachers can actually perform: designing a competency-based lesson, eliciting and judging evidence of a competency, and adapting instruction in response to that evidence. A capacity subsystem may appear well developed on input measures such as days of training or numbers reached, while remaining weak on this functioning-based criterion, and it is the latter that the framework treats as decisive. This provides the theoretical basis for the later proposition that confidence without depth produces only illusory readiness.

Diffusion and scale

Finally, the diffusion-of-innovations and scale literatures explain the temporal and spatial unevenness of reform. Innovations spread through a system at different rates depending on their compatibility, complexity, and observability (Rogers, 2003), and durable change requires depth and sustainability, not merely the numerical spread of adoption (Coburn, 2003). These perspectives caution against equating rollout with implementation and underline that faithful enactment at scale is a distinct and harder achievement than initial adoption, particularly for a reform as complex as competency-based education.



For the present framework, the diffusion and scale literatures serve chiefly as a corrective. They warn that the apparent progress of a reform, measured by the number of schools that have adopted it, can mask a near-total absence of faithful enactment, and that the challenge intensifies rather than eases as a reform moves from its pilot enthusiasts to the broad body of schools with weaker conditions and less voluntary commitment. This is why the framework centres fidelity rather than adoption, and why it expects the binding constraint to become more, not less, decisive as a reform scale into the resource-constrained majority of a system.

The Systemic-Fidelity framework

Synthesising these traditions, the Systemic-Fidelity framework models CBC implementation as the outcome of an interdependent system of three subsystems, mediated by fidelity and bounded by the weakest link. Its constructs are summarised in Table 1.

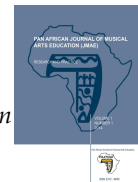
Table 1: Core constructs of the Systemic-Fidelity framework

Construct	Definition	Principal source
Curriculum-policy subsystem	The clarity, coherence, continuity and interpretability of curriculum goals, structure, assessment and their communication to schools	Fullan (2016); Spillane et al. (2002)
Human-capacity subsystem	The depth and breadth of teachers' pedagogical knowledge, skills and confidence for competency-based teaching and assessment	Becker (1993); Desimone (2011)
Material-infrastructure subsystem	The adequacy of classrooms, laboratories, materials, ICT and spaces required for practical, activity-based learning	von Bertalanffy (1968); resource studies
Alignment	The degree to which the three subsystems are mutually consistent and advance together	Systems theory; Fullan (2016)
Implementation fidelity	The degree to which the reform is enacted as designed (adherence, dosage, quality, responsiveness)	O'Donnell (2008); Century & Cassata (2016)
Binding constraint	The least-developed subsystem, which bounds the fidelity the system can achieve	Systems theory (weakest-link)
Coupling / feedback	The tightness of the links between policy signal and classroom practice, strengthened by monitoring and support	Weick (1976)

The core logic

The framework rests on two principles. The first is interdependence: the three subsystems are complements, so the effect on fidelity of strengthening any one of them rises with the level of the others. A better policy improves fidelity more when teachers can interpret and act on it and when facilities allow its enactment; better training improves fidelity more when policy is clear and facilities are adequate; better facilities improve fidelity more when teachers can use them and policy directs their use. This complementarity is why single-factor investment so often disappoints, and why alignment, the joint advancement of the subsystems, is itself a determinant of fidelity distinct from the level of any one subsystem.

The second principle is the weakest link. Because the subsystems are complements and because a competency-based reform requires all of them to function, implementation fidelity is bounded by the least-developed subsystem. A system with strong policy and capacity but weak infrastructure can be



no more faithful than its infrastructure permits, and additional investment in policy or capacity yields little until the binding constraint is relieved. Formally, fidelity is an increasing function of the minimum subsystem level and of alignment, moderated by the tightness of coupling: where coupling is loose, even a well-provisioned system loses fidelity in transmission, and monitoring and feedback that tighten coupling raise the fidelity attainable at any given subsystem level. The binding-constraint principle is the framework's most practically important claim, because it converts a vague injunction to improve everything into a diagnostic that identifies where improvement matters most.

Stated compactly, the framework holds that implementation fidelity is an increasing function of the minimum of the three subsystem levels and of their alignment, moderated by the tightness of coupling: fidelity rises with the minimum of policy, capacity and infrastructure, and with alignment, and the relationship between any one subsystem and fidelity is stronger where coupling is tighter. The core term is deliberately non-compensatory: raising a subsystem that already exceeds the minimum leaves the bound unchanged, whereas raising the minimum raises the bound. The additive intuition, that fidelity is a weighted sum of the three subsystems, is thus a limiting special case that holds only when the subsystems are perfect substitutes, which, for a reform that requires all three to function together, they are not. This is the formal sense in which the framework departs from the additive models that dominate current practice.

The design-enactment gap and symbolic implementation

A distinctive prediction of the framework concerns the character of failure. When policy runs ahead of capacity and infrastructure, the result is not random underperformance but a specific pathology, which may be called symbolic implementation: the forms of the reform are adopted while its substance is not. Schools display the vocabulary of competencies and the templates of continuous assessment, but lessons remain teacher-centred and assessment remains summative in all but name, because the capacity and the conditions for genuine enactment are absent. Symbolic implementation is the visible signature of a widening design-enactment gap, and the framework predicts that it will be most common precisely where a strong policy subsystem is paired with a weak capacity or infrastructure subsystem. This prediction distinguishes the framework from accounts that treat implementation as a matter of degree along a single continuum, because it identifies a qualitatively distinct state produced by subsystem misalignment, and it specifies where that state should be observed.

Dynamics: alignment and sequencing over time

The framework is dynamic as well as structural. Because the subsystems are complements, the trajectory of a reform depends not only on the levels the subsystems eventually reach but, on the order, and pace at which they advance. A reform that pushes curriculum policy rapidly while capacity and infrastructure lag open a design-enactment gap that, once opened, is difficult to close, because early experiences of symbolic or failed implementation harden into scepticism and resistance among the very teachers whose commitment the reform requires (Fullan, 2016). A reform that advances the subsystems in step, by contrast, keeps the gap narrow and allows each subsystem's development to raise the returns to the others, producing a virtuous rather than a vicious cycle. Sequencing is therefore not a matter of administrative convenience but a determinant of fidelity in its own right, and it is the temporal expression of the alignment principle: alignment must be maintained across time, not only achieved at a point.

Coupling, feedback and the tightening of transmission



Finally, the framework incorporates the mechanisms that govern how faithfully a policy signal reaches the classroom. In loosely coupled systems the default is attenuation: intentions dissipate as they travel, and monitoring is often confined to compliance reporting that reveals little about actual enactment. The framework treats the tightness of coupling as a moderator of the subsystem-fidelity relationship, one that is raised by feedback mechanisms which observe and support practice rather than merely audit it, such as in-school coaching, structured lesson observation and the routine use of implementation data to guide support. Because these mechanisms are comparatively inexpensive, they offer a means of raising attainable fidelity even before the binding material constraint is relieved, and they are a natural complement to, rather than a substitute for, investment in the weakest subsystem.

Contextual moderators: leadership, culture, incentives and political economy

The three subsystems and their coupling do not operate in a contextual vacuum. Four factors – leadership, culture, incentives and political economy – modify how the subsystems combine, and their omission would be indefensible in resource-constrained systems where these factors often shape whether reform advances at all. They are treated here as contextual moderators of the framework rather than as separate subsystems, because their function is to strengthen or weaken the operation of the three subsystems rather than to constitute additional load-bearing components in their own right.

School and system leadership moderates the framework's principal mechanisms. Effective instructional leadership at the school level tightens coupling between policy and classroom practice: leaders who translate reform documents into interpretable local guidance, hold teachers accountable to reform pedagogies, and protect time for professional learning reduce the transmission losses the framework identifies (Fullan, 2016). At the system level, leadership stability and administrative capacity determine whether reforms are sustained across political cycles or reset with each change of government, a moderator with particular force in Global South systems where reform continuity is often precarious.

Organisational and professional culture likewise moderates capacity and coupling. Where a professional culture treats teaching as a technical performance to be judged by inspection, the participatory pedagogies competency-based reform demands sit uneasily and are enacted symbolically. Where a culture treats teaching as a professional practice requiring collective inquiry, the same pedagogies find purchase. Community expectations shape the picture from below: in settings where an examination-oriented culture remains dominant, teachers report pressure to prepare learners for tests rather than to develop competencies, undermining the reform's intent regardless of how well the three subsystems are aligned.

Incentives shape whether teachers and school leaders act on the reform's demands. Where teacher remuneration, promotion criteria and school-level accountability metrics remain tied to examination results, teachers rationally allocate effort to what is measured rather than to what is intended. A strong capacity subsystem combined with an incentive structure that rewards examination performance produces high-quality examination coaching rather than competency development. In resource-constrained settings, the additional pressure of income supplementation through private tuition compounds this pattern.

Political economy sets the parameters within which the other three moderators operate. Which subsystems attract fiscal priority, whose interests curriculum reform serves, and which constituencies mobilise to defend or resist particular reform elements – these determine the shape and pace of



investment in the three subsystems the framework identifies. The framework is silent on whose reform this is, but the answer to that question shapes whether infrastructure gets funded, whether teacher unions engage constructively, and whether reform survives changes of government.

These moderators are integrated into the framework as external multipliers on the subsystem scores and their alignment: a system with equal subsystem scores in two different political-economic contexts will not achieve equal implementation fidelity. An additional proposition (P8) accordingly states: leadership, professional culture, incentive alignment and political-economy conditions strengthen or weaken the operation of the three-subsystem mechanism, and their measurement is a necessary condition for testing the framework in any specific setting. The framework's earlier propositions should be read as holding within a context bounded by these moderators, and empirical tests should measure them explicitly rather than treat them as noise.

Propositions

The framework yields the falsifiable propositions set out in Table 2. They specify how the constructs should relate if the framework is correct, and they are designed to be testable with the kinds of data that education researchers can realistically gather.

Table 2: Propositions of the Systemic-Fidelity framework

	Proposition
P1 (Interdependence)	The marginal effect of strengthening any one subsystem on implementation fidelity increases with the level of the other two.
P2 (Weakest link)	Implementation fidelity is bounded by the least-developed subsystem; the marginal return to investment is greatest for the binding constraint.
P3 (Design-enactment gap)	The gap between reform-as-designed and reform-as-enacted widens as subsystem misalignment increases; high policy clarity with low capacity or infrastructure produces symbolic rather than substantive implementation.
P4 (Signal, not volume)	Fidelity increases with the clarity and continuity of policy communication and decreases with the frequency of poorly sequenced directives, independent of the number of directives issued.
P5 (Depth over confidence)	Professional development raises fidelity only when it reaches sufficient coverage and depth; gains in teacher confidence without gains in pedagogical depth produce illusory readiness and do not raise fidelity.
P6 (Coupling)	Tighter coupling between policy and practice, through monitoring, coaching and feedback, raises the fidelity attainable at any given level of the three subsystems.
P7 (Sequencing)	Reforms that advance the three subsystems in step achieve higher fidelity than those that advance one subsystem ahead of the others.
P8 (Differentiated equity)	Because binding constraints are more severe in under-resourced settings, uniform national reform without differentiated support widens the between-school inequality of implementation.

The propositions fall into three clusters. The first, comprising P1 and P2, states the framework's structural core: the subsystems are complements (P1), and fidelity is bounded by the weakest of them (P2). The second, P3 through P6, specifies the mechanisms through which the structure operates: the design-enactment gap and symbolic implementation (P3), the primacy of signal quality over volume (P4), the primacy of pedagogical depth over confidence (P5), and the moderating role of coupling (P6).



The third, P7 and P8, draws out the dynamic and distributional consequences: sequencing governs fidelity over time (P7), and uniform reform imposed over uneven constraints widens inequality (P8). The clusters move from structure to mechanism to consequence, and each proposition is stated so that evidence could in principle disconfirm it, which is the property that distinguishes a framework from a description.

Relationship to existing perspectives

The framework is best understood in relation to the perspectives it integrates and extends. From evaluation traditions that catalogue context, input, process and product it borrows the insistence that multiple conditions matter, but it replaces their descriptive additivity with a causal, non-compensatory structure. From implementation science it takes the attention to multi-level enabling and constraining conditions, but it specifies a mechanism, complementarity and the weakest link, that generates predictions those inventories do not. From Fullan's theory of change it adopts coherence and capacity as central concerns, and reconceives them as properties of subsystem alignment rather than as free-standing prescriptions. From the fidelity tradition it takes its dependent construct, and supplies that construct with a systemic determinant. The framework's originality lies not in any single borrowed element but in their integration under a weakest-link logic that yields a compact, testable and practically diagnostic account. In this sense it is less a rival to these perspectives than a synthesis that makes their combined implications precise, and in doing so converts a set of complementary insights into a single mechanism with falsifiable consequences.

Illustration: Kenya's competency-based curriculum

Kenya's CBC, introduced through the 2017 Basic Education Curriculum Framework, offers an instructive illustration of the framework's explanatory value (Heto et al., 2020). The reform replaced the examination-centred 8-4-4 system with a learner-centred model built on competencies and continuous assessment, and it has been rolled out progressively and at considerable speed. Its experience maps closely onto the framework's constructs and principles, without being treated here as a formal test.

Consistent with a well-developed policy subsystem, Kenyan evidence indicates that the reform's architecture is broadly understood: teachers and school leaders recognise the competency-based orientation and the shift toward participatory methods, and the structure and organisation of content are widely seen to have improved (Pale & Amukowa, 2020). Consistent with P4, the residual difficulty in this subsystem lies not in the design of policy but in the signal, as frequent circulars and a compressed timeline generate confusion at the school level (Cheruiyot, 2024; Waruingi et al., 2022). The human-capacity subsystem displays the pattern P5 predicts: retooling has raised teachers' skills and confidence, yet coverage and depth remain insufficient, and studies across counties report teachers who feel more confident than they are prepared (Isaboke et al., 2021; Karua et al., 2025; Atonya et al., 2026). The material-infrastructure subsystem is the most constrained, with shortages of laboratories, ICT, libraries and flexible spaces widely reported and with resource adequacy shown to shape delivery (Maiyuria et al., 2024; Maluha et al., 2025).

The framework's weakest-link principle offers a parsimonious reading of this configuration. Kenya's CBC has a comparatively strong policy subsystem, a moderately developed capacity subsystem and a weak infrastructure subsystem, and the framework predicts that implementation fidelity will be bounded by the last of these. The prediction is consistent with the recurrent finding that, despite understood policy and improving teacher confidence, the practical, hands-on core of the CBC is the



hardest to enact where facilities are lacking, and with comparative evidence from neighbouring systems in which infrastructure shortfalls similarly cap otherwise sound reforms (Muzvondiwa & Gudyanga, 2024; Chisholm & Leyendecker, 2008). Read through the framework, the Kenyan case is not a story of policy failure or teacher failure but of a system bounded by its weakest subsystem, in which the largest gains in fidelity are to be had by relieving the infrastructure constraint while advancing capacity in step.

What the framework adds to the Kenyan case is explanatory economy. A policy-centred account struggles to explain why a widely understood curriculum is unevenly enacted; a teacher-centred account struggles to explain why more confident and better-trained teachers still fall short where facilities are absent; a resource-centred account struggles to explain why well-provisioned schools still falter where the policy signal is garbled. The Systemic-Fidelity framework accommodates all three observations within a single logic: each subsystem is necessary, none is sufficient, and the system is bounded by whichever is weakest, so that the observed configuration of strong policy, moderate capacity and weak infrastructure implies that infrastructure is the current binding constraint. The framework also explains the otherwise puzzling coexistence of high reported teacher confidence with low practical delivery as an instance of symbolic implementation produced by subsystem misalignment, rather than as measurement error or misreport. This economy, explaining several disparate observations with one mechanism, is the mark of a useful framework.

For Kenyan policy specifically, the framework implies a shift in the terms of debate. The recurring question of whether the CBC has succeeded or failed is, on this account, poorly posed, because the reform's fate is neither uniform nor settled: it is bounded, school by school, by whichever subsystem is weakest, and it can be improved wherever that constraint is relieved. The more useful questions are diagnostic and local: in this school, and in this sub-county, which subsystem binds, and what is the least-cost way to relieve it while keeping the three subsystems in alignment? Posed this way, the Kenyan experience becomes not a verdict on the reform but a map of where effort will repay itself, which is precisely the practical contribution the framework is designed to make.

A secondary-data empirical illustration

The Kenyan illustration can be strengthened with a secondary-data scoring exercise that applies the school-level diagnostic protocol described below to the published evidence base. Drawing on peer-reviewed studies conducted in Kenyan primary and junior schools between 2020 and 2026, three subsystem scores can be assembled on the 0–4 rubric introduced in the next section.

On the policy subsystem, Kenyan studies indicate broad teacher awareness of the CBC's competency orientation and the availability of syllabus documents, though with recurring concerns about the pace of circular changes and the interpretability of assessment guidance (Cheruiyot, 2024; Heto et al., 2020; Pale & Amukowa, 2020). This warrants a policy score in the moderate-to-strong range, provisionally 3 on the 0–4 scale.

On the capacity subsystem, the picture is mixed. Studies report substantial gaps in teacher preparedness in urban primary schools and remote sub-counties alike, with in-service training reaching a minority of teachers and observed pedagogical practice frequently falling short of the reform's participatory intent (Atonya et al., 2026; Isaboke et al., 2021; Kalla et al., 2025; Karua et al., 2025; Mwichabe et al., 2024). This warrants a capacity score in the weak-to-moderate range, provisionally 2.



On the infrastructure subsystem, the evidence is more uniformly negative. Studies across counties document under-equipped laboratories, insufficient learner materials, and unmet ICT requirements, with private-school infrastructure often substantially better than public-school infrastructure although the public sector serves the vast majority of learners (Maiyuria et al., 2024; Maluha et al., 2025; Waruingi et al., 2022). This warrants an infrastructure score in the weak range, provisionally 1.

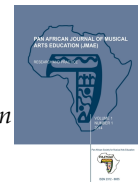
Applying the framework's weakest-link principle, infrastructure emerges as the binding constraint on Kenya's CBC implementation at the time of this writing. The framework predicts that further gains in policy clarity or teacher training will yield diminishing marginal returns on implementation fidelity unless matched by infrastructure investment, and that symbolic implementation – the ritual performance of CBC forms without the substantive shift in learning – will persist wherever infrastructure remains the weakest link. This is a testable claim: the same scoring exercise conducted in schools with strong infrastructure investment should show higher implementation fidelity than in schools with equivalent policy and capacity scores but weaker infrastructure. Existing Kenyan evidence is consistent with this prediction (Maiyuria et al., 2024; Maluha et al., 2025), and a formal cross-school test would be a valuable next step. The scoring is provisional on the published record and will shift as fresh evidence is collected under the assessment protocol described in the following section.

Implications for research

The framework is designed to be tested, and its propositions specify how. Each subsystem can be operationalised as a latent construct measured by multiple indicators, curriculum policy through clarity, coherence and communication measures, capacity through validated instruments of pedagogical knowledge and the depth as well as the breadth of training, and infrastructure through audited adequacy of facilities and materials. Implementation fidelity should be measured directly, through observation of core CBC practices and assessment behaviours, rather than inferred from adoption or self-reported use, since the framework's central distinction is between adoption and faithful enactment.

The propositions imply particular analytical strategies. The interdependence proposition (P1) predicts interaction rather than merely additive effects, and is tested by interaction terms or by comparing the marginal effect of each subsystem across levels of the others. The weakest-link proposition (P2) predicts a non-compensatory, minimum-type relationship rather than a linear-additive one, and can be tested by comparing the fit of a model in which fidelity is a function of the minimum subsystem level against an additive model, or by examining whether returns to investment concentrate on the binding constraint. The coupling proposition (P6) predicts that monitoring and support moderate the subsystem-fidelity relationship. The equity proposition (P8) predicts widening between-school variance in fidelity under uniform reform, testable with multilevel variance-decomposition across schools of differing resource levels. Longitudinal and comparative designs, across schools, counties and systems, are especially valuable because the framework is dynamic: it concerns not only levels but the alignment and sequencing of change over time.

Measuring alignment and complementarity poses the most interesting methodological challenge, and meeting it would allow the framework's two structural propositions to be tested directly rather than by proxy. Alignment can be approached as the concordance among the three subsystem scores within a school or system, for example through the dispersion of standardised subsystem levels, with lower dispersion indicating tighter alignment; the framework predicts that, holding the mean subsystem



level constant, lower dispersion is associated with higher fidelity. Complementarity, the degree to which the subsystems are non-substitutable, can be estimated from the form of the interaction between subsystems in predicting fidelity, and is itself expected to vary across settings and to be greater for the most practically demanding components of the reform. A programme that measured these quantities across many schools would move the framework from plausible synthesis toward tested theory.

Because the framework is general, it also invites tests beyond Kenya and beyond the CBC. Any systemic reform that requires the joint functioning of policy, capacity and material conditions, from inclusive education to digital-learning initiatives, is a candidate domain. Comparative application would establish the boundary conditions of the weakest-link logic and refine the framework's constructs.

Implications for policy and practice

For education planners, the framework's most useful output is a diagnostic. Rather than distributing effort evenly across reform strands, planners should first identify the binding constraint, the least-developed subsystem in a given setting, and direct marginal resources there, because that is where investment yields the greatest gain in fidelity. In systems resembling Kenya's, this implies prioritising the physical and material conditions of learning, laboratories, ICT and flexible spaces, alongside the sustained deepening of teacher capacity, while treating policy communication as a problem of clarity and continuity rather than of additional directives.

The sequencing proposition (P7) carries a second practical lesson: reforms should advance the three subsystems in step. A phased plan that pairs each tranche of curriculum guidance with the training and facilities required to enact it will achieve higher fidelity than a plan that races policy ahead of capacity and infrastructure, which is the pattern that produces symbolic implementation. The coupling proposition (P6) adds a third lesson at modest cost: institutionalised monitoring and school-based coaching, which tighten the link between policy and practice, and community engagement, which mobilises local resources and ownership, both raise attainable fidelity without the expense of infrastructure. Finally, the equity proposition (P8) warns that uniform national reform, applied without differentiated support to schools with different binding constraints, will widen rather than narrow the inequality of implementation, and that equity therefore requires resourcing to be targeted at the settings where constraints bind hardest.

Applying the diagnostic requires a defined assessment procedure, specified in the following subsection. Systems need a means of scoring the three subsystems at the level of the school or the district, so that the binding constraint can be identified where it actually bites rather than assumed from national averages. Such an assessment need not be elaborate: a short audit of facilities, a validated measure of teacher pedagogical readiness, and an appraisal of the clarity and continuity of policy communication would together locate the constraint with sufficient accuracy to guide allocation. Building this capability is itself a form of the coupling the framework commends, because the act of assessing enactment tightens the link between the centre and the classroom and creates the feedback on which faithful implementation depends.

Operationalising the diagnostic: a school-level assessment protocol

The framework's practical utility depends on a means by which a school or district can score its three subsystems, compare them, and identify the binding constraint. The following protocol operationalises the diagnostic without demanding heavy assessment infrastructure. Each subsystem



is scored on a 0–4 rubric anchored to observable indicators, with the anchors chosen so that resource-constrained systems can apply them using teacher committees rather than external evaluators.

For the curriculum-policy subsystem, three indicators are combined: (i) teachers' correct account of the CBC's competency logic when asked to describe what a competency-based lesson requires, verified against a brief written script; (ii) the presence and interpretability of current syllabus and assessment guidance at the school, in physical or digital form; and (iii) evidence that recent circulars have been read and acted upon in the period since their issue.

For the human-capacity subsystem, four indicators are combined: (i) the proportion of teachers who have completed the current in-service programme; (ii) a short lesson-observation rubric that scores whether observed practice is participatory, differentiated and formative-assessment oriented; (iii) teachers' self-reported readiness cross-checked against observation; and (iv) the presence of school-based peer learning or coaching structures.

For the material-infrastructure subsystem, three indicators are combined: (i) the pupil-to-relevant-facility ratio for laboratories, libraries and ICT resources against the curriculum's stated requirements; (ii) the availability of learner and teacher materials aligned with the current curriculum; and (iii) the working condition of these facilities and materials at the time of assessment, not merely their presence in a school inventory.

Each subsystem's indicator scores are averaged to produce a subsystem score from 0 to 4. The binding constraint is identified as the subsystem with the lowest score, with the caveat that where two subsystems fall within a specified tolerance of each other (a difference of less than 0.5), both are treated as candidate constraints and monitored in the next reform cycle. Alignment is estimated as the range across the three subsystem scores: a range greater than 2 signals a system in which the weakest link is doing severe damage to fidelity, and a range under 1 signals a system whose subsystems are advancing broadly in step. The assessment can be conducted annually by the school leadership together with a small teacher committee, and quarterly during phases of active reform. Aggregation to the district or national level uses the same instrument. This is deliberately a minimum-viable assessment; districts with greater capacity can substitute richer instruments – structured observation protocols, standardised teacher assessments, or formal facility audits – without changing the diagnostic logic. The point is that the framework specifies what to measure and how to compare, so that even modest data collection can direct scarce resources to where they will move fidelity most.

Boundary conditions and scope

The framework's claims are strongest under the conditions that characterise resource-constrained systems undertaking systemic, competency-based reform. Three boundary conditions deserve emphasis. First, the weakest-link logic depends on the subsystems being genuine complements; where a subsystem can substitute for another, for example where highly capable teachers improvise around missing facilities, the minimum-type relationship weakens toward an additive one, and the binding-constraint prescription softens. The degree of complementarity is thus an empirical parameter, not an assumption, and is itself worth measuring. Second, the framework assumes meaningful variation in subsystem levels; in well-resourced systems where all three subsystems are highly developed, fidelity will be governed by finer factors than the framework foregrounds, and the weakest-link principle becomes less salient. Third, the framework treats fidelity as the appropriate implementation criterion, which presumes that the reform-as-designed is itself sound; where the design is flawed, high fidelity



is not desirable, and the framework must be paired with an independent evaluation of the reform's design.

These boundary conditions delimit rather than diminish the framework. They specify the domain in which the weakest-link logic is expected to hold, and they identify the parameters, complementarity, subsystem variation and design quality, that determine how strongly it applies. In doing so they render the framework more testable, since its scope is stated in advance.

A further boundary condition concerns the level of analysis. The weakest-link logic is stated at the level of the school, where the three subsystems meet in the delivery of lessons, and it applies to higher levels, the district or the national system, only through aggregation. Because binding constraints may differ across schools within the same system, a system-level average can conceal the very heterogeneity the framework foregrounds, so that the framework is most powerful when applied at the level at which enactment actually occurs. This is not a weakness of the logic but a specification of where it bites, and it reinforces the practical recommendation that constraints be diagnosed locally rather than inferred from national aggregates.

Limitations of the framework

As a theoretical contribution, the framework is offered as a coherent and testable account, not as an established finding. Its propositions await systematic empirical test, and the illustration from Kenya, while consistent with the framework, is not a confirmation of it. The framework simplifies, as frameworks must: it reduces a complex system to three subsystems and one mediator, and it treats fidelity as a single, if multidimensional, construct. Reality includes further factors, among them leadership, culture, incentives and political economy, now integrated as contextual moderators on the framework's mechanism (see the Contextual moderators section) rather than deferred to future work. The measurement of the constructs, especially alignment and the degree of complementarity, will require methodological work. These are the ordinary limitations of a young framework, and they are best read as an agenda for the research the framework is meant to provoke.

Conclusion

Competency-based curriculum reforms are systemic undertakings, and their implementation cannot be understood, or improved, one factor at a time. This article has argued that the fidelity with which such reforms are enacted in resource-constrained systems is a property of an interdependent system of curriculum policy, human capacity and material infrastructure, and that it is bounded by the least-developed of these subsystems. The Systemic-Fidelity framework integrates systems theory and loose coupling, implementation-fidelity theory, educational-change and policy-cognition perspectives, human-capital and capability theory, and the diffusion and scale literatures into a parsimonious model, and it derives testable propositions and explicit boundary conditions. Its central lesson is both theoretical and practical: because a competency-based reform can be no more faithful than its weakest subsystem allows, the path from the promise of the curriculum to its realisation in classrooms runs through the binding constraint. Identifying that constraint, relieving it, and advancing the subsystems in step, offers a more disciplined route to reform than the even distribution of effort that current practice too often assumes. The framework now requires the empirical testing its propositions invite, in Kenya and in the many other systems attempting the same difficult transformation.



References

- Atonya, B. M., Maragia, S., & Sulungai, M. (2026). Status of teachers' pedagogical knowledge and the implementation of competency-based curriculum in public primary schools in Sabatia Sub-County, Kenya. *East African Journal of Education Studies*, 9(1), 367-381. <https://doi.org/10.37284/eajes.9.1.4414>
- Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis, with special reference to education* (3rd ed.). University of Chicago Press.
- Century, J., & Cassata, A. (2016). Implementation research: Finding common ground on what, how, why, where, and who. *Review of Research in Education*, 40(1), 169-215. <https://doi.org/10.3102/0091732X16665332>
- Century, J., Rudnick, M., & Freeman, C. (2010). A framework for measuring fidelity of implementation. *American Journal of Evaluation*, 31(2), 199-218. <https://doi.org/10.1177/1098214010366173>
- Cheruiyot, B. (2024). Challenges faced in the implementation of competency-based curriculum (CBC) in junior schools in Kenya. *East African Journal of Education Studies*, 7(3), 260-266. <https://doi.org/10.37284/eajes.7.3.2098>
- Chisholm, L., & Leyendecker, R. (2008). Curriculum reform in post-1990s sub-Saharan Africa. *International Journal of Educational Development*, 28(2), 195-205.
- Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher*, 32(6), 3-12. <https://doi.org/10.3102/0013189X032006003>
- Desimone, L. M. (2011). A primer on effective professional development. *Phi Delta Kappan*, 92(6), 68-71. <https://doi.org/10.1177/003172171109200616>
- Fullan, M. (2016). *The new meaning of educational change* (5th ed.). Teachers College Press.
- Heto, P. P.-K., Odari, M. H., & Sunu, W. K. (2020). Kenya's 2017 basic education curriculum framework: A comprehensive review. *Journal of Interdisciplinary Studies in Education*, 9(Special Issue), 192-210. <https://www.ojed.org/index.php/jise/article/view/1853>
- Isaboke, H., Mweru, M., & Wambiri, G. (2021). Teacher preparedness and implementation of the competency-based curriculum in public pre-primary schools in Nairobi City County, Kenya. *International Journal of Current Aspects*, 5(3), 32-53. <https://doi.org/10.35942/ijcab.v5i3.186>
- Kalla, P. H., Kanga, A., & Wambiya, P. (2025). Teacher retooling and effective implementation of the competency-based curriculum in North Horr Ward, Marsabit County, Kenya. *Journal of Education and Practice*, 9(2), 77-96. <https://doi.org/10.47941/jep.2654>
- Karua, G. W., Manyasi, B., & Kara, A. (2025). Teacher preparedness to implement competency based curriculum in public primary schools in Kinangop Sub County, Kenya. *International Journal of Scientific Research and Management*, 13(2), 22-41. <https://doi.org/10.18535/ijssrm/v13i02.ee01>
- Maiyuria, M. N., Mackatiani, C. I., & Gakunga, D. K. (2024). Competency based curriculum in Kenya: Impact of resources on implementation of the programme. *International Journal of Research and Innovation in Social Science*, 8(8), 3659-3668. <https://doi.org/10.47772/IJRISS.2024.8080271>
- Maluha, D. N., Gakunga, D. K., & Mackatiani, C. I. (2025). Influence of school infrastructure on implementation of competency-based curriculum in public and private primary schools, Vihiga County, Kenya. *East African Journal of Education Studies*, 8(2), 29-37. <https://doi.org/10.37284/eajes.8.2.2826>
- Muzvondiwa, E., & Gudyanga, A. (2024). An evaluation of preparedness of government high schools in the implementation of the competence based curriculum (CBC) in Gweru district, Zimbabwe. *Cogent Education*, 11(1), 2380625. <https://doi.org/10.1080/2331186X.2024.2380625>



- Mwichabe, W., Barasa, J., & Maiyo, J. (2024). Influence of types of training on teachers' preparedness for the implementation of the competency-based curriculum in Trans-Nzoia County, Kenya. *International Journal of Science and Research Archive*, 13(1), 946-954.
- O'Donnell, C. L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K-12 curriculum intervention research. *Review of Educational Research*, 78(1), 33-84. <https://doi.org/10.3102/0034654307313793>
- Pale, J. W., & Amukowa, D. (2020). Competency based curriculum in primary schools in Kenya: Opportunities and challenges of implementation. *Journal of Education and Practice*, 11(32), 50-56. <https://doi.org/10.7176/jep/11-32-06>
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Sen, A. (1999). *Development as freedom*. Oxford University Press.
- Spillane, J. P., Reiser, B. J., & Reimer, T. (2002). Policy implementation and cognition: Reframing and refocusing implementation research. *Review of Educational Research*, 72(3), 387-431. <https://doi.org/10.3102/00346543072003387>
- Von Bertalanffy, L. (1968). *General system theory: Foundations, development, applications*. George Braziller.
- Waruingi, A. W., Mbogo, R., & Mambo, A. (2022). Assessment of challenges faced by principals in the implementation of the competency-based curriculum in public primary schools in Kenya: A case of Kiambu County. *Journal of Education*, 2(2), 26-39.
- Weick, K. E. (1976). Educational organizations as loosely coupled systems. *Administrative Science Quarterly*, 21(1), 1-19. <https://doi.org/10.2307/2391875>