



DEVELOPING SCHOOL PRINCIPALS' MANAGEMENT COMPETENCIES THROUGH INTERNATIONAL LARGE-SCALE ASSESSMENT DATA: A STRUCTURAL AND FUNCTIONAL MODEL

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Abstract. *International large-scale assessments generate achievement and contextual data with considerable diagnostic value, yet the route from system-level evidence to a school principal's professional learning and school-improvement decisions remains insufficiently specified. This conceptual study develops a structural and functional model for strengthening principals' management competencies through responsible use of such data. An integrative design synthesis was conducted on a purposive corpus of 27 regulatory, methodological and scholarly sources. Comparative content analysis, functional decomposition, construct mapping and logic modelling were used to connect assessment evidence, leadership action, professional-learning mechanisms, observable workplace products and feedback decisions. The resulting model contains six interdependent blocks: goal and methodology; diagnosis and analysis; content and process; collaboration and resources; monitoring and reflection; and outcomes. Five implementation mechanisms operationalise the structure: a multi-source diagnostic profile, data-informed strategic decision-making, workplace professional learning with pedagogical leadership, an organisational data team, and digital monitoring with reflective adjustment. Its distinctive feature is the coupling of an individual competence-development loop and a school-improvement loop through a shared evidence portfolio. Outcomes are defined at individual, enacted-practice and organisational-routine levels; student achievement is treated as a distal indicator rather than a direct measure of principal competence. The model offers a traceable architecture for principal certification and continuing professional development while retaining an invariant core that can be adapted to local conditions. As a theoretical design, it requires subsequent expert review and longitudinal empirical validation.*

Keywords: *international large-scale assessments; school principals; management competencies; data-informed decision-making; pedagogical leadership; professional learning; school improvement; structural and functional model*

Annotatsiya. *Xalqaro yirik ko'lamli baholash dasturlari o'quv natijalari bilan birga maktab muhiti va ta'lim jarayoniga oid kontekst ma'lumotlarini ham taqdim etadi, biroq tizim darajasidagi dalilni direktorning kasbiy rivojlanishi va maktabni takomillashtirish qaroriga aylantirish yo'li yetarlicha aniqlashtirilmagan. Maqolaning maqsadi xalqaro*



baholash ma'lumotlaridan mas'uliyatli foydalanish orqali maktab direktorlarining boshqaruv kompetensiyalarini rivojlantirish strukturaviy-funksional modelini ishlab chiqishdir. 27 ta normativ, metodologik va ilmiy manba integrativ loyihaviy sintez, qiyosiy kontent-tahlil, funksional dekompozitsiya va konstrukt xaritalash usullarida o'rganildi. Natijada o'zaro bog'langan oltita blok va beshta amalga oshirish mexanizmi asoslandi. Modelning o'ziga xos jihati individual kompetensiya rivoji hamda maktabni takomillashtirish konturlarini ish joyida yaratiladigan yagona daliliy portfel orqali tutashtirishidir. Natijalar individual, amaliy faoliyat va tashkiliy tartiblar darajasida belgilanadi; o'quvchi natijasi direktor kompetensiyasining bevosita o'lchovi emas, uzoq natija sifatida qaraladi. Model ekspert baholashi va longitudinal empirik validatsiyani talab qiladigan nazariy loyiha sifatida taklif etiladi.

Kalit so'zlar: *xalqaro baholash dasturlari; maktab direktori; boshqaruv kompetensiyasi; ma'lumotga asoslangan qaror; pedagogik liderlik; kasbiy rivojlanish; maktabni takomillashtirish; strukturaviy-funksional model*

Аннотация. *Международные крупномасштабные оценивания формируют данные об учебных результатах и контексте, однако путь преобразования системных данных в профессиональное развитие директора и решения по совершенствованию школы остается недостаточно определенным. Цель статьи — разработать структурно-функциональную модель развития управленческих компетенций директоров школ посредством ответственного использования данных международных оцениваний. Интегративный проектный синтез 27 нормативных, методологических и научных источников сочетал сравнительный контент-анализ, функциональную декомпозицию, картирование конструкта и логическое моделирование. Обоснованы шесть взаимосвязанных блоков и пять механизмов реализации. Отличительной особенностью модели является соединение контура индивидуального развития компетенций и контура совершенствования школы через единый портфель доказательств, создаваемый на рабочем месте. Результаты определены на индивидуальном, деятельностном и организационном уровнях; достижения учащихся рассматриваются как отдаленный индикатор, а не как прямое измерение компетенции директора. Теоретическая модель предназначена для последующей экспертной оценки и продольной эмпирической валидации.*

Ключевые слова: *международные крупномасштабные оценивания; директор школы; управленческие компетенции; решения на основе данных; педагогическое лидерство; профессиональное развитие; совершенствование школы; структурно-функциональная модель*

1. INTRODUCTION

International large-scale assessments (ILSAs) have changed the evidence

environment in which school systems operate. They do more than report average achievement: their frameworks connect



constructs, tasks, proficiency descriptions and contextual questionnaires, allowing decision-makers to examine how opportunities to learn, school climate and resources relate to student outcomes. The leadership challenge is therefore not a shortage of indicators. It is the lack of a disciplined translation architecture that links a defensible interpretation of those indicators to a bounded school problem, a professional-learning need and an observable management action. Leadership matters most when it organises these mediating conditions rather than when it is treated as a direct cause of test scores [8; 11].

PISA illustrates this expanded evidence environment by measuring how students apply knowledge while also collecting contextual information relevant to equity and learning conditions. TALIS complements student assessments by examining teachers' and school leaders' work, professional learning, collaboration and institutional conditions. Both programmes are primarily designed for system-level comparison and policy learning. Their value at school level depends on whether a principal can distinguish a population signal from evidence that is sufficiently local to guide action [3; 4]. A published national or international association should thus initiate inquiry, not substitute for school-level diagnosis.

The same principle applies across IEA studies. TIMSS links mathematics and science achievement to curriculum and learning context; PIRLS relates

reading achievement to home, classroom and school conditions; ICILS examines computer and information literacy and computational thinking within digital learning environments. These programmes differ in target populations, constructs and questionnaire designs, so their indicators cannot be merged as interchangeable measures [5; 6; 7]. For principals, this diversity creates a competency demand: they must understand the question each data source can answer, the inference it cannot support, and the additional evidence needed before a management response is justified.

Research on educational data use repeatedly shows that the mere availability of dashboards or reports does not produce better decisions. Data become actionable through problem framing, interpretive routines, professional judgement, collaborative sense-making and monitoring. Data literacy therefore includes statistical comprehension, knowledge of educational processes and the capacity to convert an interpretation into a responsible course of action [18; 19]. This article uses the term data-informed to emphasise that assessment evidence contributes to a decision together with curricular aims, practitioner knowledge, contextual constraints and ethical considerations; it does not mechanically determine the decision.

Uzbekistan's current policy context makes this translation problem especially relevant. The management certification procedure for candidates to public-school



principals establishes an institutional entry point for developing and assessing managerial capacity, while the national framework for continuous professional development creates opportunities for learning beyond a one-off course [1; 2]. The unresolved design issue is how certification, workplace learning and school-improvement activity can be connected through the same competency construct and the same evidence cycle. Without that connection, training may remain detached from the problems principals are expected to solve.

National scholarship also points to the importance of treating educational quality as a managed process supported by monitoring rather than as a single final indicator. M.U. Axmedov's work on mechanisms for managing general secondary education quality, the pedagogical meaning of quality, and the improvement of monitoring in principal development provides a locally relevant foundation for this position [15; 16; 17]. The present article extends that line of reasoning by specifying how international assessment evidence can enter a principal-development mechanism without replacing local monitoring or professional judgement.

Existing leadership standards describe domains such as vision, instructional leadership, professional capacity, community engagement and improvement. Research on data use explains how educators interpret evidence, while studies of professional learning identify the conditions under which

knowledge is transferred into practice. What remains less explicit is the functional connection among these domains: which evidence object activates which management competency, through which learning mechanism, producing which workplace artefact, and triggering which feedback decision. A list of competencies cannot answer this process question, and a training programme cannot answer it unless its internal causal logic is made visible.

Accordingly, the study asks three questions. First, what competency demands arise when a principal uses ILSA outcome and contextual data responsibly at school level? Second, which structural blocks and implementation mechanisms can connect those demands to workplace learning and school improvement? Third, how can the model preserve a stable theoretical core while remaining adaptable to different schools and regions? The study's contribution is a traceable structural and functional model in which evidence, professional action, developmental support, observable product and feedback decision are explicitly connected. The model is presented as a theoretical design, not as proof of intervention effectiveness.

2 Materials and methods

2.1 Study design and source corpus

The study employed an integrative design synthesis. This approach was selected because the research problem spans regulatory requirements, assessment frameworks, leadership theory, data-use research and professional-learning design.



It does not claim the exhaustive coverage or effect estimation of a systematic review. Instead, it combines theoretically informative sources to construct and examine a model whose components must be coherent and open to subsequent testing. Guidance on integrative reviewing informed the transparent selection and synthesis procedure, while conceptual-framework methodology informed the iterative movement from concepts to relationships and propositions [25; 26].

The purposive corpus comprised 27 sources in five groups: two Uzbek regulatory documents; five official ILSA and international-policy publications; five leadership standards or foundational leadership texts; three Uzbek and Russian-language works by M.U. Axmedov relevant to school-quality management; and twelve studies or methodological publications on data use, improvement, workplace learning, conceptual design and measurement. Sources were eligible when they defined an assessment evidence object, a leadership or management function, a professional-development mechanism, an implementation condition or a valid outcome indicator. Professional leadership standards were included because they articulate observable expectations that a developmental model should address [9; 10; 13].

Documents were read in full where available and entered into an analytical matrix. Six fields were coded for each relevant proposition: evidence object; inference boundary; required leadership action; competence dimension; enabling

mechanism; and observable product or decision. The coding unit was a complete proposition rather than an isolated keyword. For example, a statement about contextual questionnaires was coded only when it specified what the information represented and how it could be interpreted. Measurement standards were used to distinguish a construct from its indicator and to require that claims remain proportionate to the validity evidence supporting them [27].

2.2 Analytical and modelling procedure

Analysis proceeded through four iterations. The first mapped ILSA data types to the decisions they could legitimately inform. The second decomposed school management into professional actions rather than abstract attributes. The third grouped recurring actions into competence dimensions and located the learning conditions needed for those actions to develop. The fourth assembled blocks and mechanisms into a logic model and tested each proposed connection with a traceability question: if this input changes, which professional action is expected to change, what product should make the change observable, and which rule determines the next step? Data-use research was treated as a social and organisational process, not merely an individual technical skill [21].

The structural component of the model identifies relatively stable blocks and the elements housed within them. The functional component specifies the transformation performed between blocks. This distinction prevents two frequent



category errors. A competency is not a mechanism: it describes an integrated capacity that can be enacted. A workshop, coaching session, diagnostic profile or data-team routine may be part of a mechanism because it creates conditions through which competence changes. Likewise, a dashboard is not an outcome by itself; its value depends on the interpretive and decision routines surrounding it.

Four internal quality checks were applied. Construct consistency required identical meanings for each competence dimension across goals, activities and outcomes. Traceability required every activity to terminate in an observable product or decision. Scope control prohibited causal claims about student achievement from a conceptual model. Context sensitivity separated elements that must remain invariant from delivery features that may be adapted. Competing formulations were retained until one version explained the evidence-to-action chain with fewer unassigned elements. This procedure supports theoretical plausibility; it does not replace expert judgement, field feasibility testing or psychometric validation.

2.3 Unit of analysis and boundary conditions

The primary unit of analysis is the principal-in-practice: a school leader interpreting evidence, organising collective inquiry, allocating attention and resources, and monitoring an agreed action in a real institutional setting. The model does not assume that management

competence resides only inside an individual. Some functions are distributed across a data team, deputy principals, teachers, mentors and methodological support structures. The principal nevertheless remains accountable for ensuring that roles, evidence rules, ethical safeguards and follow-up decisions are coherent.

Three boundary conditions govern the model. First, ILSA data are treated as external reference evidence and cannot represent the complete condition of an individual school. Second, an association between context and achievement is not interpreted as a causal effect without an appropriate design. Third, the model develops competence through school-relevant work but does not train participants to raise rankings or rehearse released test items. Its educational purpose is better diagnosis and management of learning conditions, including equity, curriculum implementation, teacher learning, digital capacity and student support.

3 Results

3.1 Competency demands created by ILSA evidence

The analysis first distinguished four classes of evidence available to a principal. Achievement distributions and proficiency descriptions indicate what groups of learners can demonstrate. Context indicators describe reported conditions, attitudes, opportunities and resources. Process indicators illuminate curriculum exposure, teaching arrangements, professional collaboration



or digital use. Trend and subgroup comparisons show where patterns are stable, changing or unequally distributed. PISA's framework makes clear that constructs and contextual dimensions are designed for defined analytical purposes; transferring them to school decisions therefore requires an explicit inference chain [3].

TIMSS and PIRLS add a curriculum-sensitive perspective. Their content and cognitive domains can help a school examine whether local curriculum enactment, learning tasks and internal assessment cover the intended range of knowledge and reasoning. Their contextual scales can also suggest hypotheses about opportunity to learn, confidence, school climate or home support. They cannot, however, diagnose the reason for a particular class result without corroboration. A responsible principal uses the framework to formulate questions and then triangulates those questions with lesson evidence, internal assessments, attendance, student work and teacher discussion [5; 6].

TALIS and ICILS broaden the management lens beyond conventional attainment data. TALIS provides constructs related to leadership, professional learning, collaboration, workload and school climate; ICILS requires attention to access, pedagogical use of technology, digital practices and computational thinking. Together they show why leadership development needs both pedagogical and digital dimensions. A principal must be able to examine

whether a technology indicator reflects infrastructure, teacher capacity, instructional purpose, participation or governance before allocating resources or requiring a new practice [4; 7].

Six management-competency dimensions were derived from the recurrent professional actions. Strategic and prospective competence concerns priority setting, scenario building and alignment of resources with an improvement objective. Pedagogical-leadership competence connects evidence to curriculum, teaching and teacher learning. Information and analytical competence covers data quality, comparison, uncertainty and inference. Organisational and communicative competence enables collective sense-making and role coordination. Innovative and digital competence supports purposeful technology use and information governance. Monitoring and reflective competence closes the cycle by judging implementation and revising action. These dimensions align with international expectations while remaining expressed as practices that can be evidenced [9; 10].

The strategic and pedagogical dimensions must remain connected. A technically accurate analysis has limited value when it does not change the conditions of teaching and learning, while an instructional initiative is difficult to govern when its rationale and success criteria are unclear. Research on successful school leadership and leadership for learning supports a



mediated view: principals influence learning through direction, people, organisational conditions and instructional focus [11; 12]. The model therefore treats a strategic decision as complete only when it specifies the learning problem, intended change in professional practice, required support and a monitorable near outcome.

Information and analytical competence is defined more broadly than software operation. It includes identifying the population and construct represented by a measure, recognising sampling and reporting limits, reading distributions instead of relying only on averages, comparing compatible indicators, separating description from explanation, and communicating uncertainty. Data literacy becomes managerial when these analytical judgements influence priorities, resource decisions and professional dialogue [18; 19]. This definition also prevents technical tasks from being delegated in a way that removes the principal's responsibility for the interpretation and use of evidence.

Organisational and communicative competence converts private interpretation into collective capacity. The principal establishes who will examine which evidence, how disagreement will be handled, what information requires protection, and when the group must decide or seek additional data. Innovative and digital competence provides tools for visualisation, document management and monitoring, but it also requires safeguards for access and data minimisation. Monitoring and reflective competence

makes the resulting routines adaptive. Distributed leadership is relevant here because expertise can be shared without dispersing accountability [14].

3.2 Structural blocks of the model

The synthesis produced a six-block model: goal and methodology (G), diagnosis and analysis (D), content and process (P), collaboration and resources (C), monitoring and reflection (R), and outcomes (O). Its formal representation is $M = \langle G, D, P, C, R, O; L_i, L_s \rangle$, where L_i denotes the individual competence-development loop and L_s denotes the school-improvement loop. The notation is not a statistical equation. It states the elements that must be present for the design to function and makes omissions visible during implementation.

The goal-and-methodology block converts an external signal, a national requirement and a school need into a bounded development objective. Its governing principles are systemic alignment, competence orientation, activity-based learning, data-informed judgement, adult learning, equity and ethical use of information. In Uzbekistan, management certification provides a legitimate institutional starting point, but the model requires each formal expectation to be translated into a school-relevant performance task [1]. A goal is sufficiently specified when it names the management practice to be strengthened, the setting in which it should be demonstrated and the criterion by which progress will be judged.



The diagnosis-and-analysis block constructs two connected profiles: the principal's present competence profile and the school problem profile. Evidence for the first may include scenario tasks, structured interviews, observation, portfolio analysis and reflective explanation. Evidence for the second combines an ILSA signal with local quantitative and qualitative information. Measurement standards require the interpretation to be tied to its intended use and supported by evidence [27]. The block therefore ends with a diagnostic statement and a testable working hypothesis, not with a general label such as low quality or weak leadership.

The content-and-process block turns the diagnosed gap into a differentiated learning pathway. Its content is organised around authentic management problems rather than a sequence of disconnected lectures. Core formats include data laboratories, cases, simulations, coaching, peer review and a workplace microproject. Effective professional learning needs focus, active participation, coherence, duration and collective involvement, while workplace learning requires access to meaningful tasks, feedback and reflection [23; 24]. The required product is a reasoned improvement design that the principal can enact with colleagues and revise as evidence accumulates.

The collaboration-and-resources block supplies the social and material conditions for enactment. It defines the roles of the principal, a small data team, mentor, subject leaders and external

methodological support. It also allocates time, access to relevant information, protected discussion space and appropriate digital tools. Distributed work is functional only when decision rights and accountability are explicit [14]. This block produces a role-and-resource agreement that prevents the microproject from becoming an individual assignment unrelated to the school's routines.

The monitoring-and-reflection block compares implementation evidence with the previously stated success criteria. It distinguishes fidelity, near outcomes and organisational change: whether the planned action occurred, whether professional practice changed in the intended direction, and whether the school established a repeatable routine. Short improvement cycles make it possible to retain, adapt, pause or discontinue an action on evidence rather than momentum [22]. Reflection is recorded as a decision with a rationale and a next measurement point, not as an unrestricted narrative about experience.

The outcomes block uses three levels. The individual level records change in the six-dimensional competence profile. The enacted-practice level records the quality of an observable management product and its use in a real decision. The organisational level records whether collective routines, responsibilities and monitoring practices have become more coherent and sustainable. This hierarchy reflects the principle that leadership affects student learning mainly through mediated organisational and instructional



conditions [8]. Student outcomes may be monitored as distal indicators, but they are

not treated as a direct or immediate score for principal competence.

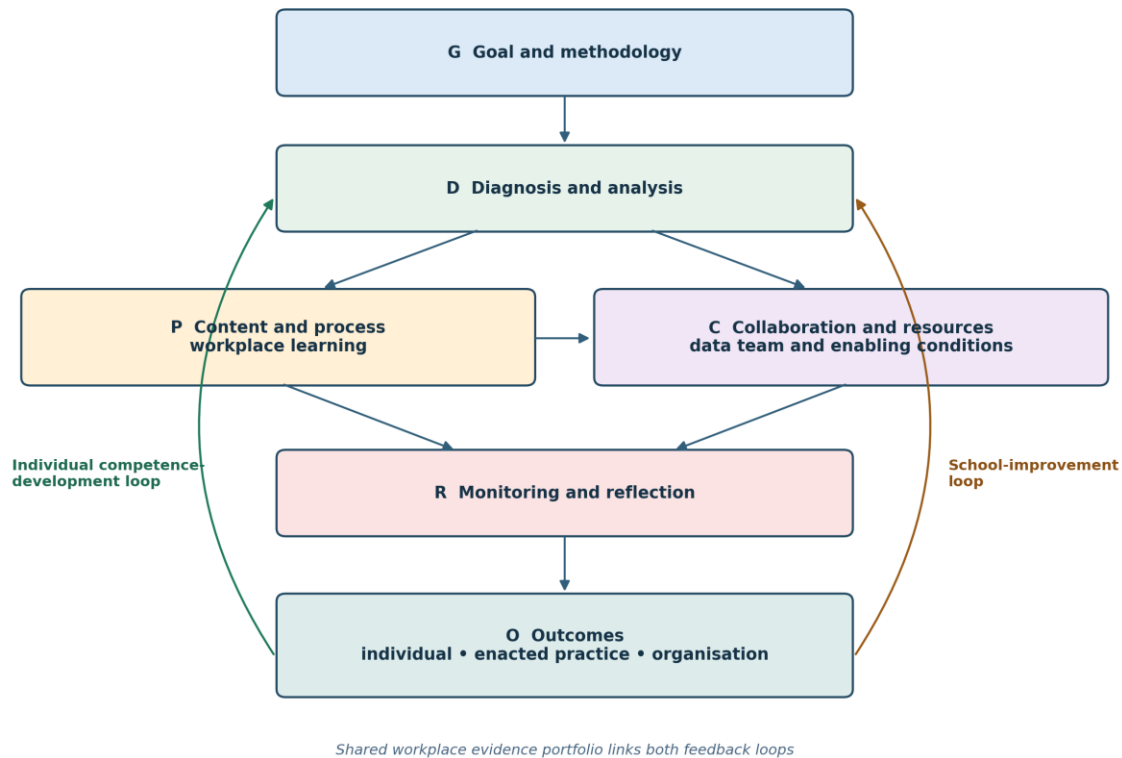


Figure 1. Structural and functional architecture with two feedback loops

Source: developed by the author from the design synthesis.

Figure 1 shows the model as a connected architecture rather than a linear training syllabus. Diagnosis influences the content and the supports provided; content and collaboration operate together during enactment; monitoring governs the transition to outcomes. The individual loop returns outcome evidence to the principal's diagnostic profile and next learning pathway. The school loop returns evidence about the organisational problem to a new local diagnosis. Both loops share the same workplace evidence portfolio, which prevents professional development and school improvement from generating separate, non-communicating records.

3.3 Functional mechanisms and traceable products

Five mechanisms animate the six structural blocks. The first is a multi-source diagnostic profile. It begins with a defensible ILSA signal, identifies its inference boundary, collects local evidence and maps the resulting problem to the six competence dimensions. The mechanism reduces two risks: designing identical development programmes for principals with different needs, and attributing an organisational problem entirely to an individual. Data use is understood as an interaction among evidence, interpretation, organisational routines and decision context [21]. Its



observable product is a diagnostic map containing a prioritised problem and a working explanation open to revision.

The second mechanism is data-informed strategic decision-making. The principal and data team move from a diagnostic question to alternative actions, assess feasibility and equity implications, select an option, allocate responsibility and specify near indicators. The mechanism is deliberately plural: evidence narrows and strengthens judgement but does not eliminate professional choice. Improvement science contributes the discipline of making a change idea explicit and examining it through repeated inquiry [20; 22]. The observable product is a one-cycle action protocol showing why the action was selected and what evidence would justify retaining or revising it.

The third mechanism combines workplace professional learning with pedagogical leadership. A principal studies the knowledge required by the diagnosed problem, rehearses a management action in a case or simulation, receives feedback, and applies the action in a school microproject. Learning is sustained long enough for planning, enactment, observation and revision. This reflects evidence that coherent, active and collective professional development is more likely to influence practice, while informal workplace learning becomes productive when experience is made discussable and feedback is available [23; 24]. The observable product is an enacted and

annotated management artefact rather than course attendance.

The fourth mechanism is organisational communication through a data team. The team is small enough to work, diverse enough to represent relevant expertise, and authorised to examine the problem. It uses agreed protocols for evidence selection, interpretation, challenge and decision recording. Effective data teams require leadership support, shared goals, expertise, structured collaboration and a route from analysis to action [20]. The product is a decision record that identifies evidence considered, competing explanations, responsibilities and unresolved questions. This record also makes ethical and methodological review possible.

The fifth mechanism is digital monitoring with reflective adjustment. A limited dashboard or monitoring sheet displays only indicators linked to the improvement hypothesis, including implementation measures and near outcomes. The principal schedules review points and applies a decision rule: maintain, adapt, stop or scale. Digital tools support memory and comparison; they do not perform the interpretive work. The mechanism is especially important when technology-related indicators are used, because access, pedagogy, capability and governance can produce similar surface patterns. Its product is a versioned monitoring record and a justified adjustment decision.



Table 1.

Traceability matrix of the structural and functional model

Model block	ILSA or local evidence input	Management competency activated	Observable workplace product	Feedback decision
Goal and methodology	External signal, national requirement and school need	Strategic and prospective; ethical judgement	Bounded development objective and success criterion	Accept, narrow or reframe the objective
Diagnosis and analysis	Construct description, distribution, contextual indicator and local corroboration	Information analytical; monitoring and reflective	Competence profile, problem statement and testable working hypothesis	Select a learning gap or collect additional evidence
Content and process	Diagnosed competence gap and authentic management problem	Pedagogical leadership; strategic and prospective	Action protocol enacted and management artefact	Proceed, revise the action or seek further support
Collaboration and resources	Role, time, expertise, access and governance constraints	Organisational and communicative; innovative and digital	Data-team agreement and resource plan	Reallocate roles or strengthen enabling conditions
Monitoring and reflection	Implementation measures, near and outcomes and qualitative feedback	Monitoring and reflective; information and analytical	Versioned monitoring record and reflective rationale	Maintain, adapt, stop or scale the action
Outcomes	Individual profile, enacted practice and organisational-routine evidence	Integrated enactment of all six dimensions	Assessed evidence portfolio and next-cycle priority	Close the cycle or return to diagnosis

Table 1 provides the model's traceability matrix. Each row begins with an evidence input, identifies the

competence activated by its interpretation, specifies a workplace product and ends with a feedback decision. This ordering is



important. If an activity produces no inspectable product, competence change cannot be distinguished from participation. If a product is produced but no decision rule follows, the development cycle does not influence management. Conversely, a decision unsupported by a defined evidence object is not data-informed merely because it is entered into a dashboard.

3.4 Dual feedback loops, sequencing and contextual adaptation

The individual competence-development loop answers the question: what must this principal learn and demonstrate next? It begins with a diagnostic profile, selects a limited learning objective, supports enactment and compares the new product with an explicit rubric. The loop closes when evidence changes the next learning pathway. It is therefore incompatible with a fixed sequence that every principal completes in the same way. Its continuity can be documented through a portfolio containing the diagnostic rationale, action protocol, artefact, feedback, monitoring evidence and reflection decision.

The school-improvement loop answers a different question: what must this school understand and change next? It begins with an external or local signal, tests competing explanations using additional evidence, implements a bounded change and examines near organisational or instructional outcomes. The loop closes when the school problem statement is confirmed, revised or replaced. The two loops interact because a

principal's learning objective is selected in relation to a school problem, while the school's capacity to improve depends partly on the principal's enacted management practice. Neither loop is reducible to the other.

Implementation is organised in four phases. In orientation, the principal and mentor agree on evidence rules, ethical boundaries and a school-relevant inquiry. In diagnosis and design, the data team triangulates evidence, identifies a competence gap and builds the action protocol. In enactment, the principal applies the targeted management action while receiving coaching and peer feedback. In consolidation, monitoring evidence is reviewed, the portfolio is assessed and a decision is made about continuation, adaptation or a new cycle. This sequence may be scheduled within existing certification and continuous-development structures rather than established as a parallel programme.

The invariant core contains the six competence dimensions, six structural blocks, five mechanisms, two feedback loops, three outcome levels and the traceability rule connecting evidence to decision. Adaptable features include the ILSA signal selected, local instruments, delivery modality, duration, mentor arrangement, digital platform, language, examples and regional support structure. Adaptation is legitimate when it improves accessibility or fit without removing an invariant connection. For example, a paper monitoring sheet may replace a digital dashboard, but monitoring indicators and a



pre-specified feedback decision must remain.

Contextual adaptation also requires an explicit readiness check. At principal level, the check concerns basic data literacy, motivation and time. At school level, it concerns access to local evidence, data-team capacity, psychological safety and authority to act. At system level, it concerns methodological support, data governance and alignment with evaluation requirements. When readiness is weak, the model begins with enabling actions rather than a high-stakes competence judgement. This protects the developmental purpose and avoids interpreting unequal access to resources as a personal deficit.

The model's immediate outputs are diagnostic profiles, action protocols, role agreements, management artefacts, monitoring records and reflective decisions. These are not administrative appendices; together they form the evidence chain through which competence can be examined. Near outcomes are improved interpretation, clearer strategic choices, stronger pedagogical dialogue and more consistent monitoring. Organisational outcomes concern repeatable routines for inquiry and improvement. Distal outcomes may include changes in learning conditions, participation, equity indicators and achievement, but attribution requires a design that accounts for time, context and alternative explanations.

4 Discussion

4.1 Theoretical contribution

The model contributes to leadership-development research in four ways. First, it treats ILSA results as inquiry inputs rather than school-level verdicts. Second, it links competency dimensions to mechanisms and inspectable products, reducing the gap between a standards framework and a development programme. Third, it couples individual learning with organisational improvement through a shared evidence portfolio. Fourth, it distinguishes an invariant theoretical core from contextual delivery features. These propositions extend policy and practice accounts of school leadership by specifying a meso-level architecture between leadership expectations and day-to-day development activity [12; 13].

The traceability matrix also clarifies what data-informed leadership means. Research often describes data use as a cycle, but implementation can collapse the cycle into report reading or target setting. In the proposed model, no indicator becomes actionable until its inference boundary, local corroboration, competence demand and feedback rule are stated. This approach locates data literacy in the interaction of technical, pedagogical and contextual knowledge. Its additional claim is developmental: the quality of that interaction can be strengthened through repeated, assessed workplace products.

The dual-loop design addresses a common transfer problem in principal development. Course learning may be assessed through recall, whereas school improvement is judged through outcomes



influenced by many actors and conditions. A shared portfolio creates an intermediate evidential layer. It can show whether the principal framed the problem soundly, organised collective inquiry, selected a proportionate action and used monitoring to revise it. These are closer to the target competence than attendance or a distant student score, while still being embedded in authentic organisational work.

4.2 Implications for principal development in Uzbekistan

For Uzbekistan, the model offers a way to align three existing functions: management certification, continuous professional development and school-level quality monitoring. Certification can assess entry-level understanding and scenario-based judgement. Continuous development can use the diagnostic profile to select a workplace pathway. School monitoring can provide the local evidence and near indicators needed for the microproject. National research on school-quality management and principal monitoring supports this integration and highlights the need for mechanisms that connect analysis to managerial action [15; 16; 17].

A practical programme should therefore be organised around a small number of evidence problems rather than a large syllabus. Participants could first analyse a PISA, TIMSS, PIRLS, TALIS or ICILS construct and identify its inference limits. They would then select a related local problem, assemble corroborating evidence, formulate alternative explanations and design a bounded

response. Mentors would assess the reasoning and the enacted management product using the same rubric. This sequence makes international assessment literacy relevant to everyday school leadership without encouraging test coaching or uncritical international comparison.

The model also changes the role of trainers and regional support providers. Their task is not limited to transmitting information. They curate credible evidence, model disciplined interpretation, challenge causal overreach, provide feedback on artefacts and help principals organise conditions for enactment. At the A. Avloniy Institute of Pedagogical Mastery and in regional preschool and school education structures, the same core protocol could be used with locally selected cases and delivery formats. The resulting evidence portfolios would support learning while preserving the distinction between developmental feedback and high-stakes administrative inspection.

Ethical implementation requires data minimisation, role-based access, secure storage and communication that avoids labelling schools, teachers or learners. Comparative indicators should be disaggregated only when group size and disclosure risk allow responsible interpretation. Professional discussion should separate a finding from an attribution of blame. Contextual and perception measures can enrich interpretation, but they remain dependent on instrument design and respondent



reports. The principal's competence therefore includes knowing when a finding should remain a question and when additional consent or protection is required.

4.3 Limitations and validation agenda

The study has four limitations. It is a conceptual synthesis and does not establish effectiveness. The purposive corpus privileges sources with high explanatory relevance rather than claiming bibliographic exhaustiveness. Several constructs originate in different policy and research traditions, so translation into a single management vocabulary may conceal differences in emphasis. Finally, the model specifies intended relationships but cannot determine whether schools possess the time, trust, authority and data infrastructure needed to enact them. These limitations define the next research steps rather than invalidate the design.

Expert validation should first test content relevance, clarity, completeness and functional coherence. Reviewers should include specialists in education management, psychometrics, principal development, school practice and international assessment. A revised model can then be piloted for usability and feasibility. Conceptual-framework methodology supports iteration, but the empirical programme must examine whether the proposed relations are observable and whether alternative configurations explain practice equally well [25; 26]. Rubrics and diagnostic instruments should undergo reliability analysis and evidence-based validation for

their intended developmental interpretations.

The planned longitudinal field study should treat the 358 principals as 358 unique participants followed across the stages, not as separate samples counted again each year. The intervention group will include 180 principals and the comparison group 178 principals. The field sites are the A. Avloniy Institute of Pedagogical Mastery and the preschool and school education departments of Fergana and Jizzakh regions. The three phases correspond to the 2023/2024 diagnostic (*aniqlovchi*) phase, the 2024/2025 confirmatory (*ta'kidlovchi*) phase, and the 2025/2026 developmental (*rivojlantiruvchi*) phase. The continuous-development framework provides an institutional rationale for following the same participants over time [2]. At this stage these figures describe the validation design; they are not reported outcomes.

Analysis should match the repeated structure of the data. Baseline equivalence and attrition need to be reported before intervention effects are estimated. Change may be examined through a group-by-time interaction in a repeated-measures or mixed-effects model, with school or regional clustering considered where the design warrants it. Difference-in-differences can provide a complementary estimate when assumptions are examined. Effect sizes and confidence intervals should accompany significance tests. Competence scores, quality of workplace artefacts and organisational routines



should be analysed separately before any claim is made about a combined outcome.

Process evidence is equally necessary. Records of coaching, data-team meetings, portfolio revisions and monitoring decisions can show whether the five mechanisms were actually enacted. Variation in implementation may explain why similar training produces different outcomes. A mixed-methods validation should therefore test the model's causal chain, not only compare final averages. Student outcomes, if included, require a longer time horizon and cautious attribution because leadership effects are mediated by organisational and instructional conditions. The primary validation question remains whether principals interpret evidence and improve management practice more coherently.

5 Conclusion and practical implications

This study developed a structural and functional model for strengthening school principals' management competencies through ILSA data. The model integrates six competency dimensions, six structural blocks, five implementation mechanisms, two feedback loops and three outcome levels. Its central proposition is that international assessment evidence becomes educationally useful at school level only through a traceable chain: a bounded signal is triangulated with local evidence, translated into a competence-related management action, enacted through supported workplace learning, documented in an observable product and subjected to a feedback decision.

For policy, the model can align principal certification, continuous professional development and school-quality monitoring around a common performance logic. For providers, it supports differentiated pathways built from diagnostic profiles rather than identical course exposure. For schools, it establishes a manageable data-team routine and a limited evidence portfolio. For researchers, it provides explicit propositions and products that can be subjected to expert, feasibility and longitudinal validation. These uses should preserve the model's developmental and ethical purpose: better professional judgement and stronger learning conditions, not ranking schools or attributing complex outcomes to one individual.

The next step is disciplined validation. Expert review should refine the constructs and links; piloting should establish usability and implementation conditions; the planned 358-participant longitudinal design should test change across the same principals and examine how mechanisms relate to outcomes. Until those stages are completed, the model should be described as a theoretically grounded design. Its scientific value lies in making the evidence-to-action pathway explicit and testable, while its practical value lies in placing principal learning inside the improvement work for which leadership competence is ultimately needed.



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