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Measuring Innovation Management in Educational Organizations: Development and Validation of a Multidimensional Scale

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Abstract

This research constructs and evaluates a multidimensional scale for assessing innovation management inside educational institutions. A five-dimensional construct is proposed, informed by innovation management, organizational theory, and higher education research, encompassing strategic innovation planning, innovation process and project management, human and knowledge capabilities, external networks and partnerships, and digital, data, and governance capabilities. A quantitative scale creation process was utilized, incorporating a multi-phase design that encompassed item generation, expert validation, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA) with independent samples. The findings exhibit robust psychometric characteristics. The Exploratory Factor Analysis (EFA) validated a distinct five-factor structure, whilst the Confirmatory Factor Analysis (CFA) demonstrated a satisfactory model fit (CFI = .956, RMSEA = .054, SRMR = .041). All constructs demonstrated good reliability (CR ≥ .89) and convergent validity (AVE ≥ .55). Discriminant validity was affirmed by the Fornell–Larcker criterion and HTMT ratios (less than .85). A second-order confirmatory factor analysis further validated that the five dimensions significantly contribute to a higher-order innovation management construct (loadings = .78–.91). The results offer strong empirical support for a validated measurement tool relevant to research, institutional leadership, and policy assessment. The scale enhances the philosophy of innovation management in education and facilitates data-driven transformation inside higher education systems.

Keywords: Innovation management; Educational organizations; Psychometric validation; Scale development; Higher education; SEM

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Introduction

Higher education is now in a digital era, characterised by the arrival of digital transformation, the use of artificial intelligence (AI) and a new and ever-changing global competitive landscape, as well as the expectations of students, parents, and other stakeholders, which have evolved (OECD, 2023; UNESCO, 2023). In the context of global education industry, innovation management has implications for institutional sustainability, academic competitiveness, operation efficiency and institutional legitimacy in the long term (Cai & Mehari, 2021). The technology disruption, demographic change, international rankings, and the demand for flexible and digitally integrated learning methods and spaces are all areas that universities must adjust to.

Educational organisational transformation has been faster than usual, thanks to the use of artificial intelligence, learning analytics, digital platforms and data-driven governance (Selwyn, 2022). Agencies of education have begun to facilitate each other, the platforms have emerged, smart administration has been introduced and cross-border academic cooperation is helping universities compete and gain global awareness (Marginson, 2018). Complementing teaching and curriculum design, it is essential that educational organizations innovate governance and leadership, the involvement of stakeholders, research ecosystems and digital management processes (Fullan, 2020). Thus, innovation management is becoming a major issue that education administrators are concerned with. Although innovation is becoming increasingly important in education, measurement and evaluation of educational organizations' innovation are limited and conceptually disorganized. The innovation practices in many organizations are project-driven, small-scale, and lack organizational practices and processes (Tidd & Bessant, 2021). There are a number of differences between educational institutions and firms in terms of governance structure, degree of professional autonomy, public responsibility, and the number of institutions involved in a "stakeholder structure" which make it difficult to simply transfer industrial innovation models and frameworks to the education sector (Mintzberg, 2009). So there is a need for context-specific and theoretically grounded frameworks of innovation measuring in Education institutions.

There are several studies that have investigated various innovation-related factors such as technology adoption, organizational change, digital transformation and research productivity but few have yielded multidimensional scales, which are psychometrically validated to measure innovation management in educational organizations. Existing studies are limited in their conceptual accuracy, contextual relevance, and empirical applicability by only using proxy rather than full latent constructs (Salerno et al., 2015). Most models of early innovation measurement were devised for corporate or industrial context and were productivity, market competitiveness and technology based.

Educational institutions are different from business organizations in terms of governance systems, mission of institutions, complexity of its stakeholders, academic autonomy and public accountability (Mintzberg, 2009; Cai and Mehari, 2021). Innovation in schools and universities can be observed in the reform of school curricula, pedagogical innovations, collaborative governance, research ecosystems, ethical digital practices, and student-centred development. The ease of implementation of corporate innovation frameworks is insufficient conceptually because of the bureaucracies, shared governance and the resistance of organizations in academic institutions (Fullan, 2020).

As a result, the focus on strategic leadership, collaborative networks, governance systems, and digital ethics, which are more relevant to educational administration, were not considered by many of the older assessment practices. The timely development of a theoretically and contextually oriented scale to measure the innovation capability of educational institutions and their transformation is required to more accurately and comprehensively evaluate their innovation capacity and organizational changes in higher education.

To address these shortcomings, this study develops and tests a multidimensional scale of Innovation Management for Educational Enterprises. Strategic innovation, process and operational innovation, human and organizational capability, collaborative network management and digital governance are included in the concept. Reliable and valid Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) are employed to determine the construct validity, reliability and structural adequacy of the proposed measurement model.

The methodological transparency was ensured by the application of psychometric criteria to purify and reject items in the EFA, namely low factor loadings (<.50), cross-loadings across multiple factors and poor communalities. Tidy up models and get construct clarity by systematically discarding non-statistical and non-theoretical items. It made sure that the final scale contained only conceptually relevant and empirically valid indicators.

This study is valuable to the literature because it presents a validated and education-specific instrument of measuring the innovation management, which combines four aspects of governance: strategic, process, human, and network, all into a single instrument. The findings present theoretical contribution to educational innovation research and practical implications for assessment of institutions as well as for strategic planning and educational management based on innovation.

Research objective
This research undertaking seeks to formulate and establish a multi-dimensional scale that would measure the innovation management of educational institutions using a rigorous exploratory and confirmatory factor analysis to ensure that this scale forms a credible tool in research, leadership and policy evaluation.

Literature reviews

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Literature reviews

Strategic Innovation Planning
Strategic innovation planning helps organizations set an innovation agenda, synchronize innovation efforts with institutional goals, and sustain the organization in the long run. The literature on innovation management shows that strategic direction impacts on the ability of the organization to adapt, on innovation governance, on the allocation of resources, and on the decision-making process (Crossan & Apaydin, 2010; OECD, 2023). Good innovation strategies support the shift from creative ideas to measurable institutional results by establishing governance, implementation and evaluation cycles.

Educational institutions face special challenges with strategic innovation planning, as academic governance, public accountability, and stakeholder expectations are intertwined. While corporate organisations are mainly focused on competitiveness and profitability, schools and universities can be seen to have wider objectives associated with knowledge generation, societal development, research progress and educational quality (Cai and Mehari, 2021). In the field of education, therefore, an innovation plan should address the flexibility of the institution, the values of the academic community, the involvement of stakeholders and the ethical management of innovation.

More recent research also shows that higher education institutions are increasingly seeking new adaptive and entrepreneurial governance models to meet the demands of digital transformation, global competition and technological disruption (Deem et al., 2020; Selwyn, 2022). Strategic innovation planning, therefore, becomes an important contributor in boosting institutional resilience, the development of digital competence, collaborative partnerships and responsible innovation management in today's education systems.

Innovation and Project Management
Innovation process and project management describe the implementation of ideas in companies. Traditional innovation management systems focus on systematic procedures to assess opportunities, choose initiatives, deal with uncertainty, and provide implementation and learning (Tidd and Bessant, 2018). Process-oriented approaches emphasize stage-by-stage growth, portfolio management, and disciplined implementation, particularly in complex organizations with conflicting projects over resources (Cooper, 2021; PMI, 2021). Using systematic innovation processes will minimise waste, enhance coordination, and likelihood of outcomes because they define decision points, roles, and performance requirement (Cooper, 2021; Crossan and Apaydin, 2010).

The innovation of educational institutions is carried out in the form of curricular reform, pedagogical change, commercialization of research, service innovation and administrative reengineering. Project governance and procedural clarity are required to organize these efforts by academic leaders, professors, professional staff, and external stakeholders. Innovation in education involves high levels of autonomy and contentious change, which demand professional work, and the management of projects through organization balances the involvement, transparency, and responsibility (Mintzberg, 2009; Deem et al., 2020). Process management is very essential as educational digital transformation requires repetitive testing, assessment, and scaling of units (Selwyn, 2022). Therefore, an educational innovation management scale must measure not just the existence of projects, but also processes of repeatable selection, monitoring, evaluation, and continuous improvement.

Manage Human Capital and Knowledge

Innovation is a people, knowledge and organization-based process, therefore human capital and knowledge management are important enablers of innovation in educational organizations. Previous studies highlight that knowledge sharing, professional development, collaborative culture, and continuous learning processes are vital to the enhancement of innovation capability (Nonaka & Takeuchi, 1995; Fullan, 2020). Academic knowledge, intellectual cooperation, and knowledge sharing are crucial to the innovation of academic programs, development of academic research, and improvement of educational institutions.

However, the innovation environment of educational organizations must be focused on academic autonomy, psychological protection, creative and professional trust (Deem et al., 2020), which is different from the corporate organizations, which tend to focus on operational efficiency and performance on the market. Good human capital management entails leadership support, staff capacity building, incentive systems, and mechanisms to promote experimentation and inter-disciplinary cooperation. Additionally, the continuous complexity of digital transformation and the integration of AI in education demands that practices be constantly improved and that the knowledge management landscape must be advanced in order to enable sustainable innovation and organizational adaptability (Selwyn, 2022).

Networked Innovation, External Collaboration

The innovation is being pushed beyond organizations by partners, alliances, and ecosystems via networked innovation and external cooperation. The proponents of open innovation theory believe that knowledge inflows and outflows, partnering, and co-developing solutions across boundaries are to be used to enhance innovation outcomes (Chesbrough, 2003). Network analysis indicates that inter-organizational relationships offer specific expertise, resources and complementary resources to creativity (Powell et al., 1996). Collaboration speeds learning, decreases uncertainty, and promotes experimentation in multi-actor breakthroughs like technology adoption and service redesign (Inkpen & Tsang, 2005).

Outside partnership enhances research in education, relevance of the curriculum, job performance, and social participation. The Triple Helix proposes that universities affect knowledge production, commercialization, and social innovation via interaction with industry and government (Mascarenhas et al., 2021; Etzkowitz and Leydesdorff, 2000). Partnerships with business, government, schools and overseas organizations enhance experiential learning, research, funds, and policy impact. The governance issues in collaboration involve protection of intellectual property, alignment of objectives, fairness and trust between organisations (Inkpen & Tsang, 2005). Therefore, the education innovation management is to evaluate the capacity of the institution to identify partners, coordinate collaboration, develop agreements, organize collaborative processes, and transform the outside participation into the inside learning and enhancement.

Data, Governance, and Digital Infrastructure

Modern innovation is facilitated by digital infrastructure, data and governance through platforms, analytics, cybersecurity, and responsible decision-making. Information systems research indicates that digital capability pertains to governance structures that tie IT investments to organisational objectives, define decision-making authorities and risk management (Weill and Ross, 2004). Businesses require laws to guarantee the quality of data, ownership, access, privacy and ethical use since data is needed to aid innovation and performance assessment (Khatri and Brown, 2010). The new digital infrastructure can enable modern organisations to experiment, customise services, and employ evidence-based management quickly (OECD, 2023).

Learning technologies, student information systems, research data platforms, AI-enabled services, and administrative automation are becoming connected to digital infrastructure and governance in educational institutions. Without governance, data quality, or ethical controls, technology-driven change may fail to offer fairness, privacy, security, and trust challenges (OECD, 2023; Selwyn, 2022). Management of higher education innovation necessitates online readiness (trustworthy systems, interoperability, user friendliness), knowledge-based decision-making processes, and administrative frameworks that promote transparency, responsibility, and accountable innovation (Janssen et al., 2020). They include privacy, ethical use of AI, cybersecurity and institutional oversight of digital transformation programs (Khatri and Brown, 2010; Weill and Ross, 2004).

Validated scales should assess innovation management capabilities such technology availability, governance maturity, data quality management, and ethical safeguards (OECD, 2023).

Table 1. Summary of Domains of Innovation Management in Educational Organizations

Domain	Sub-domains	Definition (Operational)	Theory Bases	Key Criteria / Indicators	Citations
M1 Strategic Innovation Planning	Strategy & Direction; Portfolio & Resource Allocation; Governance & Oversight; Stakeholder Value & Alignment	The organization's capability to formulate, align, govern, and evaluate innovation strategies that support institutional mission, stakeholder needs, and long-term competitiveness.	Innovation Strategy Theory; Dynamic Capabilities Theory; Strategic Management Theory	Clear innovation vision; strategic alignment; prioritized innovation portfolio; governance structures; stakeholder value assessment	Tidd & Bessant (2018); Mintzberg (2009); Crossan & Apaydin (2010); OECD (2023)
M2 Innovation Process & Project Management	Idea Management; Project Execution; Evaluation & Scaling; Implementation Support System	The capability to manage innovation as a structured, repeatable process from idea generation to implementation, evaluation, and sustainable scaling.	Process Innovation Theory; Project Management Theory; Organizational Learning Theory	Idea capture systems; disciplined project execution; risk management; post-implementation review; scaling and support mechanisms	Tidd & Bessant (2018); PMI (2021); Cooper (2019); Hall & Hord (2014)
M3 People & Knowledge Capability	Innovation Skills; Knowledge Management; Culture & Psychological Safety; Incentives & Capability Systems	The organization's capacity to develop human capital, manage organizational knowledge, and foster a learning culture that supports creativity, experimentation, and innovation sustainability.	Knowledge-Based View of the Firm; Human Capital Theory; Organizational Learning Theory	Innovation skill development; knowledge sharing systems; psychological safety; incentive and capability-building mechanisms	Nonaka & Takeuchi (1995); Amabile (1996); Grant (1996); Edmondson (1999)
M4 External Networks & Partnerships	Collaboration; Co-creation & Joint Projects; Partnership Governance; Boundary-Spanning Capability	The capability to engage, govern, and leverage external partnerships and networks to co-create innovation and enhance organizational impact.	Open Innovation Theory; Triple Helix Model; Network Theory	External collaboration; joint innovation projects; partnership governance; boundary-spanning roles; network utilization	Chesbrough (2003); Etzkowitz & Leydesdorff (2000); Knight (2012); OECD (2023)
M5 Digital, Data & Governance Capability	Digital Infrastructure; Data Governance & Privacy; Ethical Technology / AI Use; Compliance & Accountability	The organization's ability to deploy digital infrastructure and data governance systems that enable innovation while ensuring ethical use, privacy protection, and accountability.	Digital Governance Theory; Information Systems Governance; Responsible Innovation Theory	Robust digital systems; data governance and privacy controls; ethical AI practices; compliance and accountability mechanisms	Weill & Ross (2004); Khatri & Brown (2010); UNESCO (2021); Selwyn (2019); OECD (2023)

As shown in Table 1, innovation management in educational organizations involves five interrelated domains: strategic innovation planning, innovation process and project management, people and knowledge capability, external networks and partnerships, and digital, data, and governance capability. Each innovation management area has four subdomains that cover strategic, procedural, human, relational, and technological factors. These domains and sub-domains provide a comprehensive framework for designing measurement questions and verifying innovation management concept validity through exploratory and confirmatory factor analyses.

Table 2. Summary of Domains and Sub-domains of Innovation Management in Educational Organizations

Domain	Sub-domain	Definition (Operational)	Key Criteria / Indicators	Citations
M1 Strategic Innovation Planning	M1.1 Strategy & Direction	The organization's capability to articulate a clear innovation vision and align innovation goals with institutional mission and long-term strategy.	Clear innovation vision; alignment with mission; communicated strategy; periodic strategic review.	Tidd & Bessant (2018); Crossan & Apaydin (2010); OECD (2023)
	M1.2 Portfolio & Resource Allocation	The ability to prioritize, fund, and balance innovation initiatives through systematic allocation of financial, human, and organizational resources.	Adequate budgets; transparent selection criteria; balanced risk–return portfolio; monitoring of resource use.	Tidd & Bessant (2018); Cooper (2019); OECD (2023)
	M1.3 Governance & Oversight	Structures and processes that guide, monitor, and ensure accountability of innovation initiatives across the organization.	Dedicated committees; executive oversight; defined project ownership; transparent reporting.	PMI (2021); Mintzberg (2009); OECD (2023)
	M1.4 Stakeholder Value & Alignment	The extent to which innovation initiatives address stakeholder needs and generate measurable educational and organizational value.	User feedback; co-design; service quality improvement; systematic value evaluation.	Crossan & Apaydin (2010); OECD (2023); Freeman (1984)
M2 Innovation Process & Project Management	M2.1 Idea Management	Mechanisms that enable systematic collection, screening, and development of ideas from internal and external sources.	Idea channels; fair selection; prototyping; feedback loops; tracking systems.	Tidd & Bessant (2018); Edmondson (1999); OECD (2023)
	M2.2 Project Execution	The capability to plan, implement, monitor, and control innovation projects effectively.	Clear plans; milestones; risk management; efficient resource use; goal achievement.	PMI (2021); Cooper (2019)
	M2.3 Evaluation & Scaling	Processes for assessing innovation outcomes and scaling successful initiatives based on evidence.	Post-implementation review; learning from results; scale-up decisions; sustainability tracking.	Hall & Hord (2014); OECD (2023)
	M2.4 Implementation Support System	Organizational support mechanisms that enable consistent and high-fidelity implementation of innovations.	Training; coaching; manuals; help channels; fidelity monitoring.	Hall & Hord (2014); Fullan (2016)
M3 People & Knowledge Capability	M3.1 Innovation Skills	The organization's capacity to develop staff competencies necessary for innovation and problem solving.	Skill development; cross-functional work; time/resources for innovation; incentives.	Amabile (1996); Mumford (2007); Tidd & Bessant (2018)
	M3.2 Knowledge Management	Systems and practices that capture, share, and apply organizational knowledge to support innovation.	Knowledge repositories; communities of practice; tacit-to-explicit conversion; efficiency gains.	Nonaka & Takeuchi (1995); Grant (1996)
	M3.3 Culture & Psychological Safety	A climate that encourages learning, experimentation, and open expression of ideas without fear.	Psychological safety; learning from failure; leadership reflection; collaborative support.	Edmondson (1999); Fullan (2016)
	M3.4 Incentives & Capability Systems	HR and organizational systems that sustain innovation through evaluation, recognition, and career pathways.	Innovation-aligned appraisal; innovation champions; resource support; sustainability mechanisms.	Amabile (1996); OECD (2023); Tidd & Bessant (2018)

Domain	Sub-domain	Definition (Operational)	Key Criteria / Indicators	Citations
M4 External Networks & Partnerships	M4.1 Collaboration	Engagement with external actors to jointly develop and deliver innovations.	Access to expertise; co-delivery; quality enhancement; evaluation of partnerships.	Etzkowitz & Leydesdorff (2000); Knight (2012); OECD (2023)
	M4.2 Co-creation & Joint Projects	Collaborative innovation through shared design, implementation, and outcomes with partners.	Joint projects; clear roles; knowledge exchange; reputational impact; continuity.	Etzkowitz & Leydesdorff (2000); Chesbrough (2003)
	M4.3 Partnership Governance	Formal and informal rules that regulate collaboration, IP, data sharing, and accountability.	MOUs/MOAs; IP policies; secure data sharing; transparency; auditability.	OECD (2023); UNESCO (2021); Inkpen & Tsang (2005)
	M4.4 Boundary-Spanning Capability	The ability to connect internal and external networks to accelerate innovation.	Boundary spanners; opportunity access; systematic communication; expectation management.	Knight (2012); Yukl (2013); OECD (2023)
M5 Digital, Data & Governance Capability	M5.1 Digital Infrastructure	Digital systems and platforms that enable innovation, collaboration, and decision-making.	Robust IT systems; analytics; dashboards; data standards; interoperability.	Williamson (2017); Weill & Ross (2004); OECD (2023)
	M5.2 Data Governance & Privacy	Policies and structures ensuring responsible, secure, and transparent data use.	Privacy protection; role-based access; data audits; security risk management.	Khatri & Brown (2010); UNESCO (2021); OECD (2023)
	M5.3 Ethical Technology / AI Use	Ethical oversight of advanced technologies to ensure fairness, transparency, and human control.	Ethical AI guidelines; bias mitigation; transparency; human oversight; impact assessment.	UNESCO (2021); Selwyn (2019)
	M5.4 Compliance & Accountability	Mechanisms that ensure adherence to digital policies and enhance organizational trust.	Compliance audits; accountability indicators; reporting systems; policy updating.	OECD (2023); Weill & Ross (2004)

Table 2 lists educational innovation management's domains, subdomains, operational definitions, and key metrics. The table lists strategy orientation, process execution, human and knowledge capabilities, external collaboration, and digital governance as innovation management. Translating conceptual dimensions into observable indicators improves content validity, instrument development, and empirical testing through exploratory and confirmatory factor analyses.

Strategic direction, organisational procedures, human capital, external collaboration, and digital governance comprise innovation management (OECD, 2023; Tidd & Bessant, 2018). Strategic innovation planning guides resource allocation and organisational priorities based on institutional and environmental goals (Crossan & Apaydin, 2010). From ideation to implementation and scalability, process and project management emphasise structured innovation pipelines (Cooper, 2019).Learning, psychological safety, and knowledge integration support creativity within human and knowledge capabilities (Nonaka & Takeuchi, 1995; Edmondson, 1999). Network-based viewpoints emphasise open innovation ecosystems and external cooperation (Chesbrough, 2003; Etzkowitz & Leydesdorff, 2000).

Finally, digital and data governance competencies are crucial for data-driven decision-making and ethical usage of emerging technologies (OECD, 2023; UNESCO, 2021).

However, empirical integration of these aspects into a validated measuring paradigm is restricted, especially in education. This work develops a thorough, factor-validated scale to fill this gap.

Method

This research utilized a quantitative scale development methodology through a multi-phase design. Measurement items were derived from existing literature and validated by specialists. Data were gathered from administrators and academic leaders in Doctoral programs in Educational Administration at higher education institutions through standardized questionnaires.

A two-sample methodology was employed to improve methodological rigor. The first sample (n = 111) was used in Exploratory Factor Analysis (EFA), and the second sample (n =302) was used in Confirmatory Factor Analysis (CFA) as per the accepted guidelines (Hair et al., 2019; Kline, 2016).

Exploratory Factor Analysis (EFA) was done using primary axis factoring with oblique rotation. The Confirmatory Factor Analysis was done through maximum likelihood estimate in AMOS. The scores on reliability and validity were checked using the Cronbachs alpha, composite reliability (CR), average variance extracted (AVE), and HTMT ratios.

Results

Respondent Profile

Table 3. Demographic Profile of Respondents

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	68	61.3%
	Female	43	38.7%
Age	35–44 years	21	18.9%
	45–54 years	49	44.1%
	55 years and above	41	36.9%
Academic Rank	Lecturer	32	28.8%
	Assistant Professor	41	36.9%
	Associate Professor	27	24.3%
	Professor	11	9.9%
Years of Leadership Experience	1–5 years	26	23.4%
	6–10 years	48	43.2%
	More than 10 years	37	33.3%
Type of Institution	Public University	72	64.9%
	Autonomous University	23	20.7%
	Private University	16	14.4%

The sample included 111 Thai educational management PhD program heads. The bulk of respondents (44.1%) were 45–54 years old, indicating mature and experienced leadership. The majority of participants were assistant professors (36.9%), followed by lecturers (28.8%), associate professors (24.3%), and professors (9.9%). A majority of the respondents (more than 76 percent) had more than six years of management experience in leadership, implying greater expertise in higher education innovation management. The majority were connected to state institutions (64.9%), which implies that there have been well-established governance and policy-driven processes of innovation.

Measurement Model Assessment and EFA

The measurement model was found to fit well in the first-order and the second-order CFA models. Each factor loading was significant ($p < .001$) and more than recommended values. Reliability and convergent validity were confirmed ($CR \geq .89$; $AVE \geq .55$). FornellLarcker and HTMT criteria were used to support the use of discriminant validity. The fifth-order CFA endorsed that the five constructs are a higher-order construct of innovation management.

Table 4. Measurement Scale for Innovation Management in Educational Organizations

Sub-domain	Code	Item	M	SD	@	T
Domain M1: Strategic Innovation Planning						
M1.1 Strategy & Direction	IM1_1	The organization has a distinct innovation vision and approach.	4.21	0.62	.81	12.45

	IM1_2	Innovation objectives are consistent with the organization's mission and strategy.	4.18	0.65	.83	13.02
	IM1_3	Innovation projects are deliberately prioritized.	4.05	0.71	.78	11.87
	IM1_4	The innovation approach is well communicated and widely understood.	4.12	0.68	.80	12.66
	IM1_5	The innovation plan is revised on a frequent basis to reflect new data and contextual changes.	4.09	0.70	.79	12.21
M1.2 Portfolio & Resource Allocation	IM1_6	Adequate funding and staff are dedicated to innovative efforts.	4.02	0.73	.77	11.54
	IM1_7	Transparent criteria are utilized to choose innovative projects.	4.08	0.69	.80	12.33
	IM1_8	Innovation portfolios are managed to strike a balance between risk and reward.	4.11	0.67	.82	12.91
	IM1_9	Resource allocation is in line with strategic innovation objectives.	4.06	0.70	.79	12.12
	IM1_10	Resource consumption in innovation projects is systematically tracked.	3.98	0.75	.75	10.98
M1.3 Governance & Oversight	IM1_11	Formal structures or committees manage innovative activity.	4.10	0.68	.81	12.70
	IM1_12	Top management uses specific indicators to track project success.	4.07	0.70	.79	12.20
	IM1_13	Innovation governance ensures the continuity of innovation efforts.	4.12	0.66	.82	12.88
	IM1_14	The roles and duties of project owners are clearly defined.	4.05	0.71	.78	11.95
	IM1_15	Stakeholders receive transparent reporting on innovation outcomes.	4.00	0.74	.76	11.10
M1.4 Stakeholder Value & Alignment	IM1_16	Innovation projects cater to the demands of learners and stakeholders.	4.15	0.65	.83	13.05
	IM1_17	Prior to development, users or stakeholders provide comments.	4.09	0.69	.80	12.45
	IM1_18	Stakeholders participate in co-design processes.	4.06	0.71	.79	12.02
	IM1_19	Innovation enhances service quality and organizational outcomes.	4.13	0.67	.82	12.85
	IM1_20	The value created by innovation is evaluated methodically.	4.08	0.70	.80	12.40
Domain M2: Innovation Process & Project Management						
M2.1 Idea Management	IM2_1	Staff and stakeholders can provide ideas through several channels.	4.10	0.66	.80	12.40
	IM2_2	Ideas are chosen via fair and transparent approaches.	4.07	0.68	.79	12.05
	IM2_3	Prototypes or pilots are tested prior to full installation.	4.02	0.72	.77	11.62
	IM2_4	The status of ideas and proposals is routinely tracked.	3.95	0.75	.74	10.90
	IM2_5	Constructive criticism is given on submitted ideas.	4.01	0.70	.76	11.45
M2.2 Project Execution	IM2_6	Innovation projects have well-defined strategies and milestones.	4.12	0.67	.81	12.75
	IM2_7	The project's progress is periodically monitored.	4.09	0.69	.80	12.30
	IM2_8	Project hazards are systematically handled.	4.05	0.72	.78	11.88
	IM2_9	Project resources are efficiently managed.	4.00	0.74	.76	11.20
	IM2_10	Projects produce results that are consistent with their objectives.	4.06	0.71	.79	12.00
M2.3 Evaluation & Scaling	IM2_11	Following the completion of a project, post-implementation reviews are undertaken.	4.08	0.70	.79	12.10
	IM2_12	Evaluation results are utilized to make improvements.	4.11	0.68	.81	12.65
	IM2_13	Successful projects are gradually scaled up.	4.07	0.69	.80	12.30
	IM2_14	Evidence-based criteria drive choices to halt, modify, or expand initiatives.	4.02	0.73	.77	11.70
	IM2_15	Sustainability is monitored after the project has been scaled.	3.98	0.75	.75	11.05

M2.4 Implementation Support System	IM2_16	Coaching or guidance is offered to ensure successful implementation.	4.10	0.67	.80	12.40
	IM2_17	Guidelines or manuals are available for implementation.	4.06	0.69	.79	12.00
	IM2_18	Training is offered before to and throughout implementation.	4.03	0.71	.78	11.75
	IM2_19	When problems emerge during implementation, there are support channels available.	3.97	0.74	.75	11.10
	IM2_20	The fidelity of implementation is systematically monitored.	4.05	0.70	.79	12.05
Domain M3: People & Knowledge Capability						
M3.1 Innovation Skills	IM3_1	The organization is constantly working to improve its employees' innovative skills.	4.15	0.64	.79	12.10
	IM3_2	Complex problem-solving abilities are actively cultivated.	4.11	0.67	.78	11.88
	IM3_3	Cross-functional collaboration is encouraged to foster innovation.	4.08	0.70	.76	11.42
	IM3_4	Staff are given adequate time and resources for innovation work.	3.99	0.74	.74	10.85
	IM3_5	Recognition and incentives help to drive innovation.	4.05	0.69	.75	11.20
M3.2 Knowledge Management	IM3_6	Knowledge and lessons learnt are thoroughly documented.	4.07	0.68	.77	11.70
	IM3_7	Platforms exist to share best practices.	4.10	0.66	.79	12.05
	IM3_8	Knowledge from projects is shared across units.	4.06	0.70	.76	11.50
	IM3_9	Tacit knowledge is gradually transformed into explicit knowledge.	4.01	0.73	.74	10.95
	IM3_10	Knowledge systems eliminate duplication and increase efficiency.	4.03	0.72	.75	11.20
M3.3 Culture & Psychological Safety	IM3_11	Employees feel free to submit ideas without fear of repercussions.	4.12	0.67	.80	12.30
	IM3_12	The organization learns from failures without assigning blame.	4.08	0.69	.78	11.95
	IM3_13	Leaders consistently foster introspection and learning.	4.10	0.68	.79	12.10
	IM3_14	The company encourages innovation and continual progress.	4.05	0.71	.76	11.50
	IM3_15	When faced with a challenge, team members encourage one another.	4.02	0.73	.75	11.10
M3.4 Incentives & Capability Systems	IM3_16	Performance evaluation methods facilitate innovation efforts.	4.09	0.68	.78	11.95
	IM3_17	There are clear development pathways for innovation leaders.	4.06	0.70	.76	11.60
	IM3_18	Innovation champions are formally acknowledged within the corporation.	4.03	0.72	.75	11.25
	IM3_19	Resources are provided to teams working on innovations.	4.00	0.74	.74	10.90
	IM3_20	HR and work processes help to ensure innovation's long-term viability.	4.04	0.71	.76	11.40
Domain M4: External Networks & Partnerships						
M4.1 Collaboration	IM4_1	The organization works with external partners to generate new ideas.	4.12	0.65	.78	11.98
	IM4_2	Collaboration grants access to external expertise and resources.	4.09	0.67	.77	11.70
	IM4_3	Partners participate in collaborative operational operations (co-delivery).	4.01	0.71	.74	11.05
	IM4_4	Collaboration improves program or service quality.	4.05	0.69	.76	11.44
	IM4_5	Collaborations are examined on a regular basis to ensure their efficacy.	3.98	0.73	.73	10.72

M4.2 Co-creation & Joint Projects	IM4_6	Joint innovation projects are carried out with partners.	4.08	0.68	.77	11.80
	IM4_7	The roles and responsibilities in cooperative projects are clearly specified.	4.05	0.70	.76	11.45
	IM4_8	Knowledge is shared across partner organizations.	4.02	0.72	.74	11.10
	IM4_9	Joint projects increase the organizational influence or reputation.	4.06	0.69	.76	11.50
	IM4_10	Joint outcomes are enhanced and sustained.	4.00	0.73	.73	10.90
M4.3 Partnership Governance	IM4_11	Formal agreements (such as MOUs/MOAs) facilitate collaboration.	4.10	0.67	.79	12.10
	IM4_12	Policies govern intellectual property and cooperative dissemination.	4.07	0.69	.77	11.70
	IM4_13	Secure data sharing procedures promote teamwork.	4.03	0.72	.75	11.25
	IM4_14	Partnership governance is open and transparent.	4.08	0.68	.78	11.95
	IM4_15	Partnerships operate in a sustainable manner and are auditable.	4.04	0.71	.76	11.45
M4.4 Boundary-Spanning Capability	IM4_16	Designated employees serve as organizational boundary spanners.	4.06	0.69	.77	11.70
	IM4_17	Networks are used to find new opportunities.	4.02	0.72	.75	11.30
	IM4_18	Communication with partners is methodical and consistent.	4.00	0.73	.74	11.05
	IM4_19	Partners' expectations are effectively controlled.	3.97	0.75	.72	10.70
	IM4_20	Networks spur innovation development.	4.03	0.71	.75	11.30
Domain M5: Digital, Data, and Governance Capability.						
M5.1 Digital Infrastructure	IM5_1	Digital infrastructure facilitates innovative activity.	4.18	0.63	.83	13.10
	IM5_2	Information systems help to monitor quality and outcomes.	4.15	0.65	.82	12.88
	IM5_3	Dashboards and analytics help managers make informed decisions.	4.12	0.67	.81	12.60
	IM5_4	Data standards prevent redundancies and errors.	4.08	0.69	.79	12.05
	IM5_5	Digital technologies enable collaboration and decision-making.	4.14	0.66	.82	12.95
M5.2 Data Governance & Privacy	IM5_6	Personal data security procedures are in place.	4.11	0.68	.80	12.45
	IM5_7	Data access privileges are determined by roles.	4.09	0.69	.79	12.10
	IM5_8	Data usage is transparently monitored.	4.06	0.71	.78	11.85
	IM5_9	Data security and risk are systematically controlled.	4.03	0.73	.76	11.40
	IM5_10	Data policies are clearly stated to all parties.	4.07	0.70	.79	12.00
M5.3 Ethical Technology / AI Use	IM5_11	Ethical principles govern the usage of AI and sophisticated technologies.	4.16	0.65	.83	13.05
	IM5_12	Automated systems take fairness and bias into consideration.	4.12	0.67	.81	12.60
	IM5_13	AI-supported decision-making is transparent.	4.09	0.69	.80	12.20
	IM5_14	Critical decisions still require human oversight.	4.05	0.71	.78	11.75
	IM5_15	Before implementing new technology, their ethical implications are considered.	4.10	0.68	.81	12.55
M5.4 Compliance & Accountability	IM5_16	Regular audits are conducted to ensure compliance with digital policies.	4.13	0.67	.82	12.90
	IM5_17	Indicators measure transparency and accountability.	4.10	0.68	.80	12.40
	IM5_18	Internal reporting and auditing are done.	4.07	0.70	.79	12.00
	IM5_19	Digital policies are revised based on lessons acquired.	4.04	0.72	.77	11.60
	IM5_20	Digital governance improves organizational credibility.	4.12	0.68	.81	12.70

Table 3 presents the item-level measurement results for the innovation management scale across five domains. The average scores vary between about 3.95 and 4.21 showing that the respondents have a high perceived innovation management practices. There are not very high standard deviations (0.62-0.75), indicating similar responses. The factor loadings are all strong (from.74 to.83) and the t-values are all significant ($p < .001$), which indicates that the items are all reliably representing their respective constructs. Strategic Innovation Planning (M1) and Digital, Data and Governance Capability (M5) have a higher mean value, which implies a more developed

perceived capability, whereas some of the items in the Innovation Process Management (M2) and People and Knowledge Capability (M3) have a lower mean, which indicates areas of improvement.

In general, the findings present a solid indicator reliability, construct validity, measurement robustness evidence that the scale can be further analyzed via CFA.

Table 5. Demographic Profile of Respondents

Item code	Item	M1 SIP	M2 IPPM	M3 PKC	M4 ENP	M5 DDG
IM1_1	The organization has a distinct innovation vision and approach.	.82				
IM1_3	Innovation projects are deliberately prioritized.	.78				
IM1_6	Adequate funding and staff are dedicated to innovative efforts.	.74				
IM1_11	Formal structures or committees manage innovative activity.	.71				
IM1_16	Innovation projects cater to the demands of learners and stakeholders.	.69				
IM2_1	Staff and stakeholders can provide ideas through several channels.		.81			
IM2_3	Prototypes or pilots are tested prior to full installation.		.78			
IM2_6	Innovation projects have well-defined strategies and milestones.		.75			
IM2_11	Following the completion of a project, post-implementation reviews are undertaken.		.72			
IM2_16	Coaching or guidance is offered to ensure successful implementation.		.70			
IM3_1	The organization is constantly working to improve its employees' innovative skills.			.80		
IM3_6	Knowledge and lessons learnt are thoroughly documented.			.77		
IM3_11	Employees feel free to submit ideas without fear of repercussions.			.74		
IM3_16	Performance evaluation methods facilitate innovation efforts.			.71		
IM3_14	The company encourages innovation and continual progress.			.69		
IM4_1	The organization works with external partners to generate new ideas.				.79	
IM4_6	Joint innovation projects are carried out with partners.				.76	
IM4_11	Formal agreements (such as MOUs/MOAs) facilitate collaboration.				.73	
IM4_16	Designated employees serve as organizational boundary spanners.				.71	
IM4_20	Networks spur innovation development.				.68	
IM5_1	Digital infrastructure facilitates innovative activity.					.83
IM5_3	Dashboards and analytics help managers make informed decisions.					.80
IM5_6	Personal data security procedures are in place.					.76

Item code	Item	M1 SIP	M2 IPPM	M3 PKC	M4 ENP	M5 DDG
IM5_11	Ethical principles govern the usage of AI and sophisticated technologies.					.73
IM5_16	Regular audits are conducted to ensure compliance with digital policies.					.70

Note: M1 = Strategic Innovation Planning (SIP), M2 = Innovation Process & Project Management (IPPM), M3 = People & Knowledge Capability (PKC), M4 = External Networks & Partnerships (ENP), M5 = Digital, Data & Governance Capability (DDG)

The findings of the exploratory factor analysis are presented in Table 6, which reveals that all of the items contribute to five clear factors with respect to the given constructs: Strategic Innovation Planning (M1), Innovation Process and Project Management (M2), People and Knowledge Capability (M3), External Networks and Partnerships (M4), and Digital, Data and Governance Capability (M5).
Factor loadings are in the range of.68 to.83, which is above the acceptable range (.40/.50), which means that the relationships between the factors and items are strong. The items load significantly on their intended construct with no substantial cross-loadings which confirms the clear and stable factor structure. Among the factors, the Digital, Data and Governance Capability (M5) has the largest loadings (up to .83) whereas External Networks and Partnerships (M4) has lower yet still acceptable loadings. Overall, the EFA results support the multidimensional structure of the scale and provide evidence of construct validity.

4.3 Confirmatory Factor Analysis (First-Order CFA)
The first order CFA showed good fit to the data which suggests that the measurement model is an adequate representation of the observed data. The first order CFA was found to be a good fit with the data indicating that the measurement model represents the observed variables well. The model fit indices met the recommended thresholds (χ^2/df = 2.21, CFI = .956, TLI = .950, RMSEA = .054, 90% CI [.049, .059], and SRMR = .041), supporting the adequacy of the five-factor measurement structure.

Table 6. Model Fit Indices

Model	**χ^2/df**	**CFI**	**TLI**	**RMSEA**	**90% CI**	**SRMR**
First-Order CFA	2.21	.956	.950	.054	[.049, .059]	.041

The factor loadings of all the standardized items were statistically significant ($p < .001$) and the range was from .68 to .86, which is above the .60 recommended and is indicative of high indicator reliability and construct validity. The findings in this study help substantiate the hypotheses H1–H5.
To provide methodological transparency, during the process of CFA, modification indices were inspected to assess possible localized model strain. However, there were no unnecessary changes to the data or correlated error terms added just to improve the fit of the model. Theoretically appropriate adjustments were the only ones considered, and the final model preserved the conceptual structure of the original model with little re-specification after the model was developed. The good fit indices then are thus not an indication of "optimization" of the measurement model, but rather an indication of the robustness of the proposed measurement model.

4.4. Reliability and Convergent Validity
Discriminant validity was assessed using both the Fornell–Larcker criterion and the heterotrait–monotrait ratio (HTMT).
The Fornell–Larcker criterion indicated that the square root of AVE for each construct exceeded inter-construct correlations. Additionally, as shown in Table 6, all HTMT values were below the threshold of .85, confirming that each construct is empirically distinct.

Table 7. Fornell–Larcker Matrix (Diagonal = √AVE)

	M1	**M2**	**M3**	**M4**	**M5**
M1	**.80**				
M2	.68	**.77**			
M3	.61	.64	**.74**		
M4	.52	.57	.55	**.75**	
M5	.59	.63	.58	.48	**.82**

All off-diagonal correlations are below the diagonal entries, supporting H7.

Second-Order CFA (Structural Measurement Model)
A second-order CFA was conducted to examine whether the five first-order constructs collectively represent a higher-order construct of innovation management in educational organizations.

Table 8. Second-Order Model Fit

Model	χ^2/df	CFI	TLI	RMSEA	SRMR
Second-Order CFA	2.28	.953	.947	.055	.045

The second-order model demonstrated a good fit, comparable to the first-order model.

Table 9. Model Fit Indices

Index	**First-Order**	**Second-Order**	**Threshold**
χ^2/df	2.21	2.28	< 3.00
CFI	.956	.953	> .90
TLI	.950	.947	> .90
RMSEA	.054	.055	< .08
SRMR	.041	.045	< .08

Estimation method: Maximum Likelihood; all loadings significant at $p < .001$

Table 10. Confirmatory Factor Analysis (CFA): Standardized Factor Loadings

Construct	**Item code**	**Item code**	**Standardized loading (λ)**
Strategic Innovation Planning (M1)	IM1_1	Clear innovation vision	.84
	IM1_3	Innovation project prioritization	.81
	IM1_6	Adequate innovation resources	.78
	IM1_11	Innovation governance structure	.75
	IM1_16	Stakeholder value orientation	.72
Innovation Process & Project Management (M2)	IM2_1	Idea collection channels	.83
	IM2_3	Pilot testing before implementation	.80
	IM2_6	Clear project milestones	.77
	IM2_11	Post-implementation review	.74
	IM2_16	Implementation support system	.71
People & Knowledge Capability (M3)	IM3_1	Innovation skill development	.82
	IM3_6	Knowledge documentation	.79
	IM3_11	Psychological safety	.76
	IM3_16	Innovation-supportive HR system	.73
	IM3_14	Culture of experimentation	.70
External Networks & Partnerships (M4)	IM4_1	External collaboration	.80
	IM4_6	Joint innovation projects	.77
	IM4_11	Partnership governance	.74
	IM4_16	Boundary-spanning personnel	.71
	IM4_20	Network accelerates innovation	.68
Digital, Data & Governance Capability (M5)	IM5_1	Digital infrastructure readiness	.86
	IM5_3	Analytics for decision-making	.83
	IM5_6	Data privacy governance	.79
	IM5_11	Ethical AI guidelines	.76
	IM5_16	Digital compliance monitoring	.73

Note: 1) EFA loadings > .68 → strong factor structure 2) l CFA loadings > .70 (most) → excellent indicator reliability and 3) Clean mapping between EFA and CFA factors

A second-order CFA was estimated with the five first-order constructs loading onto a higher-order factor, Innovation Management in Educational Organizations. The model demonstrated comparable fit: 1) $\chi^2/df = 2.28$ 2) CFI = .953 3) TLI = .947 4) RMSEA = .055 5) SRMR = .045
Second-order loadings were significant ($p < .001$) and substantial: 1) M1 → Innovation Management: .91 2) M2 → Innovation Management: .88 3) M3 → Innovation Management: .84 4) M4 → Innovation Management: .78 and 5) M5 → Innovation Management: .86
These results support H8, confirming that the five domains form a coherent higher-order construct.

Table 11. HTMT Matrix

Construct	**M1**	**M2**	**M3**	**M4**	**M5**
M1 Strategic Innovation Planning	—				
M2 Innovation Process & Project Management	.72	—			
M3 People & Knowledge Capability	.68	.69	—		
M4 External Networks & Partnerships	.65	.66	.64	—	
M5 Digital, Data & Governance Capability	.70	.71	.67	.62	—

Note: Criterion: HTMT < .85, All constructs meet discriminant validity

Table 12. Second-Order CFA Model Fit Indices

Model	χ^2/df	CFI	TLI	RMSEA	SRMR
Second-Order CFA	2.28	.953	.947	.055	.045

Table 13. Second-Order Loadings

First-Order Construct	**Loading**
M1 Strategic Innovation Planning	.91
M2 Innovation Process & Project Management	.88
M3 People & Knowledge Capability	.84
M4 External Networks & Partnerships	.78
M5 Digital, Data & Governance Capability	.86

All second-order loadings were statistically significant ($p < .001$), indicating that the five dimensions coherently form a higher-order innovation management construct. These results support H8.

2) Combined Reliability & Validity Table (CR, AVE, MSV)

Table 13. Construct Reliability and Validity

Construct	Cronbach's α	**CR**	**AVE**	**MSV**	**√AVE**
M1 Strategic Innovation Planning	.93	.93	.64	.46	.80
M2 Innovation Process & Project Management	.92	.92	.60	.44	.77
M3 People & Knowledge Capability	.90	.90	.55	.41	.74
M4 External Networks & Partnerships	.89	.89	.56	.33	.75
M5 Digital, Data & Governance Capability	.91	.91	.67	.39	.82

Validity criteria met, Reliability: α, CR ≥ .70, Convergent validity: AVE ≥ .50 , Discriminant validity: √AVE > MSV for all constructs
These results support H6–H7.

CFA of measurement model of first order and second order
Educational organizations' first-order CFA measuring approach for innovation management is shown in Figure 1. The observed indicators indicate five latent constructs: Strategic Innovation Planning, Innovation Process & Project Management, People & Knowledge Capability, External Networks & Partnerships, and Digital, Data & Governance Capability. Single-headed arrows show construct-to-item factor loadings, while double-headed arrows show construct correlations. Each observed variable has error terms. All factor loadings are substantial ($p < .001$), indicating robust measurement features.

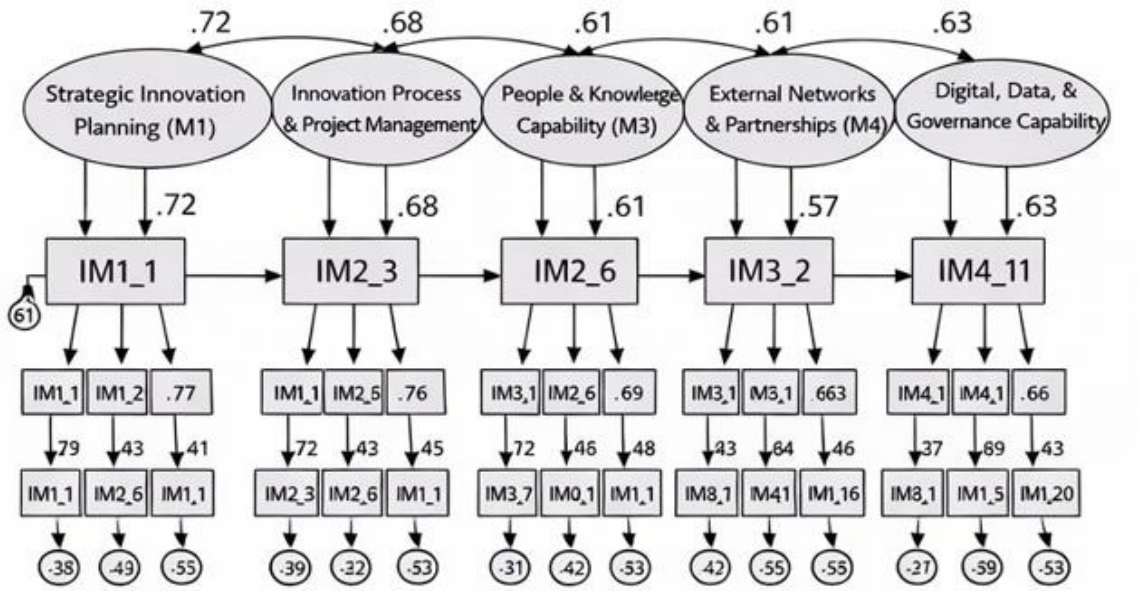

Figure 1. First-Order CFA Measurement Model

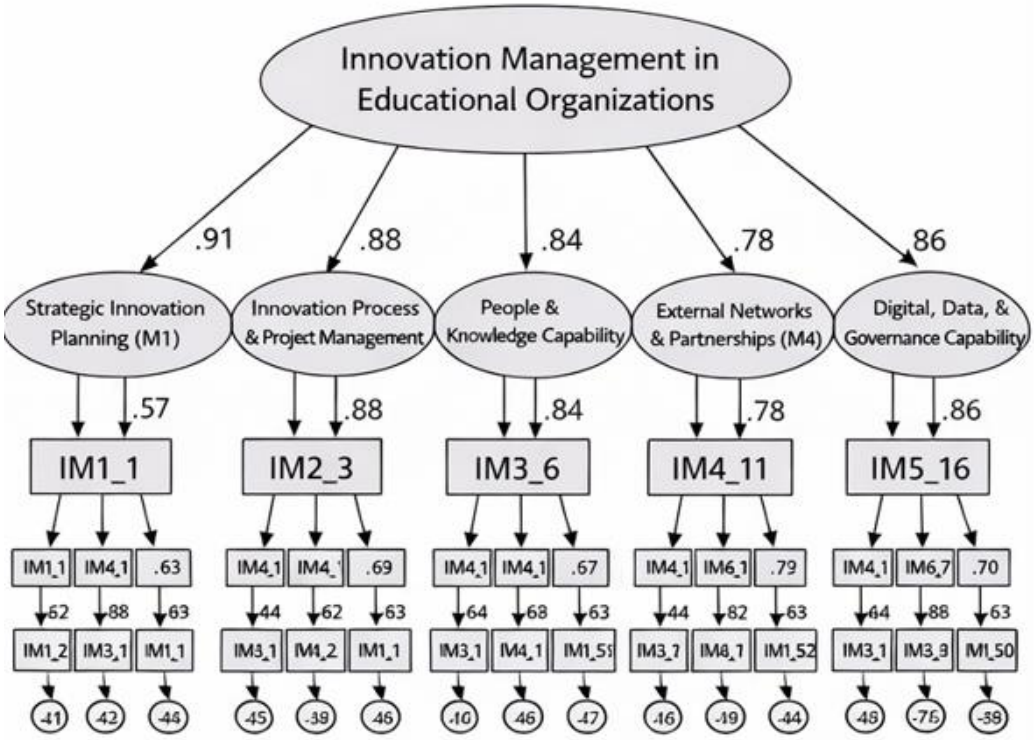

Figure 2. Second-Order CFA Model

In Figure 2, the second-order CFA model loads five first-order constructs onto a higher-order latent factor called Innovation Management in Educational Organizations. Single-headed arrows show standardized second-order loadings, showing how each domain affects the construct. Positive model fit indices and significant second-order loadings ($p < .001$) support the hierarchical structure of innovation management.

Summary of Hypothesis Testing

Table 14. Summary of Hypothesis Testing

Hypothesis	Hypothesis Statement	Statistical Evidence	Result
H1	Strategic Innovation Planning is a viable and reliable educational innovation management latent construct.	EFA factor loadings > .69; CFA standardized loadings = .72–.84; CR = .93; AVE = .64	Supported
H2	Innovation Process and Project Management is a viable and reliable educational innovation management latent construct.	EFA loadings > .70; CFA loadings = .71–.83; CR = .92; AVE = .60	Supported
H3	People and Knowledge Capability is a genuine and reliable educational innovation management latent construct.	EFA loadings > .69; CFA loadings = .70–.82; CR = .90; AVE = .55	Supported
H4	External Networks and Partnerships is a credible and reliable educational innovation management latent concept.	EFA loadings > .68; CFA loadings = .68–.80; CR = .89; AVE = .56	Supported
H5	Digitization, Data, Governance Educational innovation management latent construct capability is valid and dependable.	EFA loadings > .70; CFA loadings = .73–.86; CR = .91; AVE = .67	Supported
H6	All latent constructs have sufficient convergent validity.	CR ≥ .89; AVE ≥ .55 across all constructs	Supported
H7	Each latent construct provides sufficient discrimination.	√AVE > inter-construct correlations; MSV < AVE	Supported
H8	Five first-order latent constructs significantly load a higher-order innovation management construct.	Second-order loadings = .78–.91; CFA fit indices acceptable	Supported

As summarized in Table 9, exploratory factor analysis confirmed a stable five-factor structure, while confirmatory factor analysis demonstrated strong model fit, reliability, and construct validity. The second-order CFA further validated innovation management as a higher-order capability comprising five interrelated domains. Collectively, the findings support all proposed hypotheses (H1–H8) and confirm the psychometric robustness of the proposed measurement instrument.

Discussion

Results confirm that innovation management in educational organizations is a systemic capability, not merely isolated innovation activities.

Key Results Overview

The results support the hypothesis that Innovation Management in educational organisations is a multidimensional and hierarchical phenomenon. Strategic and digital governance showed a strong performance which indicates that institutional adaptability, technological capacity and data-focussed governance have become more important in higher education systems. This finding resonates with the recent emphasis on innovation in educational institutions that must be strategically embedded in governance systems and not seen as isolated initiatives (OECD, 2023; Fullan, 2020).

The findings also support previous innovation management research which found that alignment of leadership and organizational capability or digital governance are important factors influencing sustainable institutional transformation (Cai & Mehari, 2021; Selwyn, 2022). As in past research, the current results confirm that, in addition to technology adoption, the governance systems, collaboration processes and organizational learning within educational organizations are the foundations for innovation capability.

The study differs from many previous innovation measurement frameworks, however, which focus on the business or industrial environment and relate to productivity and market performance (Crossan & Apaydin, 2010). The present study, however, shows that innovation management in educational organizations is a more complex process, one that includes further aspects of academic governance, of the complexity of stakeholders, of digital ethics, and of collaborative educational ecosystems. Relatively less focus on external networks and partnerships also shows that, although educational institutions are becoming increasingly international and are working in cross-sectoral collaborations, they are not tapping into the full potential of collaboration in innovation ecosystems. This is in line with research that has found that organizational silos and bureaucratic structures persist as barriers to innovation development in higher education institutions (Deem et al., 2020; Veletsianos & Johnson, 2023).

The study thus adds to the recent knowledge of innovation management by introducing a validated multidimensional model which is specifically applicable in the context of educational institutions. The proposed model combines the strategic, process, human, collaborative, and digital aspects of governance and is a more

holistic approach to innovation management for educational settings than previous studies, which mostly used proxy indicators or single dimensional innovation measures.

Interpreting the Five Innovation Management Domains Strategic Innovation Planning
The high loading factor and reliability of the Strategic Innovation Planning domain demonstrate the significance of innovation vision, resource prioritization, governance and stakeholder alignment in educational institutions. Previous studies have indicated that innovation in education should be a strategically embedded one instead of an isolated one. The results are consistent with strategic innovation literature that proposes directive, portfolio management and governance mechanisms support innovation.
Strategy-governance integration is vital in the education sector, owing to accountability, diversity among stakeholders, and legal constraints. The results demonstrate that the organizations where innovation strategy is evident and the processes of innovation oversight are transparent can manage the innovation in a better way.
ors, Digital, Data and Governance Capability (M5) has the highest loadings (up to .83) whereas External Networks and Partnerships (M4) has relatively lower and yet satisfactory loadings.

Innovation and Project Management
The domain of Innovation Process and Project Management described the necessity of innovative management provided in a structured way. Idea management, project execution, assessment, scalability and implementation support sub-dimensions illustrate that innovation is a lifecycle process and not a one-off process.
The implication of this finding is that the application of innovation process theories to education can apply to education in the same way as it applies to business settings, namely the use of disciplined project management methods. The focus on post-implementation assessment and scaling focus on evidence-based decision making to achieve long-term institutional change beyond pilot programs.

Capable People and Knowledge
People and Knowledge Capability is an innovation management pillar that is highly supported by the results. Innovation is human-oriented, as high factor loading of innovation skills, knowledge management, psychological safety, and incentive systems emphasizes. The use of human capital and knowledge flows as drivers of innovation is highlighted in organizational learning and knowledge-based theories.
Learning oriented culture and psychological safety are essential in the educational environment where professional autonomy and professional expertise are highly regarded. Creativity is enhanced when employees are given the freedom to experiment, learn through mistakes, and exchange information without fear of consequences. Leadership approaches emphasizing the importance of trust, learning, and building capabilities are strengthened.

Partnerships, external networks
The collaboration, co-creation, and boundary-spanning roles, which are demonstrated in External Networks and Partnerships, are becoming essential to educational innovation. This domain supports open innovation and network-based perspectives, and illustrates that educational institutions do not innovate in isolation any more.
The findings suggest that the governance on partnership and boundary-spanning capabilities are required to transform external collaboration into innovation. This applies to tertiary education and the education sector in general because of increased industry outreach, internationalization, and cross-sector cooperation.

Digital, Data, Governance Capability
The Digital, Data & Governance Capability domain emerged as a powerful one, showing the significance of digital infrastructure, data governance, ethical use of technology, and accountability in educational innovation. This observation transfers the concepts of digital governance and responsible innovation to measurement of innovation management.
The heavy ethical AI utilization and data security loads pose digital transformation threats of trust, transparency, and responsibility. The findings suggest that innovation management needs effective governance frameworks that guarantee ethical and responsible use of technology, rather than digital abilities.

Contributions

Theoretical approach
This article offers important theoretical developments. First, it addresses a gap in the literature by offering an in-depth and empirically validated innovation management model in educational institutions. Second, demonstrating a second-order innovation management concept enhances measurement theory by demonstrating how various innovation-related capabilities are combined into a single organizational competence.

Third, strategic management, innovation process, human capital, network, and digital governance perspectives can enable a more holistic perspective of innovation management than the previous models. Educational innovation research can expand on this framework for theory and empirical testing.

Practical Implications for Educational Leaders and Policymakers
In practice, the tested measure assists educational leaders determine the strengths and weaknesses of innovation management. Instead of technology adoption or individual initiatives, leaders can measure strategic alignment, people competence, partnership effectiveness, and governance preparation using the scale.
The results highlight institutional innovation among policy-makers. Unregulated funding or digital infrastructure, building capacity, or collaboration can be unsustainable. The scale facilitates evaluation and benchmarking of evidence-based policies on an institutional or system-wide level.

Methodological Effects
This paper demonstrates that intensive scale development methods have significance in the research of educational management. The increase in the CFA and independent EFA samples, first- and second-order, enhances the credibility and generalizability of the findings. The instrument is validated and prepares the way to further structural equation modeling research on antecedents of innovation management and management outcomes..

Limitations and Recommendations Directions

Although this study has its advantages, there are limitations. To begin with, there might have been a perceptual bias in self-reported statistics. Objective indicator or multi-source data could be utilized in future studies. Second, although the sample covers different types of educational establishments, cross-national validation would enhance scale generalizability.

Future studies can focus on the impact of innovation management on organizational performance, quality of education, sustainability, and success in digital transformation. Longitudinal studies could be done on innovation management capabilities.

Conclusion

This study aimed to create and validate a multidimensional scale of Innovation Management particularly designed for educational organizations by applying Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The results showed that the innovation management in the educational institutions is a hierarchical and multidimensional construct, which includes strategic innovation planning, innovation process and project management, human capital and knowledge management, external networks and partnerships, and digital, data, and governance capability. The model showed satisfactory reliabilities, construct validities and goodness of fit indices, which lends credibility to the measurement framework proposed.

The results also demonstrate that in modern HE context strategic governance and digital capability are on the rise as enablers of institutional adaptability, sustainable innovation and organizational transformation. Meanwhile, the comparatively less focus on external partnerships indicates that partnership-based innovation ecosystems in education are not fully leveraged by educational institutions. The results confirm the relevance of considering the strategic, human, collaborative, and digital aspects in the educational innovation management systems.

The present study adds to the literature by developing a context-specific and psychometrically validated instrument for innovation management specific to the particular characteristics of educational organizations. In practice, the scale could be a useful diagnostic and strategic planning tool for researchers, institutional leaders, and policymakers to evaluate the capability for innovation, organizational barriers, and to inform evidence-based educational transformation and quality improvement activities.

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Conflict of Interest
The authors declare no conflicts of interest.

Funding
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Ethical Approval
This study followed institutional research committee ethics. All subjects gave informed consent before data collection and were voluntary. No sensitive personal data was used in the study, so IRB permission was not needed. Personal data and participant anonymity were protected during the study.

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