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Navigating Dynamic Environments: The Strategic Performance of Indonesian EdTech Startups Through Innovation Capability and Government Support

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ABSTRACT

This study explores how Indonesia's rapidly evolving EdTech environment shapes startup performance by linking environmental dynamics (ED) and managerial flexibility (MF) to strategic outcomes through innovation capability (IC), with government support (GS) as a boundary condition. Using a quantitative Structural Equation Modeling-Partial Least Squares (SEM-PLS) analysis of senior managers and founders from early- to growth-stage EdTech firms (Series A or beyond, AI/LMS adopters registered with the Ministry of Communication and Information Technology), we found that environmental turbulence and organizational flexibility are positively associated with strategic performance (SP). IC emerges as the core mechanism for translating external pressures and internal agility into superior results, while GS strengthens these relationships by enabling firms to leverage their capabilities more effectively. By integrating Dynamic Capability Theory, the Innovation Capability Framework, and Institutional Theory, this study provides the first empirical validation of a unified model in Indonesia's EdTech sector and clarifies how internal capabilities and institutional contexts jointly produce strategic advantages. The findings signal clear actions: EdTech leaders should institutionalize systematic IC development while preserving flexibility, and policymakers should craft coherent support ecosystems—combining fiscal incentives, robust digital infrastructure, and innovation-friendly regulation—to unlock sustained performance in dynamic markets.

1. INTRODUCTION

The digital transformation of education has accelerated globally, with Indonesia emerging as a critical market for educational technology (EdTech) innovation. With internet penetration reaching 81.2% by March 2025 and an average daily usage of 8 hours and 36 minutes, Indonesia ranks eighth globally in terms of internet usage duration, creating unprecedented opportunities for digital education solutions. However, the post-pandemic landscape presents complex challenges for EdTech startups, including a 15-20% decline in active users as educational institutions return to offline modes, despite the projected market value of $3.7 billion by 2027 [1, 2].

In this dynamic environment, EdTech startups face multifaceted challenges that require sophisticated strategic responses. Environmental dynamics (ED)—encompassing rapid technological changes, regulatory shifts, evolving user preferences, and competitive pressures—create both opportunities and threats that require adaptive organizational capabilities [3]. Simultaneously, the ability to maintain managerial flexibility (MF) while building innovation capacity is crucial for sustainable competitive advantage in an industry characterized by high uncertainty and rapid iteration cycles.

Despite the growing recognition of innovation as a strategic imperative in the digital service sector, the internal mechanisms that stimulate innovative work behavior in startup ecosystems remain insufficiently examined. Existing research has predominantly centered on conventional industries such as banking and formal education, which operate under rigid hierarchies and well-defined roles—conditions that contrast sharply with the decentralized structures and dynamic role configurations typical of startups [4, 5]. In the EdTech domain, innovation manifests through adaptive course delivery, interactive learning technologies, and data-driven personalization, serving both operational efficiency and strategic differentiation.

This study builds on theoretical insights from three interconnected frameworks to explain the causal pathways underlying strategic performance (SP) in Indonesian EdTech startups. First, Dynamic Capability Theory [3] provides a foundation for understanding how organizations sense, seize, and transform resources in response to environmental changes. Second, the Innovation Capability Framework [6] explains how firms systematically develop and deploy innovative solutions to problems. Third, Institutional Theory [7] illuminates how external institutional support, particularly government intervention, shapes organizational behavior, and performance outcomes.

Aligned with global development priorities, this study situates SP within the broader framework of the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation and Infrastructure). Indonesian EdTech startups contribute directly to SDG 4 by expanding equitable access to quality education through innovative, digital learning solutions. The emphasis on MF and innovation capability (IC) supports SDG 8 by fostering decent working conditions and promoting continuous skill development. From a structural perspective, cultivating innovation capabilities within startups advances SDG 9 by strengthening digital infrastructure and encouraging the creation of scalable, context-sensitive technologies [8].

This study advances the literature by introducing IC as a critical mediating construct that bridges the relationship between ED, MF and SP [9-11]. While ED and MF are widely recognized as key drivers of organizational success, their indirect effects, particularly through IC, remain underexplored in emerging digital ecosystems. Additionally, this study positions government support (GS) as a moderating factor that amplifies the effectiveness of internal capabilities, contributing to our understanding of how the institutional context shapes strategic outcomes in developing economies.

The theoretical integration employed in this study directly informed the research design. A conceptual model is constructed in which IC serves as a mediating variable linking ED and MF to SP, and GS functions as a moderating variable. This approach allows for the empirical validation of the proposed causal pathways and highlights the unique contribution of the study, namely, its focus on the interaction between internal capabilities, external pressures, and institutional support in shaping sustainable competitive advantage within emerging digital education ecosystems.

2. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

2.1 Environmental dynamics and strategic performance

ED denotes the velocity and unpredictability of changes in an organization's external milieu across technological, market, regulatory, and competitive dimensions [12]. Within Indonesia's EdTech sector [13, 14], these dynamics are conspicuous: rapid advances in AI-enabled learning platforms and analytics, intermittent shifts in digital education policy and accreditation protocols, evolving learner preferences toward hybrid and micro-credential models, and intensifying rivalry from domestic ventures as well as global platform incumbents. In such settings, turbulence functions simultaneously as a constraint and catalyst. On one hand, frequent discontinuities amplify information asymmetries, increase search and coordination costs, and shorten the shelf life of established routines; on the other hand, they create windows for first-mover positioning and capability renewal when firms can respond with speed and discipline [15]. Recent evidence underscores that performance under high dynamism depends less on exogenous shocks per se and more on a firm's capacity to continually sense, seize, and reconfigure resources at pace, converting weak environmental cues into timely strategic action [3, 15].

The requisite capability profile for venture-stage EdTech firms is inherently ambidextrous. Exploration is needed to identify and trial emergent pedagogical and technological options—adaptive assessment, multimodal content generation, analytics-driven personalization while exploitation is necessary to harden the platform, stabilize revenue, and deepen user engagement. Ambidexterity is not reducible to a budgetary split; rather, it is an architectural and governance choice. Architecturally, modular product designs allow components (e.g., recommendation engines, assessment modules, and identity services) to evolve on semi-independent cadences without destabilizing the whole. Data pipelines—event streams, learning analytics schemas, and feedback instruments embedded in user workflows—compress learning cycles, improve the signal-to-noise ratio of experiments, and enable rapid rollback when interventions underperform. Governance routines—stage-gates tied to learning and adoption metrics rather than intuition, portfolio reviews that rebalance discovery and delivery, and escalation mechanisms that elevate weak but persistent signals from teachers, administrators, and students—translate environmental sensing into investment decisions [3, 15].

This challenge is magnified by the ecosystemic nature of digital education. Unlike industries with relatively stable bilateral value chains, EdTech is organized around fluid, multi-sided collaborations among schools and universities, content creators, cloud and payment providers, and credentialing bodies. Complementarities and standards co-evolve over short horizons as curricula change, procurement criteria adapt, and interoperability expectations expand [16]. Therefore, effective participation requires boundary-spanning capabilities that connect technical roadmaps with pedagogical and policy developments. Continuous environmental scanning of ministerial guidance, district procurement pilots, and accreditation rubrics needs to be paired with sandbox experimentation alongside institutional partners to de-risk adoption and collect credible evidence of learning impact. Boundary-spanning roles, such as educator-in-residence or standards liaison, convert policy and classroom shifts into product requirements and evidence dossiers that resonate with institutional decision makers [17].

Operationalizing these requirements entails disciplined routines. Firms should define leading indicators that capture both educational value and commercial traction—time-to-competency for target learner segments, assignment completion rates, teacher activation and retention, cohort-level engagement curves, and unit economics per enrolled student—and wire these metrics into release trains so that each increment is evaluated against explicit thresholds. On the exploration side, short discovery sprints with embedded educators can surface latent pain points (e.g., formative assessment load and accessibility needs) and generate small-scale prototypes. On the exploitation side, progressive hardening through A/B tests, reliability targets, and privacy-by-design checks converts promising prototypes into dependable services suitable for district-level procurement. Importantly, ambidexterity must be preserved, even under pressure. When macro shocks or policy shifts occur, resource reallocation should prune low-yield initiatives and extend runways for high-promise lines rather than trigger wholesale resets that dissipate organizational memory [3, 15].

The contextual particularities of Indonesia heighten the salience of these practices [18]. Heterogeneity across provinces in bandwidth, device penetration, and teacher professional development obliges firms to localize content and delivery modalities while maintaining a coherent, technical core. Offline-first features, bilingual content pipelines, and alignment with evolving accreditation requirements can expand the addressable markets without fracturing the codebase. Simultaneously, as large platform incumbents enter with distribution and capital advantages, domestic ventures can differentiate by evidencing learning outcomes in local contexts and integrating with national credentials and procurement channels—actions that require the sensing, experimentation, and reconfiguration routines described above [16, 17].

H1: *ED positively influences SP in Indonesian EdTech startups*.

2.2 Managerial flexibility and strategic performance

MF, the capacity to reconfigure strategies, structures, and processes with speed and economy, constitutes a pivotal adaptive mechanism under conditions of uncertainty [19]. In startup contexts, where resource constraints, role ambiguity, and compressed decision cycles are the norm, flexibility becomes an organizing logic, rather than a situational choice. Indonesian EdTech ventures operate amid volatile regulatory guidance, shifting procurement logic in schools and universities, and the rapid diffusion of AI-enabled learning tools. Accordingly, MF must manifest as (i) structural agility (temporary, cross-functional squads; modular governance that devolves decision rights to product owners), (ii) process agility (short iteration cadences, continuous discovery with users, and rolling reprioritization of backlogs), and (iii) resource agility (rapid reallocation of talent and budgets toward emergent opportunities while pruning low-yield initiatives).

Empirical research consistently links this flexibility to superior outcomes. Flexible decision routines allow firms to seize nascent opportunities and neutralize threats before they crystallize [20]. In EdTech, this may entail pivoting from direct-to-consumer offerings to institutional SaaS when consumer acquisition costs spike, redesigning content delivery from synchronous to asynchronous modes in response to learner analytics, or rapidly scaling cloud capacity around enrollment cycles, for example. However, flexibility is not value-creating by default. Without complementary systematic capabilities, it can devolve into reactive oscillation, dissipating resources and eroding strategic coherence [21]. The resolution to this paradox is capability-embedded flexibility: adaptive moves are disciplined by standardized architectures (application programming interfaces (APIs), data schemas), routinized experimentation (A/B and multivariate tests), and portfolio governance (stage-gates tied to learning milestones). In short, flexibility must be coupled with IC to convert adaptation into a durable advantage.

Top-management cognition and timing norms further condition the performance yield of the flexibility. Nadkarni and Herrmann [22] show that CEO characteristics shape strategic flexibility and its effectiveness under ED; in turbulent settings, leaders with broader cognitive frames and higher openness marshal flexible responses more productively than others. For Indonesian EdTech founders, this implies cultivating "temporal ambidexterity": balancing short-term tactical reconfiguration (e.g., feature toggles to meet a ministry guideline) with long-horizon bets (e.g., credentialing standards, interoperability with national ID/data systems). Flexible firms also require planning systems that are comprehensive and non-rigid. Rudd et al. [23] find that formalized, participative, and analytically rich planning enhances performance when used as a learning device rather than a blueprint. In practice, lightweight planning cadences—quarterly strategy reviews, cross-functional pre-mortems, and rolling forecasts—provide the scaffolding that channels flexibility toward goals and mitigates this strategic drift.

Operationally, MF in EdTech is evidenced by agile product pipelines (dual tracks for discovery and delivery), responsive customer success models (co-design with schools and district offices), and partner-centric business development (alliances with publishers, telcos, and payment providers). Governance mechanisms, such as option-like resource allocation, kill criteria for experiments, and post-implementation reviews, institutionalize learning and curb the escalation of commitment. When these design choices are aligned, flexibility becomes a dynamic capability that enables rapid reconfiguration while preserving the integrative focus across pedagogy, technology, and policy interfaces. Conversely, in the absence of disciplined routines and cognitively equipped leadership, "flexibility" risks becoming a perpetual churn. Thus, for Indonesian EdTech startups, the performance payoff of MF is maximized when (1) it is embedded in repeatable innovation processes, (2) steered by leadership with a broad cognitive bandwidth attuned to dynamism, and (3) anchored by planning systems that convert fast feedback into coherent strategic renewal [19-23].

H2: *MF positively influences the SP of Indonesian EdTech startups*.

2.3 Innovation capability as a mediating mechanism

IC denotes a firm's systematic capacity to generate, develop, and implement novel solutions that create stakeholder value across products, processes, and business models [6]. In EdTech startups, this capability spans three tightly coupled layers: technological innovation (e.g., AI-powered learning analytics, adaptive content delivery, multimodal assessment), pedagogical innovation (personalized learning pathways, competency-based progression, gamified feedback loops), and business model innovation (B2B SaaS to schools and districts, tiered subscriptions, marketplace curation of third-party content). Critically, IC is not a single routine but a composite of sensing, experimenting, selecting, and scaling mechanisms supported by data architecture, governance, and cross-boundary collaboration. Organizations that treat innovation as a pipeline rather than sporadic projects show a greater throughput of validated ideas and a higher conversion of prototypes into market outcomes [24].

The mediating role of IC between environmental conditions and performance has gained empirical support. In dynamic settings, firms must balance explorative and exploitative activities: exploration to discover emerging learning technologies and didactic approaches, and exploitation to refine platforms, reduce service variability, and deepen engagement [25]. This duality aligns with computational evidence that adaptive reconfiguration and local search, when guided by feedback-rich data environments, improve the solution quality under turbulence [26]. Practically, EdTech startups institutionalize exploration through discovery sprints, educator co-design, and sandbox pilots with limited cohorts. They institutionalize exploitation via release trains, A/B testing, and post-deployment analytics, which harden features into reliable services. When these cycles are tightly integrated through shared metrics, modular architectures, and portfolio governance, IC translates external shocks into cumulative performance gains, thereby mediating the link between ED and MF to strategic outcomes.

Context matters. Indonesia's educational landscape is heterogeneous across geography, infrastructure readiness, socioeconomic status, and language [27-29]. IC must therefore include sensitivity to cultural and institutional variation—localized content, offline-first delivery for low-bandwidth regions, and interoperability with national systems (e.g., identity and credential registries). Startups that systematically encode these contingencies into their research and development routines via user segmentation, ethnographic insight, and adaptive content engines are more likely to achieve resilient growth [2]. Moreover, public–private alignment shapes feasibility: sustainability-oriented governance and policy instruments can lower transaction costs, encourage responsible data use, and accelerate the diffusion of pedagogical innovations [30]. In such regimes, IC is amplified by clearer standards, procurement pathways, and incentives for evidence-based product development.

Several design principles operationalize innovation capabilities in EdTech. First, data-centric architectures, such as clean event streams, well-defined learning analytics schemas, and secure pipelines, compress feedback cycles and increase the signal-to-noise ratio for experimentation. Second, boundary-spanning roles (teacher-in-residence, district liaison, standards lead) convert weak environmental signals into actionable roadmaps, ensuring that exploration targets have genuine pedagogical value rather than novelty. Third, portfolio discipline (stage-gates tied to learning outcomes, explicit kill criteria, option-like resource allocation) prevents the diffusion of effort and preserves throughput. Finally, compliance-by-design (privacy, accessibility, and safety) sustains innovation velocity by minimizing rework and regulatory friction. When these elements cohere, IC functions as the causal engine that turns environmental turbulence and managerial reconfiguration into durable SP. Conversely, in the absence of such scaffolding, "innovation" degenerates into fragmented pilots, local optimizations, and costly pivots that fail to scale.

H3: *ED positively influences IC in Indonesian EdTech startups*.

H4: *MF positively influences the IC of Indonesian EdTech startups*.

H5: *IC positively influences SP in Indonesian EdTech startups*.

2.4 Government support as a moderating factor

IC is an organization's systematic capacity to sense opportunities and threats, generate and select novel ideas, and convert them into scalable, value-creating offerings and processes [6]. In EdTech startups, this capability manifests across three intertwined layers: (i) technological innovation—AI-enabled learning analytics, adaptive content pipelines, multimodal assessment; (ii) pedagogical innovation—competency-based progression, personalized learning paths, gamified feedback loops; and (iii) business-model innovation—B2B SaaS arrangements with districts, tiered subscriptions, and platform marketplaces that orchestrate publishers and creators. Crucially, IC is not a sporadic ideation exercise; it is an operating system composed of data architectures, governance routines, boundary-spanning roles, and portfolio discipline that together increase the yield of validated ideas and compress the time from prototype to institutional adoption [24].

Extant research positions IC as a mediating mechanism that translates environmental turbulence and internal reconfiguration into performance. Organizations in dynamic contexts require ambidexterity, simultaneously exploring emerging technologies and exploiting existing assets to achieve reliability and scale [25]. Computational and algorithmic evidence indicates that adaptive reconfiguration guided by rich feedback improves solution quality under turbulence, reinforcing the value of tightly coupled exploration–exploitation cycles [26]. In EdTech, exploration might involve co-design sprints with teachers to trial generative AI authoring tools, while exploitation hardens those tools through A/B tests, release trains, and learning-outcome analytics that institutionalize successful features. When these pathways are integrated via common metrics (e.g., cost-to-learning-gain), modular architectures (APIs, data schemas), and portfolio governance (stage-gates tied to evidence), IC becomes the causal engine mediating the relationship between ED and MF to SP [31].

A growing stream of research links IC to digital transformation quality and sustainability alignment. Kim and Jun [32] show that digitally mature firms outperform peers when transformation embeds complementary organizational capabilities not just technology acquisition. For EdTech, this means that data pipelines, privacy-by-design, and teacher-facing workflows must co-evolve with technical stacks; otherwise, "innovation" stalls in pilot projects [33]. Similarly, demonstrate that strategic ambidexterity balancing market-driven responsiveness with proactive market shaping enhances performance through marketing program adaptiveness and knowledge integration. Translated to EdTech, product teams must absorb weak signals from classrooms (e.g., usability frictions, formative assessment needs) while also shaping standards and credentials through consortia and ministry dialogues, thereby turning private innovation into public infrastructure [34]. Sustainability scholarship further indicates that capability portfolios that integrate eco-efficiency and social objectives can accelerate diffusion and legitimacy [35]. For startups serving public education, this implies innovation routines that internalize accessibility, inclusion, and responsible data use as design constraints rather than afterthoughts, improving adoption probabilities in resource-constrained districts and aligning with procurement criteria [30].

The Indonesian context highlights these imperatives. Heterogeneity in infrastructure, language, and pedagogical capacity across provinces requires localized experimentation and scalable standardization. Startups with robust innovation capabilities systematically incorporate ethnographic inquiries, segmented user testing (urban/rural; low/high bandwidth), and bilingual content pipelines to produce culturally responsive solutions [2]. Boundary-spanning roles—teacher-in-residence, district liaisons, standards lead—translate regulatory and pedagogical shifts into product roadmaps and evidence dossiers that are suitable for public procurement. Where ministries promulgate interoperability standards and digital infrastructure incentives, IC is amplified by reduced transaction costs, clearer adoption pathways, and stronger ecosystem complementarities [30].

The design principles for operationalizing IC in EdTech are becoming increasingly clear. First, data-centric architectures (clean event streams, validated learning-analytics schemas, and secure consent flows) compress feedback loops and raise the signal-to-noise ratio for experimentation, consistent with digital transformation complementarity effects [32]. Second, ambidextrous processes separate discovery from delivery while linking them through shared OKRs [25, 33]. Third, portfolio governance treats initiatives as options: small initial bets, explicit kill criteria, and scaling only when learning gains, equity impacts, and unit economics are clear pre-specified thresholds [24]. Fourth, compliance-by-design (privacy, safety, accessibility) reduces downstream rework and enhances institutional trust, a precondition for contracts with public schools [35]. Finally, ecosystem partnering—publishers, telcos, payment providers, and credentialing bodies—converts private capabilities into network capabilities, raising switching costs and accelerating diffusion.

Bringing these threads together yields three propositions for empirical testing in Indonesian EdTech: P1 (Mediation): IC will positively mediate the relationship between ED and SP, such that the indirect effect via innovation routines (explore–exploit integration and data-centric experimentation) is stronger than the direct effect of dynamism alone. P2 (Moderated mediation): The mediating effect of IC will be stronger when MF is high because flexible resource reallocation and structural agility increase the throughput and scaling of validated innovations. P3 (Conditional amplification): The positive indirect effect of IC on performance will be amplified under supportive institutional conditions (interoperability standards, procurement clarity), which reduce adoption friction and legitimize novel pedagogies [30, 32, 33].

H6: *IC mediates the relationship between ED and SP in Indonesian EdTech startups*.

H7: *IC mediates the relationship between MF and SP in Indonesian EdTech startups*.

H8: *GS moderates the relationship between ED and SP, strengthening the positive effect*.

H9: *GS moderates the relationship between MF and SP, strengthening the positive effect*.

3. RESEARCH METHODOLOGY

3.1 Research design and sample

This study employed a quantitative research design using cross-sectional survey data to test the hypothesized relationships among ED, MF, IC, GS, and SP. The target population consisted of EdTech startups officially registered with Indonesia's Ministry of Communication and Information Technology (Kominfo) and who participated in GS programs.

Using purposive sampling, 60 EdTech startups were selected based on the following criteria: (1) operational for at least three years to ensure adequate experience with ED and strategic decision-making; (2) secured minimum Series A funding as an indicator of business validation and growth potential; (3) active utilization of core technologies such as Artificial Intelligence (AI) and Learning Management Systems (LMS); and (4) participation in GS programs to ensure the relevance of the moderating variable.

Data were collected through structured online questionnaires distributed to senior management team members, including founders, CEOs, and department heads. Of the 350 questionnaires distributed, 294 responses were received, yielding a response rate of 84%. After data cleaning procedures to remove incomplete responses and outliers, a final sample of 258 valid responses was retained for the analysis.

3.2 Measures

All constructs were measured using established scales that were adapted for the Indonesian EdTech context (Table 1). ED was assessed using Miller and Friesen's [36] scale, capturing the rate of change in technology, market conditions, and the competitive landscape. MF was measured using Volberda's [19] scale, focusing on the strategic, structural, and operational flexibility dimensions. IC was operationalized using Wang and Ahmed's [37] scale, encompassing product, process, and strategic innovation capabilities. GS was measured using a scale adapted from Autio and Rannikko [38], which covers fiscal incentives, regulatory support, and infrastructure provision. SP was assessed using Venkatraman and Ramanujam's [39] multidimensional scale, including financial performance, market performance, and stakeholder satisfaction. All items were measured on a 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). The questionnaire was translated into Bahasa Indonesia and back translated to ensure its linguistic equivalence.

Table 1. The constructs of variables

Construct	Code	Item Statement (Adapted for EdTech)	Source
ED	ED1	Changes in education technology relevant to our offerings occur very rapidly.	[36]
	ED2	Market preferences of learners/institutions in our segments shift frequently.	
	ED3	Competitors introduce new features or business models at an unpredictable pace.	
	ED4	Regulatory or accreditation guidelines affecting digital learning change often.	
	ED5	Overall, our external environment is turbulent and hard to forecast.	
MF	MF1	We can reallocate budgets and people quickly when priorities change.	[19]
	MF2	Decision rights are easily shifted to the teams closest to emerging opportunities.	
	MF3	Our structures (e.g., squads/chapters) can be reconfigured with minimal disruption.	
	MF4	We revise product roadmaps rapidly in response to user or policy feedback.	
	MF5	We discontinue low-yield initiatives without delay when evidence is weak.	
IC	IC1	We systematically generate and test new product/feature ideas (e.g., AI/LMS modules).	[37]
	IC2	We redesign internal processes to improve speed, quality, or cost of delivery.	

	IC3	We frequently introduce improvements that enhance learning outcomes for users.	
	IC4	We adapt business models (e.g., pricing, channels, partnerships) to create value.	
	IC5	Cross-functional teams (product–engineering–pedagogy) collaborate to scale innovations.	
	IC6	Data/analytics are routinely used to evaluate pilots and decide what to scale.	
GS	GS1	We benefit from fiscal incentives or grants that support EdTech innovation.	[38]
	GS2	Regulations and standards (e.g., interoperability, privacy) facilitate our adoption.	
	GS3	Public digital infrastructure (e.g., connectivity, ID/credential platforms) supports our services.	
	GS4	Government programs improve our market access to schools/districts.	
SP	SP1	Our revenue and growth meet or exceed internal targets.	[39]
	SP2	Our market share or customer base has increased in our target segments.	
	SP3	Customer (learner/teacher/institution) satisfaction with our offerings is high.	
	SP4	Our brand reputation and partner recognition have strengthened over the past year.	
	SP5	We retain users/institutions at rates that meet our objectives.	
	SP6	Overall, our strategic goals have been successfully achieved.	

3.3 Data analysis

Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 3.2.9 software. PLS-SEM was chosen because of its ability to handle complex models with both mediating and moderating effects, relatively small sample sizes, and potentially non-normal data distributions [40]. The analysis followed a two-stage approach: (1) evaluation of the measurement model to ensure the reliability and validity of the constructs, and (2) assessment of the structural model to test the hypothesized relationships. Bootstrapping with 5,000 subsamples was used to determine the significance of the path coefficients and indirect effects.

4. RESULTS AND DISCUSSION

4.1 Common Method Bias (CMB)

In PLS-SEM, each latent construct is regressed on a common criterion to obtain full collinearity VIFs; values < 3.3 indicate that neither vertical nor lateral collinearity often symptomatic of CMB is likely to distort estimates (a more lenient benchmark is < 5.0). This test complements our procedural remedies (anonymity, neutral wording, randomized item order, separated predictor–criterion blocks) and item-level validity checks (convergent/discriminant validity), providing a model-wide screen for spurious inflation due to shared method.

All VIFs fall comfortably < 3.3, suggesting that CMB is unlikely to pose a material threat to our results (Table 2). Substantively, the values indicate moderate shared variance consistent with theoretically related constructs, but not at levels that would imply problematic collinearity or method-driven inflation. Together with our other diagnostics (measurement reliability/validity and model fit/predictive checks), these results support the construct validity and robustness of the reported structural relationships.

Table 2. Result of VIF

Construct	Full Collinearity VIF
ED	2.41
MF	2.27
IC	2.72
GS	2.11
SP	2.58

4.2 Measurement model assessment

The measurement model demonstrated strong psychometric adequacy across all latent constructs (Table 3). Item loadings fell within acceptable to high ranges for each scale: ED (0.72–0.85), MF (0.74–0.82), IC (0.71–0.86), GS (0.75–0.83), and SP (0.73–0.84). This indicates that individual indicators share substantial variance with their intended factors and that the construct indicators are neither weak nor excessively heterogeneous. The internal consistency was also satisfactory. Cronbach's alpha exceeded the conventional 0.70 threshold for every construct (ED (α = 0.847); MF (α = 0.823); IC (α = 0.856); GS (α = 0.798); SP (α = 0.834)), suggesting that the items within each scale reliably captured a common, underlying domain. The composite reliability (CR) values are uniformly high, ranging from 0.869 for GS to 0.902 for IC, providing further evidence that the latent variables exhibit stable and dependable measurements beyond the more conservative alpha estimates.

Table 3. Measurement model results

Construct	Items	Loadings	α	CR	AVE
ED	5	0.72-0.85	0.847	0.896	0.682
MF	5	0.74-0.82	0.823	0.884	0.658
IC	6	0.71-0.86	0.856	0.902	0.698
GS	4	0.75-0.83	0.798	0.869	0.625
SP	6	0.73-0.84	0.834	0.889	0.668

Source: Authors' analysis using SmartPLS 3.2.9 (n = 258)

Convergent validity is supported by average variance extracted (AVE) values that all exceed 0.50, with ED at 0.682, MF at 0.658, IC at 0.698, GS at 0.625, and SP at 0.668. These AVE estimates imply that each construct explains well over half of the variance in its indicators, reducing concerns about measurement errors dominating the shared variance. Among the constructs, IC displayed the strongest overall measurement properties, combining the highest CR (0.902) with a robust AVE (0.698) and consistently strong loadings (0.71–0.86), which is appropriate given its central role in the structural model. ED and SP also show exemplary convergence and reliability, while MF and GS, although marginally lower, remain firmly within the recommended bounds. Collectively, the loading patterns, alpha, CR, and AVE indicate that the reflective measures are reliable and convergent, providing a sound basis for subsequent tests of the structural relationships. Discriminant validity should be confirmed in complementary analyses (e.g., HTMT/Fornell–Larcker), but the present evidence supports the suitability of the measurement model for hypothesis testing.

4.3 PLS predict

Below, we assess out-of-sample predictive performance using PLSpredict in SmartPLS, contrasting PLS-SEM predictions with a linear model (LM) benchmark under k-fold cross-validation (default: 10 folds). We report Q^2_predict (values > 0 indicate predictive relevance) alongside RMSE/MAE at the indicator level. The model exhibits meaningful predictive power when (i) most indicators have Q^2_predict > 0 and (ii) RMSE(PLS) < RMSE(LM) for a majority of indicators of each endogenous construct. The result is presented in Table 4.

Every indicator shows Q^2_predict > 0, evidencing predictive relevance for both endogenous constructs. For all 12 indicators, RMSE(PLS) < RMSE(LM) and MAE(PLS) < MAE(LM), indicating that the PLS-SEM model consistently outperforms the naïve linear benchmark. Aggregating by construct, SP (SP) yields average Q^2_predict ≈ 0.29 and IC ≈ 0.32, with uniform RMSE/MAE advantages criteria consistent with medium-to-high predictive power. Substantively, the capability-in-context model (ED and MF driving IC and, in turn, SP, conditioned by GS) not only explains variance in-sample but also generalizes well to unseen cases of Indonesian EdTech startups.

4.4 Structural model assessment

The structural model explained substantial variance in the endogenous constructs, with R^2 values of 0.642 for IC and 0.573 for SP, indicating moderate-to-substantial explanatory power [41]. The Q^2 values (0.389 for SP and 0.455 for IC) were all positive, confirming the model's predictive relevance (Table 5).

Table 4. Result of PLS prediction

Construct	Indicator	Q²_Predict	RMSE (PLS)	RMSE (LM)	Winner	MAE (PLS)	MAE (LM)
SP	SP1	0.27	0.70	0.73	PLS	0.55	0.58
	SP2	0.29	0.68	0.71	PLS	0.53	0.56
	SP3	0.30	0.67	0.70	PLS	0.52	0.55
	SP4	0.26	0.72	0.74	PLS	0.57	0.59
	SP5	0.33	0.66	0.69	PLS	0.51	0.54
	SP6	0.27	0.69	0.72	PLS	0.54	0.57
IC	IC1	0.31	0.63	0.66	PLS	0.49	0.52
	IC2	0.32	0.61	0.64	PLS	0.47	0.50
	IC3	0.34	0.60	0.63	PLS	0.46	0.49
	IC4	0.28	0.66	0.69	PLS	0.51	0.54
	IC5	0.36	0.58	0.61	PLS	0.45	0.48
	IC6	0.30	0.62	0.65	PLS	0.48	0.51

Table 5. Structural model results

Hypothesis	Path	β	T-Value	P-Value	Decision
H1	ED → SP	0.264	4.074	0	Supported
H2	MF → SP	0.331	3.127	0.002	Supported
H3	ED → IC	0.412	4.013	0	Supported
H4	MF → IC	0.455	4.529	0	Supported
H5	IC → SP	0.287	3.456	0.001	Supported
H6	ED → IC → SP	0.143	2.219	0.027	Supported
H7	MF → IC → SP	0.174	2.643	0.009	Supported
H8	ED × GS → SP	0.198	2.093	0.037	Supported
H9	MF × GS → SP	0.212	2.411	0.016	Supported

Source: Authors' analysis using SmartPLS 3.2.9 with 5,000 bootstrap samples

The structural results depict a capability-led and context-amplified performance logic in which both exogenous turbulence and endogenous agility matter, but their effects are realized most fully through a firm's innovation engine. ED is positively associated with SP (β = 0.264, p < .001), suggesting that in volatile markets, the frequency of technological and regulatory shifts can be converted into an advantage rather than a disruption when firms are attuned to change. MF shows an even stronger direct association with performance (β = 0.331, p = .002), underscoring the value of rapid resource reallocation, fluid structures, and reversible decision routines in translating uncertainty into results. Consistent with the dynamic capabilities view, IC sits at the core of this system: it is substantively strengthened by ED (β = 0.412, p < .001) and MF (β = 0.455, p < .001), and it exerts its own direct effect on performance (β = 0.287, p = .001). Mediation tests indicate that IC partially transmits the influence of both antecedents to performance (indirect effects = 0.143, p = .027; 0.174, p = .009), implying that adaptive sensing and flexible orchestration improve outcomes to the extent that they raise the throughput and scaling of validated innovations. In aggregate terms, the implied total association of ED with performance is approximately 0.407, while MF attains the largest overall association at approximately 0.505, highlighting flexibility as the pivotal lever in the model. Importantly, GS amplifies these relationships: the interaction effects are positive and significant for both ED and MF (β = 0.198, p = .037; β = 0.212, p = .016), indicating that standards, procurement clarity, and digital infrastructure steepen the performance slope associated with firm-level capabilities. Taken together, the evidence supports a nuanced prescription: firms operating under high dynamism should institutionalize flexible, experiment-driven routines and actively engage with policy and ecosystem partners because internal capability and external munificence operate as complements rather than substitutes in driving sustained SP.

4.5 Mediation and moderation analysis

The mediation tests indicate that IC is a substantive transmission mechanism, rather than a peripheral correlate. The indirect pathway from ED to SP via IC was statistically significant and practically meaningful (indirect effect = 0.143, $p < .027$), as was the corresponding pathway for MF (indirect effect = 0.174, $p < .009$). Given that the direct effects of ED and MF on performance remain significant in the full model, the pattern is best characterized as partial mediation: external turbulence and internal reconfiguration still contribute directly to outcomes, but a sizable share of their performance yield is routed through the firm's ability to sense opportunities, experiment, and scale validated solutions. Interpreted alongside the direct paths, these figures imply enlarged total associations with performance when the mediated component is considered, underscoring that capability building in innovation is not an optional "glue" but a core causal conduit that converts both environmental pressure and organizational agility into measurable gains.

The moderation results add an important contextual layer. GS significantly steepens the slopes linking ED and MF to SP (βinteraction = 0.198, $p < .037$; βinteraction = 0.212, $p < .016$), which means that the same unit increase in turbulence-sensing or internal flexibility pays off more in supportive policy regimes than in austere ones. Simple slope analysis confirms this amplification: firms operating under high GS—manifested in clearer procurement pathways, interoperability standards, fiscal incentives, or digital infrastructure—achieve stronger performance returns from both environmental vigilance and flexible orchestration than peers facing weak support. Substantively, the results point to conditional complementarity: internal capabilities and external institutional munificence are multiplicative rather than interchangeable. Practically, the route to higher performance is twofold and simultaneous: professionalizing IC to capture mediated gains and actively engaging with policy and ecosystem programs to increase the gradient of returns from both ED and MF.

5. DISCUSSION

The results provide a theoretically coherent and empirically robust account of how startups in dynamic markets convert turbulence and organizational agility into superior performance. The positive direct effects of ED and MF on SP (H1–H2) align with classic contingency arguments that strategy–environment fit under uncertainty requires adaptive, rather than positional, logics [12, 19, 36]. In EdTech—where technologies, user preferences, and rules co-evolve — dynamism appears less as a liability and more as a reservoir of opportunities when firms can reconfigure resources [3]. The significant path from MF to performance reinforces this view and echoes the evidence that flexible decision processes enable rapid opportunity capture and threat mitigation [20]. At the apex, leader cognition likely conditions these benefits: CEOs with broader cognitive frames and temporal agility better translate turbulence into performance through flexible orchestration [22].

The strong effects of ED and MF on IC (H3–H4), coupled with the direct effect of IC on performance (H5), substantiate the centrality of innovation routines as the "engine" of dynamic capabilities [6]. This pattern is consistent with the ambidexterity literature: firms facing high dynamism must balance explorative activities (e.g., new pedagogical technologies) with exploitative refinements (e.g., hardening learning platforms) to realize performance gains [25]. The significant indirect effects of IC (H6–H7) extend this logic, indicating partial mediation: environmental pressures and flexible structures increase the throughput of validated innovations, which in turn propels strategic outcomes. This mirrors recent evidence that strategic flexibility enhances performance predominantly through innovation pathways rather than direct operational levers [42] and is consistent with validated measures of organizational innovativeness [37].

The moderating role of GS (H8–H9) dovetails with an institutional–capability synthesis. Public interventions can lower transaction costs, coordinate standards, and de-risk experimentation, thereby amplifying returns to internal capabilities [32, 33]. The strengthening of the ED/SP and MF/SP links at higher levels of support suggests a "conditional complementarity": institutional munificence unlocks firm-level adaptive capacity. Prior work shows analogous patterns: governmental scaffolding catalyzing innovative entrepreneurship [33], targeted support improving performance among mission-oriented enterprises [32], and institutional backing enabling eco-innovation when market traction is present [35]. At the macro level, the finding is consistent with the entrepreneurial-state perspective, in which public agencies play a market-shaping role rather than merely fixing failures [43]. In Indonesia's EdTech context, this moderating effect is also consistent with sector diagnostics indicating rapid digital adoption but uneven absorptive capacity across regions and institutions [1, 44]. Where procurement clarity, interoperability standards, and digital infrastructure are stronger, firm capabilities appear to be more fully converted into performance.

These results also speak to the longstanding debate on the value of formal strategic planning in dynamic environments. Rather than displacing flexibility, planning can enhance it when used as a learning device—broad, participative, and analytically grounded—thereby improving performance [23]. The present evidence implies that flexible structures, coupled with disciplined innovation processes, benefit from planning routines that channel exploration and exploitation into coherent portfolios under uncertainty. Relatedly, institutional isomorphism pressures [7] would predict convergence toward "legitimate" EdTech practices; our moderation result suggests that when governments specify standards that privilege evidence and inclusivity, such isomorphic drift may actually upgrade rather than homogenize market quality.

The finding that IC fully mediates the relationships between ED, MF, and SP extends existing theories by revealing the mechanism through which external pressures and internal flexibility translate into competitive advantage. This mediating role suggests that IC functions not only as an organizational competency but also as a transformative process that converts adaptive responses into sustainable performance outcomes. The moderating role of GS provides new insights into Institutional Theory by demonstrating how institutional enablers can amplify the effectiveness of internal capabilities. Unlike previous studies that treat government intervention as either beneficial or detrimental, this study shows that well-designed support programs can enhance the strategic value of organizational flexibility and environmental responsiveness. For EdTech startup leaders, the findings emphasize the critical importance of developing systematic innovation capabilities rather than relying solely on ad-hoc responses to environmental changes. Organizations should invest in structured innovation processes that can consistently transform market insights and organizational flexibility into new products, services, and new business models. The mediating role of IC suggests that startups should prioritize building innovation systems that include (1) systematic market-sensing mechanisms to identify emerging educational needs and technological opportunities, (2) cross-functional innovation teams that can rapidly develop and test new solutions, and (3) organizational learning processes that capture and disseminate insights from innovation experiments.

6. CONCLUSION

This study elucidates how ED and MF jointly shape SP in Indonesian EdTech startups by channeling their effects through IC and by leveraging GS as a performance-enhancing boundary condition. Empirically, both ED and MF exhibit positive direct effects on performance, while IC operates as a critical mediating mechanism that translates external pressures and internal agility into competitive advantage; GS further strengthens these links, extending Institutional Theory by showing how supportive policy regimes amplify the returns to firm capabilities. Theoretically, the work integrates capability-based, innovation-driven, and institutional perspectives to explain performance in emerging digital ecosystems, offering validated evidence of IC's centrality. Practically, founders should invest deliberately in capability building—processes, talent, and data-driven routines—while preserving structural flexibility; policymakers should craft targeted programs that reduce regulatory friction, expand infrastructure, and open market access so capability investments convert into measurable performance gains. Aligned with global priorities, the model highlights how successful EdTech ventures advance SDG 4 (quality education), SDG 8 (decent work), and SDG 9 (industry, innovation, infrastructure). Looking ahead, longitudinal designs, cross-country comparisons, and mechanism-focused evaluations of heterogeneous support instruments (e.g., grants vs. procurement vs. sandboxes) are needed to unpack temporal causality, contextual boundary conditions, and the specific policy levers that most effectively turn dynamic capabilities into sustained competitive advantage and broader societal impact.

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