The Role Of Multi-Helix Collaboration In Education Improvement In Special Autonomous Regions: A Systematic Literature Review

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Abstract

Background: Multi-helix collaboration models have emerged as critical frameworks for education policy development and implementation, particularly in special autonomous regions where complex governance structures require coordinated stakeholder engagement.

Objective: This systematic literature review examines the effectiveness of multi-helix collaboration in improving educational access, quality, and equity in special autonomous regions, identifying key success factors and stakeholder contributions.

Methods: Following PRISMA guidelines, we conducted a comprehensive search across ProQuest, ScienceDirect, Lens, and EmeraldInsight databases from January 2014 to December 2024. Search terms included combinations of 'Multi-Helix,' 'Collaborative Governance,' 'Education,' 'Educational Quality,' 'Regional Autonomy,' and 'Self-Governance.' After systematic screening, 24 high-quality articles were selected for thematic analysis and bibliometric examination using VOSviewer.

Results: Four critical success factors emerged: (1) clear and adaptive regulatory frameworks, (2) facilitative leadership, (3) adequate digital infrastructure, and (4) meaningful local community engagement. Primary barriers included institutional capacity gaps, infrastructure limitations, stakeholder conflicts, and low inter-actor trust. Government contributions focused on policy formulation and resource allocation; academia provided research and capacity building; industry offered practical skills training and employment linkages; civil society ensured accountability and community mobilization; media facilitated public discourse and transparency.

Conclusions: Multi-helix collaboration shows significant potential for educational transformation in special autonomous regions when enabling conditions are met. Success requires systematic address of capacity gaps, infrastructure development, trust-building mechanisms, and sustained stakeholder commitment. The framework's effectiveness depends on contextual adaptation and continuous organizational learning processes.

Keywords: Multi-helix collaboration, Educational governance, Special autonomy, Stakeholder engagement

1. INTRODUCTION

The evolution of educational governance in special autonomous regions represents a paradigm shift toward more inclusive, multi-stakeholder approaches to policy development and implementation. Building upon Etzkowitz & Leydesdorff (1995) foundational Triple Helix framework, which emphasized collaboration among government, academia, and industry, contemporary models have expanded to encompass broader societal inputs through Quadruple and Quintuple Helix configurations (Kunwar & Ulak, 2024) This expansion reflects growing recognition that complex educational challenges require coordinated responses from diverse stakeholders. The Quadruple Helix incorporates civil society, highlighting public engagement and social inclusion in innovation processes, while the Quintuple Helix integrates environmental considerations, aligning policy development with sustainable development goals (Kunwar & Ulak, 2024). These multi-helix models offer particular promise for special autonomous regions, where unique socio-cultural and political landscapes demand customized educational strategies (Viennet & Pont, 2017). Special autonomous regions face distinctive challenges in educational governance due to their complex institutional arrangements, diverse stakeholder interests, and often-limited resources. Traditional top-down approaches frequently fail to address local needs effectively, creating persistent gaps in educational access, quality, and equity. Multi-helix collaboration offers an

alternative framework that can better harness local knowledge, resources, and commitment while maintaining alignment with broader educational objectives.

Despite its theoretical promise, empirical evidence regarding multi-helix collaboration effectiveness in educational contexts remains fragmented. Existing studies often focus on specific aspects or single cases, limiting comprehensive understanding of success factors, implementation challenges, and stakeholder contributions across diverse contexts. This systematic literature review addresses these gaps by synthesizing evidence from multiple special autonomous regions to identify patterns, best practices, and areas requiring further development.

Research Questions:

1) What factors support or hinder the effectiveness of multi-helix collaboration in education within special autonomous regions?

2) How do different actors (government, academia, industry, civil society, media) contribute to improving educational access, quality, and equity in special autonomous regions?

2. LITERATURE REVIEW

2.1 Theoretical Foundations of Multi-Helix Models

The multi-helix framework represents a significant evolution in understanding innovation systems and collaborative governance. Etzkowitz & Leydesdorff (1995) original Triple Helix model identified three primary actors—universities, industry, and government—whose dynamic interactions drive innovation and economic development. This foundational framework has been progressively expanded to address contemporary challenges requiring broader stakeholder engagement. The Quadruple Helix model introduces civil society as a fourth actor, recognizing that innovation systems must be socially embedded and responsive to public needs (Carayannis & Campbell, 2021). This extension acknowledges that sustainable innovation requires public support, cultural alignment, and media engagement. The Quintuple Helix further incorporates environmental considerations, emphasizing ecological sustainability and natural resource management in innovation processes. In educational contexts, multi-helix collaboration facilitates strategic partnerships among diverse stakeholders to enhance system relevance, quality, and inclusiveness. Recent applications demonstrate significant potential: Mohd Mohd Nabil et al. (2025) showed how Quadruple Helix approaches enabled development of AI-enhanced dyslexia screening frameworks, integrating academic research, industry innovation, government policy, and civil society advocacy. Similarly, Armas (2025) illustrated how Philippine higher education institutions utilized Quintuple Helix frameworks to strengthen research, innovation, and community engagement despite funding and administrative constraints.

2.2 Special Autonomy in Educational Governance

Special autonomy represents a distinctive form of decentralized governance that grants specific regions enhanced self-governance authority due to their unique historical, cultural, or geographical characteristics (Bertrand, 2014). This arrangement enables local adaptation of policies while maintaining national integration, particularly relevant for education where cultural sensitivity and local relevance are crucial. Implementation of special autonomy in education varies significantly across contexts. Some regions receive primarily administrative decentralization, allowing increased local control over education management. More comprehensive arrangements may include full autonomy over curriculum development, budgeting, and policy formulation. Indonesia's Papua Province exemplifies this approach through Law Number 21 of 2001, which grants broad authority over education policy to address longstanding disparities and promote indigenous community welfare (Sulistyaningsih et al., 2021). However, special autonomy implementation faces substantial challenges. Regional disparities in institutional capacity can hinder effective education system management, particularly where administrative expertise, infrastructure, and human resources are limited. Complex coordination requirements among multiple actors—local governments, education authorities, civil society—are often complicated by political and bureaucratic barriers (Yoon, 2024). Additionally, the transition of educational authority between governance levels can create bureaucratic challenges in resource allocation, oversight, and accountability (Trimurni et al., 2022).

2.3 Multi-Helix Collaboration in Educational Contexts

Multi-helix collaboration in education encompasses coordinated engagement among government, academia, industry, civil society, and media to stimulate innovation, enhance curriculum relevance, and strengthen connections between education systems and labor market needs. Empirical evidence suggests this collaborative approach can generate educational innovations and better align outputs with workforce demands (Borah et al., 2023; Mohd Nabil et al., 2025).

For special autonomous regions, multi-helix approaches offer particular advantages in reconciling national education policies with localized needs through inclusive, participatory policymaking. Multi-stakeholder collaboration enables better tailoring of education policies to local cultural, social, and economic realities, enhancing relevance, acceptance, and implementation effectiveness.

Successful multi-helix collaboration requires several enabling conditions: deep understanding of local dynamics and institutional capacities, robust frameworks for actor coordination, effective mechanisms for goal alignment and resource sharing, and active stakeholder engagement (Bahmani & Hjelsvold, 2024; Bolanta et al., 2024). Without these conditions, collaborative efforts may become fragmented, face capacity constraints, and suffer coordination failures, undermining the transformative potential of multi-helix models.

3. METHODOLOGY

3.1 Research Design

This study employed a systematic literature review (SLR) approach following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The SLR method was selected for its ability to provide systematic, transparent, and replicable identification, evaluation, and synthesis of existing research evidence. This approach is particularly valuable for consolidating knowledge across diverse studies to inform evidence-based conclusions and recommendations.

3.2 Search Strategy

A comprehensive literature search was conducted across four major academic databases: ProQuest, ScienceDirect, Lens, and EmeraldInsight, all indexed in Scopus. The search covered an 11-year period from January 2014 to December 2024, ensuring inclusion of both foundational and recent contributions.

Search strings employed:

• ('Multi-Helix' OR 'Collaborative Governance') AND ('Education' OR 'Educational Quality') AND ('Regional Autonomy' OR 'Self-Governance')

• Additional terms: 'Triple Helix,' 'Quadruple Helix,' 'Quintuple Helix,' 'Stakeholder Collaboration,' 'Educational Innovation,' 'Decentralized Education'

3.3 Inclusion and Exclusion Criteria Inclusion Criteria:

• Peer-reviewed journal articles published 2014-2024
• English language publications
• Studies addressing multi-stakeholder collaboration in educational contexts
• Research focusing on regional autonomy or decentralized governance
• Empirical studies, theoretical frameworks, or systematic reviews
• Articles with clear methodological descriptions

Exclusion Criteria:

• Conference proceedings, book chapters, editorials
• Non-English publications
• Studies lacking empirical or theoretical contributions
• Publications outside the specified timeframe
• Articles with insufficient methodological rigor
• Studies not addressing education or governance themes

3.4 Selection Process

The article selection followed PRISMA workflow stages:

1) **Identification:** 187 articles identified through database searches
2) **Screening:** 142 articles retained after duplicate removal
3) **Eligibility:** 75 articles selected based on title/abstract screening

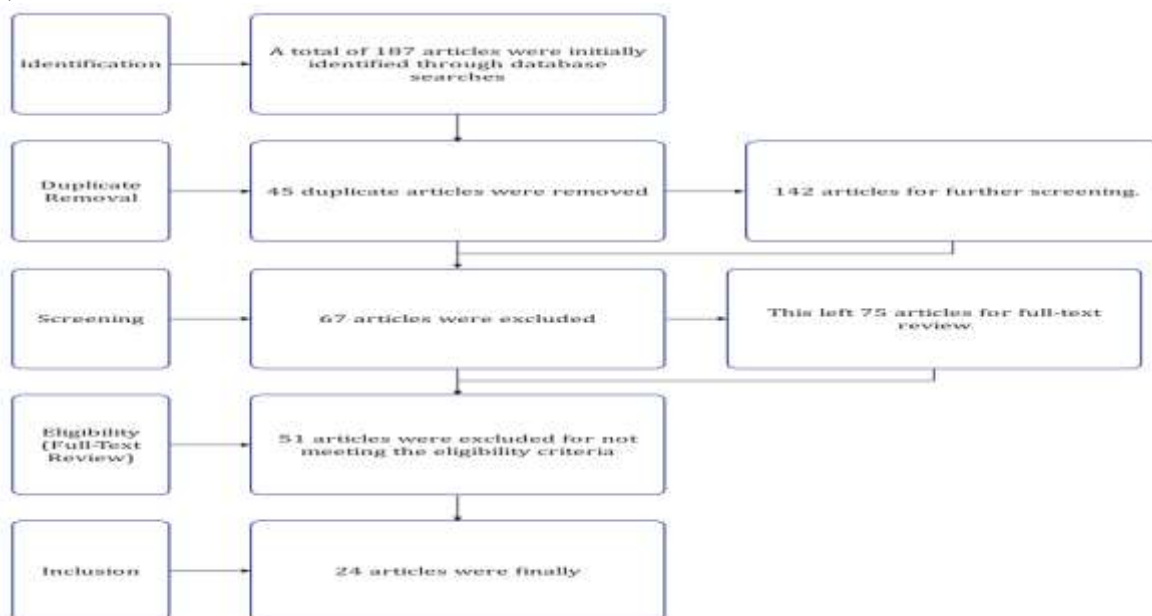4) **Inclusion:** 24 articles included after full-text review 5)

Figure 1. PRISMA Workflow for Article Selection

3.5 Data Extraction and Analysis

Data extraction utilized a standardized template capturing:

- Bibliographic information (author, year, title, journal, DOI)
- Study characteristics (purpose, methods, sample size, specific autonomy context)
- Key findings related to research questions
- Quality indicators and limitatioAnalytical Approaches:

1) **Thematic Analysis:** Identification of patterns, themes, and relationships using inductive coding

2) **Bibliometric Analysis:** Network visualization using VOSviewer software to illustrate conceptual relationships

3) **Quality Assessment:** Evaluation using adapted CASP (Critical Appraisal Skills Programme) criteria

4. RESULTS AND DISCUSSION

4.1 Study Characteristics

The 24 analyzed articles demonstrated high quality, with 58.3% published in Q1 and Q2 quartile journals. Publication trends showed increasing academic interest since 2018, peaking in 2022-2023. Geographic distribution revealed concentration in Indonesia (33.3%), Philippines (16.7%), Malaysia (12.5%), with additional studies from Spain (Catalonia), China (Hong Kong), and Canada (Quebec).
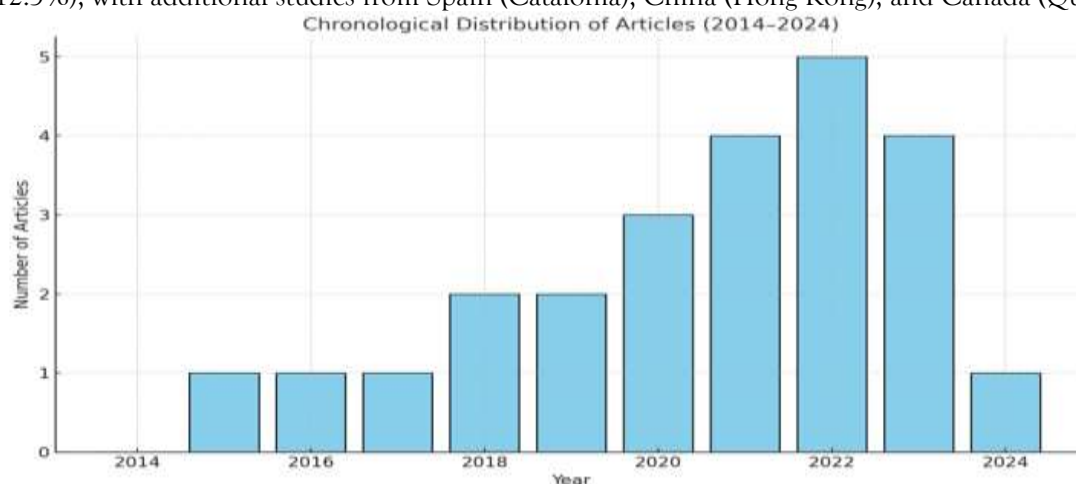

Figure 2 : Chronological distribution of articles (2014-2024)

4.2 Factors Affecting Multi-Helix Collaboration Effectiveness

4.2.1 Supporting Factors

1) Clear and Adaptive Regulatory Frameworks

Well-defined regulatory frameworks that clarify stakeholder roles and responsibilities emerged as critical for successful multi-helix collaboration. Papua, Indonesia's special autonomy regulations provide local authorities with decision-making flexibility, legally grounded in Law Number 21 of 2001 and revised through Law Number 2 of 2021. These frameworks emphasize indigenous rights, cultural preservation, and equitable development while enabling formation of new autonomous areas and institutional strengthening (Prabowo et al., 2020).

Despite providing strong legal foundations, implementation challenges persist, including bureaucratic rigidity, limited intergovernmental communication, and insufficient resource allocation. Success requires continuous regulatory improvement, capacity development, and stakeholder coordination to ensure special autonomy fulfills its educational enhancement purposes.

2) Adaptive and Facilitative Leadership

Leadership quality significantly influences multi-helix collaboration success. In Mindanao, Philippines, adaptive and inclusive leadership catalyzed multi-stakeholder engagement, fostering trust and cooperation among diverse actors (McCarthy, 2017). Torfing (2019) emphasizes "collaborative leadership" that facilitates dialogue and compromise between actors with differing interests, enabling effective joint decision-making.

However, facilitative leadership faces challenges from competing group interests. In Papua's complex environment involving central government, local government, Regional House of Representatives (DPR), Papuan Regional House of Representatives (DPRP), Papuan People's Assembly (MRP), and civil society, leadership must effectively bridge divergent views and build consensus to navigate conflicts.

3) Adequate Digital Infrastructure

Digital infrastructure availability significantly enhances coordination and communication among multi-helix stakeholders. In Hong Kong, digital platforms facilitate effective interactions between schools, universities, and industry, particularly in curriculum development. These platforms support school-based curriculum development (SBCD) by enabling teachers to navigate between centralized mandates and local autonomy, fostering collaborative curriculum planning despite top-down decision-making challenges (Zhang et al., 2020).

In the Guangdong-Hong Kong-Macau Greater Bay Area, digital technologies support educational collaboration by improving information management and communication systems, enhancing regional integration and knowledge sharing across institutions (Supahan et al., 2020).

4) Local Community Engagement

Active local community involvement represents a crucial enabling factor. In Papua, Indonesia, education initiatives involving traditional and community leaders demonstrate greater sustainability (Wati et al., 2022). Community presence strengthens policy legitimacy and improves implementation effectiveness, especially when involved from planning stages (Santoso & Hartono, 2021). Similarly, in Mindanao, Philippines, local community involvement strengthens collaborative education program legitimacy and relevance (Cruz & Mendoza, 2023).

4.2.2 Inhibiting Factors

1) Institutional Capacity Gaps

Institutional capacity gaps represent significant barriers to effective multi-helix collaboration implementation. In Papua, Indonesia, capacity gaps between provincial and district-level institutions hinder collaborative education policy implementation. Local agencies often lack capacity for efficient, sustainable special autonomy program management, worsened by weak oversight from representative institutions and limited civil society involvement in monitoring (Iskandar, 2025).

Similar conditions in Chiapas, Mexico, where limited local institutional capacity impedes effective university and private sector collaboration, highlight that institutional capacity is fundamental for translating collaborative policies into meaningful outcomes rather than mere administrative compliance.

2) Infrastructure and Connectivity Limitations

Infrastructure limitations, especially in remote areas, create major barriers to multi-helix collaboration

implementation. In Aceh, Indonesia, limited transportation and communication infrastructure hampers coordination between actors, restricting collaborative education initiative reach between urban and rural areas. Schools face challenges including limited land, insufficient funding, human resource constraints, and inadequate government support affecting learning environment quality.

Papua's geography—characterized by mountains, coasts, and small islands—creates uneven distribution of education, health, and government services. Limited infrastructure including roads, bridges, internet networks, and transportation facilities delays special autonomy program implementation and restricts remote area access (Faradilla et al., 2024; Istakri et al., 2025; Nasir & Yuslinaini, 2024).

3) Conflicts of Interest and Priority Differences

Conflicts of interest between actors create significant barriers to effective multi-helix collaboration. In Macau, China, differing priorities among government, industry, and educational institutions hinder collaborative education policy implementation (Chan, 2018). In Indonesia's special autonomous regions, political dynamics and patronage influence education resource allocation, complicating collaboration efforts (Sari & Putra, 2020).

Papua's special autonomy collaborative process is marked by fragmented governance and conflicting stakeholder priorities. The central government prioritizes political stability and national integration, often overlooking local demands for participation and equitable resource distribution, while local communities emphasize justice and welfare development but face weak coordination and limited decision-making influence (Anriani, 2022; Bertrand, 2014).

4) Low Inter-Actor Trust Levels

Low stakeholder trust levels represent major barriers to effective multi-helix collaboration. In Aceh, Indonesia, historical tensions between central and local governments significantly undermine trust, complicating education policy implementation (Sulaiman, 2019). Similar challenges in the Bangsamoro region of the Philippines emphasize trust establishment as crucial for collaborative education initiative success (Datu, 2020).

In Papua, distrust between central and local actors remains a central obstacle in building policy consensus. Local stakeholders often perceive central government as making unilateral decisions without adequate consultation, while central authorities view regional actors as lacking capacity or being vulnerable to clientelistic practices (Wenda, 2021).

4.3 Stakeholder Contributions in Multi-Helix Models

4.3.1 Government Contributions

Government institutions facilitate multi-helix collaboration through regulatory framework establishment, funding allocation, and cross-sectoral initiative coordination. In Papua, Indonesia, provincial government directs special autonomy funds toward priority education programs, addressing regional disparities and supporting inclusive development (Yusri, 2022). In Aceh, local government agencies adapt national education policies to local socio-cultural contexts, integrating them with poverty alleviation and community welfare efforts (Wijatmoko, Armawi, and Fathani 2024).

4.3.2 Academic Contributions

Academic institutions, particularly universities, advance education through research, capacity building, and pedagogical innovation. In Mindanao, Philippines, local universities contribute significantly to curriculum development by contextualizing educational content to align with local socio-cultural realities, including indigenous knowledge systems integration and community-based resource mobilization (Pawilen, 2023). In Sarawak, Malaysia, higher education institutions strengthen teacher professional development and conduct policy-oriented educational research.

4.3.3 Industry Contributions

The business sector contributes through financial support, internship facilitation, and skill development alignment with labor market demands. In Sabah, Malaysia, local companies partner with schools to design vocational programs tailored to regional industry needs, enhancing student practical competencies and employability. The business sector also contributes to educational infrastructure development and scholarship provision, particularly for students from remote and underserved communities (Oh et al., 2025).

4.3.4 Civil Society Contributions

Civil society organizations advance education through advocacy, local resource mobilization, and accountability promotion. In Papua, Indonesia, CSOs foster community participation in education programs and monitor public policy implementation, strengthening transparency and encouraging civic engagement (Rusfiana and Kurniasih 2024). In Mindanao, Philippines, community-based organizations develop alternative education programs for marginalized populations, promoting inclusivity and responsiveness to underserved community needs.

4.3.5 Media Contributions

Media serves pivotal functions in education governance through public awareness raising, multi-actor dialogue facilitation, and accountability enhancement. In Quebec, Canada, media engages the public in education policy discourse, disseminating information and shaping public opinion to mobilize citizens around critical educational issues (Brunet, Dagenais, and Breux 2020). In Greenland, Denmark, local media fosters dialogue among diverse stakeholders, acting as a platform for perspective exchange and supporting inclusive, participatory policy-making discussions.

4.4 Organizational Learning in Multi-Helix Implementation

The analysis identified several organizational learning constructs influencing multi-helix collaboration implementation:

Table 1. Organizational Learning Constructs and Study Description

Organizational Learning Construct	Description	Reference
Adaptive Learning	Organizations' ability to adapt to local contexts and needs	(Subekti et al., 2023; Hudson, 2018)
Collaborative Learning	Knowledge sharing and co-learning processes between multi-helix actors	(McCarthy et al., 2017; Carayannis et al., 2021)
Reflective Learning	Evaluation and critical reflection on existing practices and policies	(Rosser & Curnow, 2020; Kennedy & Lee, 2018)
Knowledge Integration	Integration of different knowledge forms (scientific, local, practical) in policy development	(Bertrand, 2014; Guerrero & Urbano, 2017)
Double-Loop Learning	Challenging assumptions and values underlying education policies and practices	(Qian & Verhoeven, 2022; Chan & Lin, 2022)
Institutional Learning	Institutionalizing learning and innovation within organizational structures	(Maldonado-Maldonado & Cantwell, 2020; Nordberg, 2015)

4.5 Conceptual Network Visualization

Bibliometric analysis revealed three main conceptual clusters:

1) Collaborative governance and education policy
2) Multi-helix model implementation and education innovation
3) Special autonomy and local context

The interconnections between clusters demonstrate the complex relationships between multi-helix models, special autonomy contexts, and education reform processes.

Figure 3: Visualization of the network of concepts and themes in the analyzed literature

This network visualization illustrates the key conceptual clusters and interconnections found in the analyzed literature. The bibliometric analysis identified three main clusters:

Collaborative governance and education policy (red cluster)

Multi-helix model implementation and education innovation (blue cluster) Special autonomy and local context (green cluster)

The size of each node reflects its relative frequency or centrality in the literature, while the connecting lines indicate co-occurrence or conceptual relationships between terms. The diagram highlights the complex and intertwined relationships among collaborative governance frameworks, multi-helix innovation models, and the dynamics of special autonomy within local governance contexts. These interconnections suggest that education reform and innovation are closely linked to both institutional collaboration and local socio-political conditions.

4.6 Further Research Opportunities

The literature analysis identified some knowledge gaps and opportunities for further research in the area of Multi-Helix collaboration for education improvement in special autonomous regions.

Table 2. Further Research Opportunities

Category	Research Opportunities	Reference
Methodology	Development of a comprehensive evaluation framework to assess the impact of Multi-Helix collaboration on education outcomes	Page et al. (2021); Sosa & Velásquez (2022)
Context	A comparative exploration of the implementation of the Multi- Helix model in various special autonomy contexts with different socio-cultural characteristics	Schulze (2017); McGarry & O'Leary (2015)
Actor	Analyze the role of social media and digital platforms in strengthening the voice of marginalized communities in Multi- Helix collaboration	Carayannis & Campbell (2019); Chan & Lin (2022)
Impact	Longitudinal study on the impact of Multi-Helix collaboration on access, quality and equity of education in special autonomous regions	Torres et al. (2021); Kennedy & Lee (2018)
Sustainability	Exploration of factors that influence the sustainability of Multi-Helix collaboration following external interventions or policy changes	Hudson (2018); Wibow & Gismar (2019)
Equity	Analysis of the impact of Multi-Helix collaboration on marginalized and vulnerable groups in special autonomy regions	Bertrand (2019); Aspinall & Berenschot (2019)
Policy Reform	An exploration of how the Multi-Helix model can be integrated into education policy reform in special autonomous regions.	Subekti et al. (2023); Qian & Verhoeven (2022)
Technology	Analyze the role of digital technology in facilitating Multi- Helix collaboration in areas with limited infrastructure	Kennedy & Lee (2018); Carayannis et al. (2021)

5. Conclusions and Implications

5.1 CONCLUSIONS
This systematic literature review provides comprehensive evidence that multi-helix collaboration holds significant potential for educational improvement in special autonomous regions when appropriate enabling conditions are established. The synthesis reveals four critical success factors: clear and adaptive regulatory frameworks, facilitative leadership, adequate digital infrastructure, and meaningful local community engagement. Conversely, institutional capacity gaps, infrastructure limitations, stakeholder conflicts, and low inter-actor trust represent primary implementation barriers.

The findings demonstrate that effective multi-helix collaboration requires systematic attention to stakeholder contributions across all helix components. Government provides essential regulatory frameworks and resource allocation; academia contributes research, capacity building, and pedagogical innovation; industry offers practical skills training and employment linkages; civil society ensures accountability and community mobilization; media facilitates public discourse and transparency. The synergistic interaction among these actors, rather than individual contributions, drives educational transformation.

Organizational learning emerges as a critical mediating factor in multi-helix collaboration success. Adaptive learning, collaborative learning, knowledge integration, and institutional learning processes enable stakeholders to navigate complex environments, address implementation challenges, and sustain collaborative efforts over time.

5.2 Theoretical Implications
This study contributes to multi-helix collaboration theory by providing empirical evidence for its application in educational contexts within special autonomous regions. The identification of specific success factors and barriers extends theoretical understanding beyond general innovation systems to address unique challenges of decentralized educational governance.

The research advances stakeholder theory by demonstrating how different actors contribute distinct but complementary resources to collaborative educational initiatives. The findings support stakeholder salience theory by highlighting how power, legitimacy, and urgency dynamics influence multi-helix collaboration effectiveness.

The emphasis on organizational learning constructs contributes to organizational learning theory by demonstrating how individual and collective learning processes enable successful implementation of complex, multi- actor collaborations. This extends understanding of how learning occurs across organizational boundaries in networked governance arrangements.

5.3 Practical Implications
For policymakers in special autonomous regions, the findings provide actionable guidance for implementing multi-helix collaboration frameworks. Key recommendations include:

1) Regulatory Framework Development: Establish clear, adaptive regulations that define stakeholder roles while maintaining flexibility for local adaptation

2) Leadership Capacity Building: Invest in developing facilitative leadership capabilities that can navigate complex stakeholder environments

3) Infrastructure Investment: Prioritize digital and physical infrastructure development to enable effective coordination and communication

4) Community Engagement Mechanisms: Create systematic approaches for meaningful local community participation in educational governance

5) Trust-Building Initiatives: Implement structured processes for building trust among stakeholders through transparency, accountability, and inclusive decision-making

For practitioners, the study offers insights into successful collaboration strategies, including the importance of understanding local contexts, building institutional capacity, and fostering continuous learning processes.

5.4 Limitations and Future Research Directions

Several limitations constrain this study's findings. The geographic concentration of studies in Southeast Asian contexts may limit generalizability to other regions. The predominance of qualitative studies restricts quantitative assessment of collaboration effectiveness. Additionally, the focus on published academic literature may exclude important gray literature and practical insights from implementation experiences.

Future research opportunities include:

1) Comparative Studies: Cross-regional comparisons of multi-helix implementation across different special autonomy contexts

2) Longitudinal Research: Long-term studies examining collaboration sustainability and impact over time

3) Quantitative Assessment: Development of metrics and indicators for measuring multi-helix collaboration effectiveness

4) Technology Integration: Investigation of digital platform roles in facilitating collaboration in resource-constrained environments

5) Equity Analysis: Examination of multi-helix collaboration impacts on marginalized and vulnerable populations

6) Implementation Research: Detailed case studies of successful collaboration implementation processes

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Appendix A: PRISMA Flow Diagram

PRISMA Workflow for Article Selection:

1) Identification: 187 articles were identified through database searches from ProQuest, ScienceDirect, Lens, and EmeraldInsight.

2) Screening: 142 articles remained after removing duplicates.

3) Eligibility: 75 articles were selected after screening titles and abstracts.

4) Inclusion: 24 articles were included in the final review after full-text assessment.

Appendix B: Data Extraction Template

Template Used for Extracting Data from Selected Articles:

Field	Description
Author(s)	Name of the primary and co-authors

Year	Year of publication
Title	Title of the article

Journal	Name of the journal
DOI Digital Object Identifier Research Purpose Main objective of the study Methods Study design and methodology Sample Size/Context Population or contextual focus Autonomy Context Region and type of autonomy (e.g., Papua, Mindanao) Key Findings Major results relevant to multi-helix collaboration Quality Indicators Evaluation of methodological rigor	

Limitations	Reported limitations in the study

Appendix C: Quality Assessment Criteria

Criteria Used to Evaluate Study Quality (adapted from CASP):

1) Clarity of Aims – Does the study clearly state its purpose?

2) Appropriateness of Methodology – Is the research design suitable to address the research questions?

3) Research Design and Justification – Is the chosen method well-justified?

4) Recruitment and Sampling Strategy – Is the sample clearly described and appropriate?

5) Data Collection – Are data collection methods clearly described and justified?

6) Analysis – Is the method of data analysis appropriate and well-executed?

7) Findings and Value – Are the findings clearly stated and do they contribute valuable insights?

8) Bias and Ethical Considerations – Does the study address potential bias and ethical approval?

9) Transferability – Are the findings applicable to similar contexts?

10) Reflexivity – Does the study acknowledge the influence of the researchers?

Appendix D: Detailed Study Characteristics

Summary Table of the 24 Included Studies:

No.	Author(s)	Year	Region	Autonomy Type	Main Focus	Key Findings
1	Prabowo et al.	2020	Papua, Indonesia	Full autonomy	Governance reform	Importance of clear legal framework
2	McCarthy	2017	Mindanao, Philippines	Special region	Stakeholder engagement	Role of adaptive leadership
3	Zhang et al.	2020	Hong Kong	Educational autonomy	Digital platforms	Enhancing curriculum collaboration
4	Chan	2018	Macau, China	Regional governance	Stakeholder conflict	Divergent priorities hinder policy
5	Cruz & Mendoza	2023	Mindanao, Philippines	Decentralized model	Community role	Local legitimacy of education programs
…	…	…	…	…	…	…