Intelligent One-Stop Student Communities Based on AIoT and Big Data: A Cross-Case Study

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Abstract. With the integration of AI, IoT, big data, and cloud computing, "one-stop" student communities are undergoing an intelligent transformation. This study conducts a cross-case comparison of Yale University (USA) and Zhejiang University (China) to examine how intelligent student-community models evolve under different institutional contexts. To strengthen analytical consistency, the comparison is organized through a five-dimensional framework that maps observable technical and governance indicators to: (i) technical system architecture, (ii) service/workflow integration, (iii) data platforms and governance, (iv) AI-enabled student support, and (v) digital community governance. The study finds that Yale tends to adopt a privacy- and compliance-oriented, decentralized smart-campus approach, whereas ZJU develops a highly integrated, AIoT-driven governance model supported by a unified data platform and mobile service hub. Importantly, the findings do not interpret integration as a purely technical advantage; instead, they highlight how data architecture choices, governance constraints, and accountability mechanisms jointly shape administrative efficiency, student-facing responsiveness, and the feasible scope of predictive analytics in student communities.

Keywords: AIoT; One-stop student community; Data governance; Smart campus

1 Introduction

Student communities are key environments for students' daily life, academic support, mental health, and social interactions (Polin et al., 2023; Santos et al., 2024)[1][17]. With the rapid development of AI, big data analytics, IoT sensing, edge computing, and mobile service platforms, universities worldwide are transitioning from traditional management models toward data-informed and algorithm-supported governance systems (Haggag et al., 2025; Castellanos Acuña et al., 2021)[3][4].In China, national policies such as the "One-stop Student Community Comprehensive Management Model" have accelerated the systematic integration of information technologies into student-centered services and governance (Xia et al., 2025)[18].

International smart-campus research has historically emphasized smart facilities, sustainable campus management, and e-learning platforms, often conceptualizing the

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campus as a miniature smart city or living lab (Polin et al., 2023; Pinho et al., 2022; Santos et al., 2024)[1][2][17].In contrast, many Chinese universities have advanced governance-oriented digital systems that integrate digital technologies into student development and community construction, moving from infrastructure-oriented projects toward integrated, data-driven governance architectures (Rodríguez-Abitia & Bribiesca-Correa, 2021; Ulufer et al., 2022; Cabero-Almenara et al., 2022)[5][9][10].However, two gaps remain. First, many digital transformation studies emphasize institutional or infrastructural maturity, with limited attention to the everyday governance of student communities and residential life spaces (Bravo-Jaico et al., 2025a; Bravo-Jaico et al., 2025b; Singun, 2025)[6][7][11].Second, systematic cross-national comparisons linking technological ecosystems, AI governance, and student-community practices remain scarce (Oncioiu & Bularca, 2025; Wu et al., 2024; Pereira et al., 2024; González-Pérez et al., 2025)[12][13][16][19].

To address these gaps, this paper conducts a dual-case analysis of Yale University (Yale) and Zhejiang University (ZJU). Yale represents a privacy- and compliance-oriented digital modernization pathway shaped by regulatory constraints and institutional governance norms, whereas ZJU represents an integrated "AIoT sensing + unified data platform + one-stop mobile services + AI-enabled support" pathway shaped by governance-driven platform consolidation. Building on recent work on smart-campus architectures, IoT-based sensing platforms, and digital maturity assessment in higher education (Castellanos Acuña et al., 2021; Haggag et al., 2025; Alfirević et al., 2025)[3][4][8], this study compares the two institutions' approaches from a computing-and-governance perspective, including system architectures, AioT deployment patterns, data middle platforms, AI analytics, mobile service systems, and accountability mechanisms. It further situates the comparison within emerging debates on AI governance and algorithmic decision-making in universities (Oncioiu & Bularca, 2025; Barus et al., 2025; Gkanatsiou et al., 2025)[12][14][15], and aligns it with China's evolving "one-stop student community" policy framework (Xia et al., 2025)[18].

To improve comparability and internal coherence, the cross-case results are reported by explicitly mapping mechanism-level indicators to a five-dimensional analytical framework (Section 2.4).In addition, the analysis distinguishes administrative efficiency (process streamlining and cross-departmental coordination) from student-centered outcomes (accessibility, experience consistency, and responsiveness). Finally, the study treats privacy-by-design not only as a normative principle but also as a structural design choice that may constrain real-time responsiveness in decentralized systems, a trade-off examined in the results and discussion sections.

2 Methodology

2.1 Research Design

This study adopts a multi-method qualitative design integrating case study methodology, technical architecture analysis, and comparative evaluation. Given the complexity of intelligent student-community construction—spanning AIoT infrastructures, data governance, AI-enabled analytics, and platform integration—this approach supports a holistic understanding of both technical mechanisms and governance constraints (Izourane et al., 2024)[20]. A dual-case strategy enables the extraction of cross-context patterns and divergences between Yale and ZJU, while allowing the comparison to focus on mechanism-level design choices rather than performance benchmarking.

2.2 Case Selection and Rationale

Two universities were selected for their representativeness and accessibility of publicly describable system information: Yale University represents a privacy- and compliance-oriented smart-campus modernization pathway with decentralized services and cautious behavioral analytics. Zhejiang University (ZJU) represents a governance-embedded digital transformation pathway supported by unified data integration, one-stop mobile services, and broader AIoT deployment.

These contrasting ecosystems provide a foundation for cross-national comparative analysis (Trevisan et al., 2022)[21]. More importantly, the contrast supports analytical attention to how governance logic (decentralization vs. platform consolidation) influences service integration depth, data linkage feasibility, and the responsiveness of student-community support.

Although Yale University and Zhejiang University are both elite institutions, this study does not treat them as representative "national models" of U.S. and Chinese higher education digitalization. Rather, they are selected as analytical extreme cases that anchor two contrasting ends of a broader governance–technology spectrum. Prior research shows that digital practices vary substantially within each national context. For example, several U.S. public universities (e.g., Georgia State University) have adopted extensive predictive analytics for student success and retention, while some Chinese universities continue to experience fragmented data ownership and internal silos despite national policy support.

Therefore, the Yale–ZJU comparison should be interpreted as a mechanism-oriented contrast, illustrating how different governance logics (privacy-first decentralization versus platform-centered integration) shape the scope and form of intelligent student-community systems. The findings do not imply a binary national dichotomy, but rather illuminate structural design choices that may appear in varying combinations across institutions in different contexts.

2.3 Data Collection Methods

Document and Policy Analysis: Institutional documents, digital campus plans, data governance protocols, and policy guidelines were reviewed to extract system architectures, platform functions, and governance objectives (Léger, 2022).

- Technical Architecture Examination: We analyzed each institution's computing infrastructure, including AIoT sensing topology, API integration patterns, identity and access control (SSO, RBAC/ABAC), data integration approaches, and security mechanisms (Polin et al., 2023)[22].

- Hardware parameter extraction for the sensing layer (ZJU focus): For the ZJU case, we explicitly recorded device categories and key configuration parameters when such information was available from public descriptions or technical reports. Parameters were organized using a standardized template (Section 2.5). When a parameter was not publicly obtainable, it was marked as "not specified (N/S)" rather than inferred.
- Data-collection window and heterogenous event-stream scale (both cases): For each data source category (e.g., access-control logs, campus card events, library entry, mobile-service logs), we recorded (i) the observation window (start/end dates or "academic-year based"), (ii) the approximate volume using a common unit (e.g., events/day, events/month, unique users), and (iii) the granularity (per transaction / per minute / per session). If only qualitative descriptions were available, we reported them as such and did not fabricate counts.
- Comparative data mapping: A structured matrix was used to code technical systems, platform functions, data mechanisms, and governance practices at Yale and ZJU , enabling each observation to be mapped to the analytical framework dimensions in Section 2.4.
- Source Transparency and Evidence Scope: Empirical observations in this study are derived exclusively from publicly accessible and institutionally sanctioned sources. These include official university policy documents, publicly released digital campus plans, platform descriptions, academic publications, government policy texts, and peer-reviewed research literature. The study does not rely on interviews with administrators or IT staff, site visits, internal system audits, or access to proprietary operational logs. This methodological choice reflects both practical access constraints—particularly in the context of Chinese university systems—and a deliberate commitment to verifiable and replicable evidence. To address potential asymmetries in disclosure practices across national contexts, the analysis adopts a conservative reporting strategy: when system parameters, data volumes, or architectural details are not explicitly disclosed in public materials, they are marked as Not specified (N/S) rather than inferred. This approach prioritizes methodological transparency and avoids overstating technical capabilities based on speculative assumptions.

2.4 Analytical Framework

This study employs a five-dimensional framework integrating computing and governance perspectives: Technical system architecture; Service integration and platform functionality; Data governance and middle-platform capabilities; AI-enhanced student support mechanisms (Mudhol, 2025); Digital community governance model.

A closed-loop model (Figure 1) illustrates the AIoT sensing layer, data integration layer, AI analytics layer, decision/service layer, and student–advisor feedback layer.

To strengthen consistency across sections, the study treats "technical indicators" as mechanism-level descriptors (e.g., integration logic, identity linkage, workflow orchestration, and governance constraints) rather than performance metrics. Each comparative claim in the results section is reported in a way that can be directly mapped back to one or more of the five dimensions above.

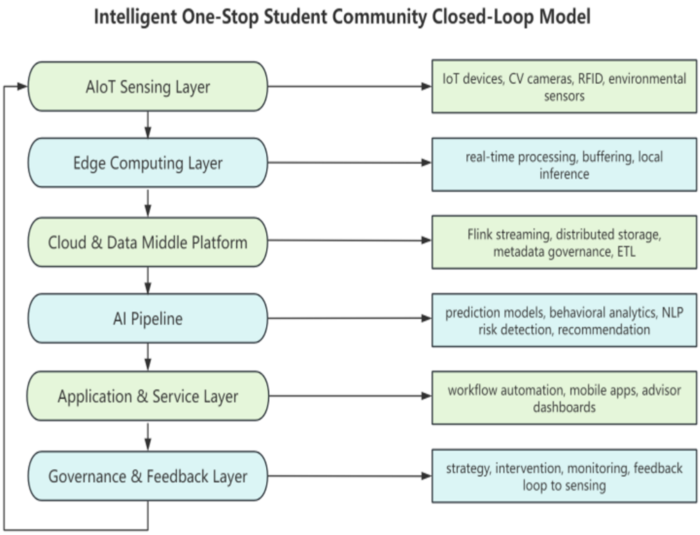

Fig. 1. Intelligent One-Stop Student Community Closed-Loop Model

The five analytical dimensions in this study are assessed through qualitative descriptive mapping, rather than scoring rubrics or quantitative coding schemes. Each dimension is operationalized using observable mechanism-level indicators extracted from publicly described system architectures and governance practices.

For example, within the Data governance and middle-platform capabilities dimension, indicators include whether an institution explicitly describes: (i) a unified student identifier linking academic, residential, dining, and service systems; (ii) shared data services or data middle platforms supporting interoperability; and (iii) access-control, auditing, or anonymization mechanisms governing cross-domain data use.

Similarly, the Service integration and platform functionality dimension is assessed by examining the presence of a unified service entry point (e.g., one-stop mobile platforms), workflow orchestration across departments, and feedback or appeal channels. The framework thus enables consistent cross-case comparison while remaining adaptable to institutions with different scales, disclosure practices, and governance contexts.

2.5 Computing Pipeline and Technical Indicators

To enable a transparent and reproducible cross-case comparison, this study operationalizes the analytical framework into a computing-oriented "data–compute–service" pipeline, which is widely adopted in contemporary smart-campus and AIoT research (Haggag et al., 2025; Pauline et al., 2022). Rather than benchmarking performance metrics or system scale, the pipeline focuses on architectural design choices, integration mechanisms, and governance affordances that shape intelligent student-community construction. The pipeline is used as an organizing device to connect observable mechanisms to the five-dimensional framework in Section 2.4.

- Data acquisition and sensing layer:At the sensing level, student-community systems rely on heterogeneous cyber - physical data sources, including access-control records, campus card transactions, library entry logs, learning-platform interactions, and mobile-service usage traces. These sources collectively form heterogeneous event streams rather than a single unified dataset. For the Zhejiang University (ZJU) case, sensing-layer characteristics were documented only when explicitly disclosed in public institutional descriptions or technical reports. Key parameters—such as sampling frequency, sensor density or coverage, communication protocols, and the presence of gateways or edge nodes—were recorded using a standardized template. When such information was not publicly available, the parameter was marked as Not specified (N/S) rather than inferred. This approach avoids speculative reporting while preserving structural comparability. This layer primarily supports analysis of Technical system architecture.
- Data integration and processing layer: We evaluated whether each campus uses batch ETL/ELT, change-data-capture (CDC), and/or stream processing (e.g., message queues + real-time computing engines) to support low-latency analytics. Data governance indicators included metadata management, data lineage, role-based access control (RBAC) or attribute-based access control (ABAC), anonymization/pseudonymization, auditing, and policy enforcement, consistent with smart-campus data governance requirements and risk-aware institutional practices. The integration layer examines how heterogeneous event streams are consolidated and prepared for downstream use. Instead of quantifying throughput or latency, the analysis focuses on mechanism-level indicators, including: Whether data ingestion is primarily batch-oriented, stream-oriented, or hybrid; Whether a unified identifier or cross-system linkage mechanism is described; The presence of metadata management, lineage tracking, and access-control policies; The use of governance mechanisms such as auditing, anonymization, or role-based access control.

This design choice aligns with prior research emphasizing that governance architecture and integration logic are more stable and comparable indicators than raw system-scale metrics in cross-institutional studies. This layer primarily supports analysis of Data governance and middle-platform capabilities.

- AI analytics and decision-support layer: The AI layer is analyzed in terms of functional categories rather than algorithmic performance. Specifically, we examine whether AI-enabled components are described as supporting: Descriptive or diagnostic analytics (e.g., dashboards, summaries); Advisory or recommendation functions; Predictive or risk-identification functions.

When model types or deployment modes (batch vs. online; cloud vs. edge) are mentioned in public materials, they are reported at a categorical level. No assumptions are made about training data volume, model accuracy, or internal optimization strategies. This layer primarily supports analysis of AI-enhanced student support mechanisms.

- Service integration and feedback layer: At the service layer, the pipeline evaluates how analytics outputs are embedded into student-facing or administrative workflows. Key indicators include: The presence of a unified service entry point (e.g., one-stop mobile platforms); Workflow orchestration and approval routing mechanisms; Human-in-the-loop validation, override, or appeal channels.

These elements collectively determine whether the system forms a closed-loop service structure, where data, analytics, decisions, and feedback are cyclically connected. This layer primarily supports analysis of Service integration and platform functionality and Digital community governance model.

- Study observation window and evidence scope: The evidence used for this pipeline analysis was collected during a study observation window from September 2023 to June 2024. This window defines the temporal scope of documents, platform descriptions, and academic literature analyzed in this study. It does not imply access to or analysis of internal operational logs retained by either institution.

2.6 Validity and Reliability Measures

Several strategies were employed to enhance validity and reliability. First, methodological triangulation was applied by combining institutional documents, platform descriptions, and peer-reviewed literature. Second, cross-source verification was used to confirm architectural and governance claims across multiple independent materials whenever possible. Third, a replication-oriented case logic was adopted, applying the same analytical dimensions and pipeline structure to both cases.

Importantly, the study avoids unverifiable quantitative claims. When parameters, data volumes, or operational details were not publicly disclosed, they were explicitly marked as unspecified. This conservative reporting strategy prioritizes transparency and methodological integrity over apparent precision, and supports consistent mapping of evidence to the five-dimensional framework.

2.7 Limitations

This study has several limitations. First, access to proprietary system documentation, sensing-layer specifications, and operational log statistics was not available. As a result, parameters such as sensor sampling frequency, event-stream volume, and system latency could not be quantitatively benchmarked. Second, differences in national governance frameworks and disclosure practices constrain the comparability of technical detail across cases. Third, the analysis focuses on two institutions, limiting statistical generalization.

Nevertheless, by emphasizing architectural mechanisms, integration logic, and governance design, the study provides analytically robust insights into intelligent student-community construction. Future research could extend this work by incorporating audited technical disclosures, collaborative data access, or reproducible datasets to enable parameter-level and volume-level comparison, and to better evaluate the relationship between administrative efficiency and student-centered outcomes.

3 Case Description

3.1 Case A: Yale University (Yale)

- Institutional Background: Yale University is a leading research-intensive university in the United States, operating under a strong regulatory and ethical framework governing data protection, student privacy, and institutional accountability. Digital transformation initiatives at Yale are shaped by compliance requirements (e.g., FERPA), sustainability goals, and long-standing traditions of decentralized governance.
- Digital Infrastructure and Smart-campus Orientation: Yale's smart-campus development emphasizes secure connectivity, reliability, and sustainability rather than large-scale AIoT-driven behavioral integration. Core infrastructure includes secure campus-wide wireless networks, VPN services for remote access, and managed identity systems supporting faculty, staff, and students. Smart sensing is primarily deployed in scenario-specific contexts, such as environmental monitoring and energy management, where data collection is clearly purpose-bounded and operationally justified.
- Service System and Platform Integration: Student services at Yale are delivered through a set of decentralized but interoperable portals and applications, including virtual application access platforms, campus communication tools, and official mobile resources. Integration is achieved mainly through identity federation and single sign-on (SSO) rather than deep data consolidation. This architecture preserves departmental autonomy and minimizes cross-domain data linkage while maintaining a consistent user experience.
- Data Governance and Analytics Posture: Yale adopts a compliance-first data governance model, in which data access, linkage, and reuse are tightly constrained by institutional policy. Cross-system aggregation of student behavioral data is limited, and analytics capabilities are typically oriented toward operational reporting and service improvement within clearly defined domains. Public materials indicate a cautious stance toward institution-wide predictive profiling based on fused behavioral streams.
- AI-Driven Student Support: AI adoption at Yale is primarily positioned as decision support rather than automated governance. Examples include guidance for teaching and learning, responsible AI initiatives, and sustainability-related analytics. AI tools are deployed with explicit ethical considerations, and there is limited evidence of closed-loop predictive intervention systems embedded into student-community governance.

Overall, Yale's case reflects a privacy- and compliance-oriented modernization pathway in which decentralization and purpose limitation are central design principles. While this configuration supports accountability and trust, it also implies that cross-domain integration and rapid closed-loop responsiveness may be structurally constrained—an issue examined comparatively in Section 4.

3.2 Case B: Zhejiang University (ZJU)

- Institutional Background: Zhejiang University (ZJU) is one of China's leading comprehensive research universities and an early adopter of large-scale digital campus initiatives. Its digital transformation has been supported by national policies on educational digitization as well as sustained institutional investment, enabling coordinated development across infrastructure, platforms, and governance processes. Within this context, the construction of intelligent "one-stop" student communities is positioned as an integral component of broader campus governance and service modernization.
- Digital Campus and Intelligent Environment: ZJU has developed an integrated digital campus environment that combines network infrastructure, platform-based services, and AIoT-enabled operational support. Institutional materials describe the use of sensing technologies across multiple campus scenarios—such as facilities management, environmental monitoring, and service coordination—to enhance situational awareness and operational efficiency. In this study, sensing-layer characteristics are documented at a categorical and orientation level, focusing on deployment scope and functional purpose. Parameter-level details (e.g., sampling frequency, sensor density, communication protocols, and gateway specifications) are reported only when explicitly disclosed; otherwise, they are treated as Not specified (N/S) to avoid inference beyond available evidence.
- Data Platform and Service Integration: A defining feature of ZJU's digital transformation is its emphasis on institution-level data integration and platform governance. Public descriptions highlight the consolidation of information from multiple campus systems—such as academic administration, student services, and operational platforms—into shared data services that support interoperability and coordinated service delivery. On this foundation, ZJU has developed a one-stop mobile service platform that functions as a unified entry point for student-facing services and administrative workflows. Integration is achieved through unified authentication and platform-based orchestration, enabling more streamlined service access and cross-departmental coordination.
- AI-enabled Student Support: ZJU actively promotes the application of AI technologies in student support, teaching assistance, and service coordination. AI-enabled functions described in public materials include analytics dashboards, advisory tools, and recommendation-oriented services that aim to enhance responsiveness and personalization. In this study, these applications are analyzed in terms of their functional role within service and governance workflows, rather than specific algorithms or performance metrics. Where predictive or advisory functions are mentioned, they are understood as being embedded within institutional oversight structures rather than operating as fully autonomous decision systems.
- Digital Community Governance Mechanisms: Digital platforms at ZJU are closely linked to community governance practices. Data-informed dashboards, intelligent

query systems, and workflow-based service routing are described as supporting more coordinated student-community management. These mechanisms contribute to a more explicit coupling between information, decision support, and service delivery, forming the basis for a platform-supported governance model in student communities. At the same time, institutional materials emphasize the continued role of human oversight, suggesting that analytics outputs function as decision aids within established administrative processes.

Table 1 summarizes the comparative architectural characteristics of Yale and ZJU from a mechanism-oriented perspective. Rather than benchmarking hardware specifications, data volumes, or algorithmic performance, the table focuses on institutionally observable design choices, including sensing orientation, integration logic, service architecture, and governance mechanisms. For the ZJU case, descriptions of AIoT deployment, data integration, and analytics-enabled services are derived from publicly available institutional and policy-oriented materials. Where parameter-level or scale-level details are not explicitly disclosed, they are intentionally not inferred, in order to maintain transparency and avoid over-claiming.

Table 1. Comparison of Digital Student Community Architectures at Yale and ZJU

Dimension	Yale University (Yale)	Zhejiang University (ZJU)
Institutional model	Privacy- and compliance-oriented digital modernization, shaped by regulatory and ethical constraints	Governance-embedded and platform-oriented intelligent student community construction
AIoT sensing orientation	Scenario-specific and purpose-bounded sensing (e.g., sustainability and facilities-related applications)	Multi-scenario sensing described in institutional materials; parameter-level details not publicly disclosed
Sensing-layer specification disclosure	Limited disclosure; sensing details typically described at functional level	Selective disclosure at categorical level; hardware parameters (e.g., frequency, density) treated as Not specified (N/S)
Edge / cloud computing strategy	Predominantly cloud-based services; minimal reliance on edge computing	Cloud-centered platform with selective use of near-source or edge processing in latency-sensitive scenarios
Data integration approach	Secure cloud services with strong data governance; no unified behavioral data middle platform	Institution-level data integration and interoperability mechanisms described at platform level
Service architecture	Decentralized portals and applications integrated via identity federation (SSO)	One-stop mobile service platform integrating multiple student services through unified authentication
AI-enabled functions	Cautious and ethics-oriented AI adoption; AI primarily positioned as decision support	Analytics- and recommendation-oriented AI functions embedded within service and governance workflows

Role of AI in governance	Human-driven governance with digital tools supporting decision-making	Platform-supported governance with analytics-informed dashboards and service coordination
Real-time and event-driven capabilities	Limited and scenario-specific; not a dominant architectural feature	Event-driven integration and near-real-time service coordination where institutionally supported
Digital maturity profile	Mature privacy-focused digital services; limited large-scale AIoT integration	Higher degree of platform integration supporting coordinated intelligent services
Feedback and accountability loop	Decentralized feedback mediated by staff and departments	More explicit service–decision–feedback coupling within platform workflows, with human oversight

To bridge the case descriptions and the subsequent comparative analysis, this study synthesizes the key architectural characteristics of Yale University and Zhejiang University into a conceptual overview. Figure 2 illustrates the dominant technical and governance-oriented pathways underlying the two digital student-community systems, as derived from publicly described institutional architectures and platform practices. Rather than presenting empirical results, the figure serves as an analytical reference framework that highlights differences in sensing orientation, integration logic, service architecture, and governance coupling. This conceptual comparison provides contextual grounding for the results and interpretations discussed in Section 4.

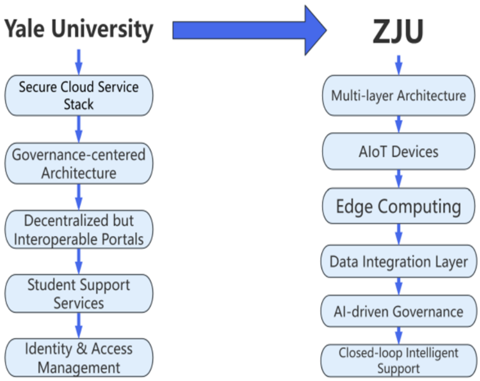

Fig. 2. Conceptual comparison of digital student-community technical architectures at Yale University and Zhejiang University, synthesized from publicly described institutional architectures.

4 Results and Analysis

4.1 Overall Technological Outcomes

The cross-case analysis shows that both Yale University (Yale) and Zhejiang University (ZJU) employ digital technologies to enhance student-community services, yet they do so through fundamentally different architectural and governance logics. To improve clarity and consistency, the findings are presented in a way that maps mechanism-level observations to the five-dimensional framework (technical architecture, service integration, data governance, AI-enabled support, and community governance).Yale's approach emphasizes secure access, regulatory compliance, and sustainability-oriented digital modernization. Its technological outcomes are reflected in reliable connectivity, identity-centered integration, and stable digital service provision rather than deep cross-domain data fusion. This configuration aligns with privacy-preserving smart-campus models that prioritize institutional trust and ethical legitimacy over extensive behavioral analytics (Polin et al., 2023; Pauline & Nyaupane, 2022)[1][23].

In contrast, ZJU demonstrates outcomes associated with a more integrated, platform-oriented ecosystem. Institutional materials describe coordinated service delivery supported by data integration and analytics-enabled platforms, enabling closer coupling between information systems, service workflows, and governance processes. Rather than representing a purely technical advantage, these outcomes reflect a governance strategy that leverages platform consolidation to improve coordination and responsiveness, consistent with findings in smart-campus and digital transformation research (Haggag et al., 2025; Trevisan et al., 2023)[3][21].

From a systems perspective, the contrast can be summarized as a governance-first secure service environment at Yale versus a platform-centered integrated service environment at ZJU. These differences illustrate how institutional context shapes not only technology adoption but also the form and scope of intelligent student-community services.

4.2 Service Efficiency and Workflow Integration

Service efficiency in intelligent student-community settings should be analytically distinguished between administrative efficiency and student-centered outcomes. Administrative efficiency refers to process streamlining, cross-departmental coordination, and workflow execution speed, whereas student-centered outcomes refer to service accessibility, experience consistency, and perceived responsiveness from the student perspective. Importantly, improvements in administrative efficiency do not automatically imply improved student-centered outcomes.

Service efficiency at Yale is primarily achieved through federated digital access. Students interact with multiple portals and applications that are unified through single sign-on (SSO), ensuring continuity of access while preserving departmental autonomy. Workflow execution, however, remains largely human-mediated, with staff and administrators retaining decision authority. This integration pattern minimizes data coupling across domains and reduces governance risks, which can support accountability and trust; however, it also limits the extent of process automation and real-time coordination, thereby constraining rapid responsiveness at the system level.

ZJU exhibits a higher degree of workflow integration through its one-stop mobile service platform. Institutional descriptions indicate that multiple student services and administrative processes are coordinated through unified service entry points and platform-based orchestration. This integration reduces procedural fragmentation and supports more timely service delivery. Prior studies on smart-campus platforms suggest that such workflow-oriented integration is a key enabler of service efficiency when supported by standardized interfaces and governance-aligned platform design (Eldeeb & Alves, 2023; Haggag et al., 2025)[3][24]. From a student-centered perspective, the same integration may improve accessibility and continuity of service, but only if the platform's interaction design and feedback mechanisms effectively translate workflow speed into user-perceived responsiveness.

The results indicate that service efficiency gains are not solely dependent on technological sophistication, but on how workflow integration is aligned with institutional governance structures and on whether administrative efficiency is intentionally converted into student-centered outcomes.

4.3 Data Governance and Integration Outcomes

Both universities emphasize data governance, yet their integration outcomes differ markedly. Yale adopts a compliance-first approach in which data access and reuse are tightly constrained. Cross-domain linkage of student behavioral data is limited, and analytics activities are typically bounded within specific functional areas. This model aligns with governance frameworks that prioritize data minimization, purpose limitation, and accountability in higher education environments (Pauline & Nyaupane, 2022)[23]. At the same time, the same constraints can reduce the feasibility of cross-domain linkage and near-real-time coordination, implying a structural trade-off between privacy-by-design and system-level responsiveness.

ZJU's approach emphasizes institution-level data integration and interoperability. Public materials describe shared data services that support coordinated service delivery and analytics-enabled applications across systems. While detailed quantitative indicators (e.g., data volume or processing latency) are not disclosed, the presence of integration mechanisms and governance structures suggests a higher capacity for coordinated analytics and decision support. This finding is consistent with research highlighting the role of data platforms as foundational infrastructure for advanced smart-campus services (Rodríguez-Abitia & Bribiesca-Correa, 2021; Trevisan et al., 2023)[5][21]. However, deeper integration also elevates the importance of accountability mechanisms and oversight, because broader linkage expands potential governance risk.

Importantly, this comparison focuses on governance and architectural mechanisms rather than numerical performance metrics, reflecting the constraints of publicly available evidence.

4.4 AI-Enabled Student Support and Predictive Governance

AI-enabled student support represents the most pronounced divergence between the two cases. Yale's AI adoption is characterized by low coupling between analytics and governance. AI tools are primarily positioned as decision support for teaching, learning, and operational insight, rather than as automated intervention systems. This cautious integration reflects ethical considerations and regulatory requirements that limit large-scale predictive profiling in student communities (Oncioiu & Bularca, 2025; Polin et al., 2023)[12][22]. From a critical perspective, privacy-by-design and decentralized integration can also constrain responsiveness: when cross-domain behavioral linkage is limited, predictive or proactive support is harder to scale into closed-loop community governance, and human-mediated coordination remains the primary channel for response. These limitations should be interpreted as structural consequences of governance-oriented privacy design rather than as a lack of technical capability.

ZJU, by contrast, describes a broader application of analytics-enabled services within student support and governance workflows. Institutional materials reference dashboards, advisory tools, and recommendation-oriented services that inform decision-making and service coordination. These functions suggest the presence of feedback mechanisms linking data, analytics, and service responses. However, due to limited disclosure, this study does not assess algorithmic performance or predictive accuracy, focusing instead on the structural role of AI within governance processes (Barus et al., 2025; Gkanatsiou et al., 2025)[14][15].

The results indicate that AI-enabled governance capacity depends not only on technical capability, but also on institutional willingness to integrate analytics outputs into decision-making structures and on the governance conditions under which prediction and intervention are considered legitimate.

4.5 Governance and Community-Level Implications

At the community governance level, Yale's digital systems enhance accessibility, reliability, and sustainability while maintaining strong human oversight. Governance remains predominantly staff-driven, with digital tools serving as enablers rather than decision-makers. This configuration supports accountability and trust but limits the scalability of data-driven intervention and the speed of cross-domain responsiveness, especially when services remain decentralized across departments.

ZJU's model demonstrates stronger coupling between digital platforms and governance processes. Analytics-informed dashboards and integrated service workflows support more coordinated community management and responsiveness. At the same time, such integration increases the importance of accountability mechanisms, including transparency, auditability, and human-in-the-loop oversight, to mitigate risks associated with algorithm-supported governance (Pauline & Nyaupane, 2022; Wu et al., 2024)[13][23]. In addition, platform integration may improve administrative efficiency by standardizing workflows, but student-centered outcomes require that governance priorities remain aligned with student needs and feedback loops are effectively operationalized.

5 Discussion

This study compares Yale University and Zhejiang University as two analytically contrasting cases to examine how institutional governance contexts shape the construction of intelligent "one-stop" student communities. Rather than representing national models, the two cases illustrate different positions along a broader governance–integration spectrum, where varying combinations of privacy norms, data governance regimes, and organizational structures condition the scope and form of AIoT-enabled campus systems.

5.1 Governance Logics and Digital Transformation Pathways

The comparison reveals two distinct but non-exclusive digital transformation pathways. Yale exemplifies a privacy- and compliance-oriented pathway, prioritizing secure identity management, decentralized services, and purpose-limited data use. This configuration aligns with smart-campus approaches that emphasize ethical legitimacy and regulatory compliance as foundations for sustainable digital transformation (Polin et al., 2023; Pauline & Nyaupane, 2022)[22][23].

Zhejiang University represents a more platform-centered governance pathway, characterized by institutional data integration, unified service platforms, and analytics-enabled coordination embedded within governance workflows. Such integration supports cross-departmental collaboration and faster service delivery, consistent with prior research on data-driven campus governance (Haggag et al., 2025; Trevisan et al., 2023)[3][21].Importantly, these pathways should be understood as governance choices rather than as indicators of technological superiority.

5.2 Privacy-by-Design and System Responsiveness

A key finding concerns the structural trade-off between privacy-by-design and system-level responsiveness. In Yale's decentralized environment, strict purpose limitation and constrained cross-domain data linkage enhance accountability and trust, but they also limit the feasibility of closed-loop predictive governance in student communities. Coordination and intervention therefore remain largely human-mediated.

In contrast, ZJU's integrated platforms enable closer coupling between data, analytics, and service workflows, supporting more responsive coordination. However, increased integration elevates governance demands related to transparency, auditability, and human oversight, particularly as analytics and automation deepen (Oncioiu & Bularca, 2025; Barus et al., 2025)[12][14].Thus, integration should be interpreted as a shift in governance conditions rather than as a purely technical upgrade.

5.3 Student Experience, Trust, and Agency

Although this study focuses on technical architectures and governance mechanisms, student experience remains central to the legitimacy of intelligent student communities. Prior research indicates that students often experience ambivalence toward smart-campus systems, balancing service convenience against concerns about surveillance, consent, and algorithmic decision-making (Pauline & Nyaupane, 2022)[23].

From this perspective, Yale's decentralized and purpose-bounded systems may mitigate perceptions of pervasive monitoring, reinforcing trust and perceived accountability. ZJU's more integrated platforms may enhance continuity and responsiveness, but they also raise questions about student awareness and agency when multiple aspects of campus life are mediated through unified systems. While this study does not include direct student surveys or interviews, the findings underscore the importance of incorporating student voices in future research to assess trust, consent, and the perceived legitimacy of AI-enabled governance.

5.4 Implications for Intelligent Student-Community Design

Overall, the results highlight that intelligent student-community construction is a socio-technical process requiring alignment between technological integration, governance frameworks, and student-centered design. Administrative efficiency achieved through platform consolidation does not automatically translate into improved student experiences. Institutions must therefore balance integration and privacy, automation and human oversight, and efficiency and legitimacy in ways that reflect their regulatory contexts and student expectations.

6 Conclusion

This study conducted a cross-case comparison of Yale University (United States) and Zhejiang University (China) to examine how institutional context shapes the construction of intelligent “one-stop” student communities under AIoT and big data paradigms. The findings show that Yale follows a privacy- and compliance-oriented digital transformation pathway, emphasizing secure infrastructure, decentralized services, and cautious AI adoption. Zhejiang University follows a more integrated pathway, emphasizing platform consolidation, coordinated service delivery, and analytics-enabled support embedded within governance processes.

The comparison highlights that data integration architecture and governance mechanisms are central determinants of intelligent student-community development. While integrated platforms can enhance coordination and responsiveness, privacy-by-design and accountability remain essential for ethical and sustainable transformation. Overall, the study suggests that effective one-stop student communities require a balanced integration of AIoT infrastructure, data governance, organizational alignment, and responsible AI principles, rather than isolated technological adoption (Trevisan et al., 2022)[21]. Furthermore, “one-stop” platform integration should not be equated with student-centered outcomes by default; converting workflow integration into student-experienced responsiveness requires explicit service design and governance alignment.

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