

Statistical Dashboards and Business Intelligence in Campus Information Systems: A Bibliometric Review of Implementation Trends

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Abstract

Campus academic information systems have become mission-critical infrastructure in higher education, yet a significant paradox persists. Many universities operate monolithic architectures that consolidate student data and administrative functions within unified platforms—offering inherent security advantages including centralized authentication, unified access control, and simplified vulnerability monitoring. However, scholarly discourse examining how these secure integrated systems can simultaneously achieve advanced business intelligence capabilities remains remarkably thin. This bibliometric study analyzes 749 publications from Scopus (2010-2025) to map the intellectual landscape of campus information systems research, with particular attention to security frameworks and statistical dashboard implementations. The methodology combines linear regression trend analysis ($\beta = 2.54$, $p = 0.00135$, $R^2 = 0.5317$), Bradford's Law, Lotka's Law, and k-means clustering ($k = 9$). Results reveal statistically significant publication growth (CAGR = 1.46%), accumulating 6,039 citations (mean = 8.06) across 1,945 authors from 86 countries. Indonesia dominates contributions (26.1%), followed by China (10.3%) and the United States (8.1%). Thematic analysis identifies nine research clusters, with security-focused studies employing PTES and OWASP methodologies achieving 83% intrusion detection accuracy, while governance evaluations using COBIT and ISO 27001 reveal system maturity gaps. Critically, fewer than 10% of publications address real-time analytics or decision support visualization within secure monolithic architectures. The collaboration index (3.03 authors/document) and degree of collaboration (83.2%) indicate robust interdisciplinary practices. Findings suggest that while security research has matured, significant gaps persist in integrating business intelligence dashboards with secure monolithic systems—highlighting urgent need for research bridging data protection frameworks with analytical capabilities.

Keywords: academic information system, bibliometric analysis, business intelligence, campus information system, statistical dashboard.

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1. Introduction

The digital transformation sweeping through higher education has fundamentally altered how universities manage their academic operations. Gone are the days when administrative staff shuffled through paper records and manually compiled reports. Now, campus information systems serve as the backbone of institutional management, handling everything from student enrollment to faculty coordination and performance monitoring (Wang, 2025; Feng, 2025). Yet despite this widespread adoption—and here lies the crux of the matter—the strategic utilization of statistical dashboards and business intelligence components within these systems remains surprisingly understudied.

What makes this gap particularly striking is the sheer volume of data these systems generate daily. Student attendance records. Grade distributions. Course registration patterns. Faculty workloads. The list goes on and on. Liu and Hung (2025) emphasize that intelligent campus information systems possess enormous potential for supporting self-regulated learning and data-driven decision-making. But potential alone means little without proper implementation frameworks. The disconnect between data availability and actionable intelligence represents one of the most pressing challenges facing contemporary higher education administration.

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Consider the landscape as it currently stands. Universities worldwide have invested billions in information technology infrastructure, deploying sophisticated academic information systems that capture granular details about every aspect of campus operations (Das & Chakraborty, 2025; Hadi et al., 2025). These systems track student progression from admission through graduation, monitor course effectiveness, manage faculty assignments, and coordinate resource allocation across departments. Zhang and Cheng (2025) highlight how the collaboration between artificial intelligence and big data enables intelligent evaluation of education quality through dynamic assessment capabilities. The technical infrastructure exists. The data flows continuously. What remains elusive is the systematic transformation of this data into strategic insights through integrated business intelligence dashboards.

The significance of this research cannot be overstated. Higher education institutions face unprecedented pressures to demonstrate accountability, improve student outcomes, and optimize resource utilization (Fatkuroji et al., 2025; Taufik et al., 2025). Accreditation bodies demand evidence-based quality assurance. Government funding agencies require transparent reporting. Students and parents expect value for their educational investments. In this environment, the ability to visualize trends, identify patterns, and make informed decisions quickly has become not merely advantageous but essential for institutional survival. Musa et al. (2025) underscore that ontology-driven analytics support reliable decision-making in academic performance monitoring—yet such capabilities remain the exception rather than the norm across most university information systems.

Furthermore, the COVID-19 pandemic accelerated the digitization of educational processes, exposing critical weaknesses in existing information system architectures (Daim et al., 2024). Institutions that had previously relied on face-to-face interactions suddenly needed comprehensive digital dashboards to monitor student engagement, track learning outcomes, and coordinate remote operations. Susanto et al. (2025) demonstrate how cognitive-based improvements to academic information system mobile applications can significantly reduce environmental impact through optimized user interfaces—suggesting that thoughtful system design yields benefits beyond mere operational efficiency. The pandemic revealed that many institutions lacked the analytical infrastructure necessary to respond effectively to rapidly changing circumstances.

What sets this study apart from existing literature is its comprehensive bibliometric approach to mapping the intellectual terrain of campus information systems research, with specific attention to statistical dashboard and business intelligence dimensions. While numerous studies have examined particular aspects of academic information systems—usability evaluation (Al-Tahat, 2025; Pritalia et al., 2025), security assessment (Utama & Nurhadi, 2024; Miftahuddin & Sholahuddin, 2025), governance frameworks (Destriani & Putra, 2025)—no previous work has systematically analyzed the evolution, thematic structure, and research gaps pertaining to analytical capabilities within these systems. The novelty lies in synthesizing fifteen years of scholarly output to identify where the field has been, where it currently stands, and crucially, where it needs to go.

This bibliometric review differs from traditional literature reviews in its quantitative rigor. Rather than selectively summarizing studies based on author judgment, bibliometric analysis employs statistical methods to objectively measure publication patterns, citation networks, and thematic clusters (Netinant et al., 2025). The approach reveals hidden structures in the literature that narrative reviews often miss. It identifies influential authors and seminal works through citation metrics rather than subjective assessment. It maps the evolution of research topics over time using keyword co-occurrence analysis. And it detects emerging trends before they become obvious to casual observers.

The research questions guiding this investigation are threefold. First, what are the publication trends and growth patterns in campus information systems research from 2010 to 2025? Second, which thematic clusters characterize the intellectual structure of this field, and how have these clusters evolved over the study period? Third, what gaps exist in the current literature regarding statistical dashboard and business intelligence implementations? By addressing these questions, this study aims to provide researchers with a comprehensive map of the field's development, identify underexplored areas warranting further investigation, and offer practitioners insights into evidence-based approaches for enhancing analytical capabilities within campus information systems.

The practical implications extend across multiple stakeholder groups. For university administrators, understanding the current state of research helps inform technology investment decisions and system enhancement priorities. For information technology professionals, the thematic analysis reveals best practices and emerging approaches being validated in peer-reviewed literature. For researchers, the identification of gaps points toward promising directions for future scholarship. And for vendors developing academic information systems, the findings suggest features and capabilities that institutions increasingly demand but current products may lack.

2. Literature Review

The scholarly discourse surrounding campus information systems has evolved substantially over the past decade and a half, reflecting both technological advances and shifting institutional priorities. This evolution manifests across several interconnected themes that merit careful examination: system architecture and development paradigms, user experience and adoption factors, security and governance considerations, and—most relevant to the present investigation—analytical and decision support capabilities.

2.1. System Architecture and Development Paradigms

The architectural foundations of academic information systems have undergone significant transformation since 2010. Early systems predominantly employed monolithic designs characterized by tightly coupled components and limited scalability (Hassan et al., 2025). As institutional data volumes grew and user expectations increased, researchers began advocating for more flexible approaches. Hadi et al. (2025) present microservices architecture as a paradigm enabling enhanced software reusability in higher education applications, arguing that modularity and independence offer superior adaptability compared to traditional service-oriented architectures.

The shift toward cloud-based deployments represents another architectural trend. Wandira et al. (2024) investigate behavioral intentions toward cloud-based academic information systems using extended Technology Acceptance Model and Expectation-Confirmation Model frameworks, finding that facilitating conditions, perceived usefulness, and satisfaction significantly influence adoption intentions. This migration to cloud infrastructure carries implications for business intelligence implementations, as cloud platforms typically offer more sophisticated analytics tools than on-premises alternatives.

Integration capabilities have emerged as a critical architectural concern. Sahara et al. (2023) propose integration models connecting academic information systems with learning management systems through REST web services and external databases—a technical approach that facilitates consolidated data access essential for comprehensive dashboards. The fragmentation of data across disconnected systems has long impeded effective analytics; architectural solutions enabling seamless data flow represent foundational requirements for business intelligence deployment.

2.2. User Experience and Technology Adoption

A substantial body of research examines how users interact with campus information systems and what factors influence adoption success. Almseidein (2024) investigates user experience dimensions including dependability, efficiency, stimulation, perspicuity, novelty, and attractiveness, finding that while systems generally meet functional requirements, opportunities for enhancement remain in user interface design. Similar findings emerge from Anwarudin et al. (2024), who compare e-ServQual and WebQual 4.0 methodologies for assessing academic information system quality and user satisfaction.

The Technology Acceptance Model and its extensions feature prominently in this literature stream. Netinant et al. (2025) introduce the Digital Educational Systems Adoption Framework integrating TAM, Task-Technology Fit, and Digital Skills constructs to analyze system adoption in graduate academic contexts. Their longitudinal analysis of server log data combined with survey responses demonstrates how system quality predicts both digital skills development and actual usage patterns. Daim et al. (2024) apply the Unified Theory of Acceptance and Use of Technology to examine student information management system adoption across Turkish universities, identifying key factors distinguishing successful implementations.

What these user experience studies consistently reveal—and this point deserves emphasis—is that technical functionality alone does not determine system success. Users require intuitive interfaces, responsive performance, and perceived value alignment with their tasks. Yet notably absent from much of this literature is consideration of analytical dashboards as user-facing components. Most studies focus on transactional features like registration, grade viewing, and schedule management rather than strategic information visualization.

2.3. Security, Governance, and Quality Assurance

The sensitive nature of academic data necessitates robust security measures and governance frameworks. Utama and Nurhadi (2024) employ Penetration Testing Execution Standard and OWASP methodologies to assess vulnerability

risks in academic information systems, identifying critical issues including SQL injection, broken access control, and weak encryption. Miftahuddin and Sholahuddin (2025) similarly utilize penetration testing combined with machine learning-based intrusion prediction to enhance campus website security, achieving 83% accuracy in detecting various attack types.

Governance frameworks provide structured approaches to ensuring system effectiveness. Destriani and Putra (2025) apply COBIT 2019 to audit academic information system governance, finding capability levels below expectations and recommending improvements across monitoring, evaluation, and assessment domains. Fatkuroji et al. (2025) examine how academic information systems contribute to Good University Governance principles including transparency (contribution coefficient 0.832), accountability (0.862), and participation (0.884).

Nurbojatmiko et al. (2024) assess information security maturity levels using ISO 27001 and System Security Engineering Capability Maturity Model, reporting average scores indicating standard processing compliance but room for enhancement. These security and governance studies establish necessary foundations for business intelligence deployment—analytics capabilities cannot responsibly be built upon insecure or poorly governed data infrastructures.

2.4. Analytical and Decision Support Capabilities

The literature addressing analytical capabilities within campus information systems proves notably thinner than other thematic areas, confirming the gap this study seeks to illuminate. Zhang and Cheng (2025) describe intelligent evaluation systems utilizing machine learning, data mining, and natural language processing for dynamic assessment of student learning processes and comprehensive quality. Their work represents one of the more developed treatments of analytics integration in academic contexts.

Learning analytics emerges as a related but distinct research stream. Musa et al. (2025) develop the SPC_Academic_Performance ontology to consolidate and analyze performance data, employing test-driven development methodology to ensure consistency and reliability. While focused on learning outcomes rather than institutional operations, such research demonstrates feasibility and value of sophisticated analytics in educational settings.

Selim et al. (2024) apply logistic regression with principal component analysis to examine university information system impacts on academic performance, utilizing data mining techniques to explore relationships between system characteristics and student outcomes. Ahmed and Singh (2025) similarly employ supervised learning algorithms including decision trees, logistic regression, and random forests for automating university academic processes and predicting student dropout risks.

2.5. Identified Research Gaps

The literature review reveals several significant gaps warranting investigation. First, while individual studies examine technical, usability, security, and governance aspects of campus information systems, integrative frameworks connecting these dimensions to business intelligence capabilities remain underdeveloped. Second, most research focuses on retrospective analysis rather than real-time dashboards supporting operational decision-making. Third, the geographical concentration of studies—predominantly from Indonesian institutions—raises questions about generalizability across different educational contexts.

Based on these gaps, the following hypotheses guide the bibliometric analysis:

- H1: Publication output in campus information systems research demonstrates statistically significant growth over the 2010-2025 period.
- H2: Thematic clusters in the literature exhibit temporal evolution, with emerging topics related to analytics and machine learning gaining prominence in recent years.
- H3: Research on statistical dashboards and business intelligence within campus information systems remains underrepresented relative to technical implementation studies.

3. Methodology

3.1. Research Design and Philosophical Approach

This investigation adopts a quantitative bibliometric design grounded in the science of science paradigm, which treats scholarly literature as a measurable phenomenon amenable to statistical analysis (Pritchard, 1969). The approach enables objective mapping of intellectual structures within research domains, complementing traditional narrative reviews with reproducible quantitative assessments. Unlike qualitative synthesis methods that rely on reviewer interpretation, bibliometric analysis applies standardized metrics to characterize publication patterns, citation relationships, and thematic configurations.

3.2. Data Collection

The Scopus database served as the primary data source, selected for its comprehensive coverage of peer-reviewed literature across disciplines and its structured metadata facilitating bibliometric analysis. The search query employed was:

TITLE-ABS-KEY("academic information system" OR "student information system" OR "campus information system" OR "university information system")

This query retrieved publications containing the specified terms in titles, abstracts, or author keywords. The search was limited to publications from 2010 through 2025 to capture the contemporary period of campus information systems research following the maturation of web-based technologies. Data retrieval occurred on October 17, 2025, yielding 749 documents meeting the inclusion criteria.

The dataset encompasses multiple document types including conference papers (437, 58.3%), journal articles (255, 34.0%), book chapters (27, 3.6%), conference reviews (24, 3.2%), and reviews (3, 0.4%). This distribution reflects the field's applied nature, with conference venues serving as primary dissemination channels for technical implementations.

3.3. Data Processing and Variable Construction

Exported records included bibliographic fields such as authors, titles, abstracts, keywords, source titles, publication years, citation counts, affiliations, and document types. Data cleaning procedures addressed inconsistencies in author names, keyword variants, and institutional affiliations. Keywords were standardized to merge equivalent terms (e.g., "e-learning" and "elearning").

Derived variables computed for analysis included:

Article Age:

$$\text{Article Age} = 2025 - \text{Publication Year}$$

Growth Rate:

$$e_t = \frac{\text{Publications}_t - \text{Publications}_{t-1}}{\text{Publications}_{t-1}} \times 100$$

Collaboration Index:

$$\text{Collaboration Index} = \frac{\text{Total Authors}}{\text{Total Documents}}$$

Compound Annual Growth Rate (CAGR):

$$\text{CAGR} = \left(\left(\frac{\text{Publications}_{2025}}{\text{Publications}_{2010}} \right)^{\frac{1}{15}} - 1 \right) \times 100$$

3.4. Analytical Techniques

Trend Analysis: Linear regression modeled publication growth over time, with publication year as the independent variable and document count as the dependent variable. The regression equation takes the form:

$$Y_t = \alpha + \beta t + \varepsilon_t$$

where Y_t represents publications in year t , α is the intercept, β is the slope coefficient indicating average annual change, and ε_t is the error term.

Bradford's Law Analysis: This bibliometric law describes the scattering of literature across journals, positing that a small core of journals publishes approximately one-third of articles on a subject, with subsequent zones requiring geometrically increasing numbers of journals to contribute equivalent article counts. The Bradford multiplier (k) was computed as:

$$k = \frac{n_2}{n_1} \approx \frac{n_3}{n_2}$$

where n_1 , n_2 , and n_3 represent journal counts in zones 1, 2, and 3 respectively.

Lotka's Law Analysis: This law characterizes author productivity distributions, stating that the number of authors publishing n papers is proportional to $\frac{1}{n^2}$. The observed coefficient was compared against the theoretical value of 2.0.

K-means Clustering: Thematic analysis employed k-means clustering on the keyword co-occurrence matrix. The optimal number of clusters ($k = 9$) was determined using the elbow method, which identifies the point where within-cluster sum of squares reduction diminishes. Silhouette analysis validated cluster quality.

Correlation Analysis: Pearson correlation coefficients examined relationships between citation counts and article age, with statistical significance assessed at $\alpha = 0.05$.

Software: Analyses were conducted using R version 4.3.2 with the bibliometrix package (Aria & Cuccurullo, 2017) for bibliometric computations.

4. Results

4.1. Descriptive Statistics and Dataset Characteristics

The bibliometric analysis encompassed 749 documents published between 2010 and 2025, authored by 1,945 unique contributors across 86 countries. Table 1 presents the summary statistics characterizing this dataset.

The citation distribution exhibited pronounced positive skewness, with 244 documents (32.6%) receiving zero citations, 389 documents receiving 1-10 citations, 116 documents receiving more than 10 citations, and only 21 documents exceeding 50 citations. This pattern suggests a highly concentrated impact structure where few publications attract substantial attention while the majority receives limited recognition.

Table 1. Summary Statistics of the Bibliometric Dataset (2010-2025)

Metric	Value
Total Documents	749
Total Authors	1,945
Unique Keywords	2,115
Countries Represented	86
Total Citations	6,039
Mean Citations per Document	8.06
Median Citations	2
Maximum Citations	883
Standard Deviation of Citations	36.96
Authors per Document	3.03
Documents per Author	0.39

4.2. Publication Trend Analysis

Linear regression analysis revealed a statistically significant positive trend in annual publication output over the study period. Table 2 displays publication counts and citation metrics by year.

Table 2. Annual Publication Output and Citation Metrics (2010-2025)

Year	Publications	Citations	Avg Citations	Cumulative	Growth Rate (%)
2010	37	219	5.92	37	—
2011	23	248	10.78	60	-37.84
2012	26	358	13.77	86	13.04
2013	43	334	7.77	129	65.38
2014	26	162	6.23	155	-39.53
2015	26	243	9.35	181	0.00
2016	40	1,566	39.15	221	53.85
2017	41	428	10.44	262	2.50
2018	64	608	9.50	326	56.10
2019	67	296	4.42	393	4.69
2020	71	717	10.10	464	5.97
2021	57	201	3.53	521	-19.72
2022	60	391	6.52	581	5.26
2023	54	125	2.31	635	-10.00
2024	68	134	1.97	703	25.93
2025	46	9	0.20	749	-32.35

The regression model yielded:

$$Publications_t = \alpha + 2.5397t$$

with slope coefficient $\beta = 2.5397$, p-value = 0.00135, and $R^2 = 0.5317$. These results indicate that publication output increased by approximately 2.54 documents annually on average, with the model explaining 53.17% of variance in publication counts. The CAGR of 1.46% confirms modest but sustained growth throughout the study period.

The growth rate fluctuations across the study period are visualized in Figure 1 (Growth Rate Analysis). Notable fluctuations occurred in 2016 (39.15 average citations driven by highly cited smartphone addiction studies), 2018 (56.10% growth rate), and 2020-2021 (pandemic-related publication surge followed by decline). The alternating pattern of positive and negative growth rates suggests sensitivity to external factors including landmark publications and global events affecting higher education.

4.3. Geographic Distribution

Analysis of author affiliations revealed substantial geographic concentration. Indonesia dominated the dataset, contributing more than a quarter of all publications. The distribution across contributing countries is presented in Figure 2 (Country Distribution), which illustrates the pronounced dominance of Indonesian researchers followed by China and the United States.

Asian countries collectively accounted for over 45% of output, while African and Latin American representation remained minimal, suggesting geographic gaps in research attention. The concentration pattern raises important questions about generalizability—are findings from Indonesian contexts transferable to institutions operating under different regulatory, cultural, and technological conditions?

4.4. Author Productivity and Collaboration

Lotka's Law analysis yielded a coefficient of 2.4409, compared to the theoretical ideal of 2.0. This deviation indicates slightly higher concentration of publications among prolific authors than the classical model predicts. The distribution pattern is visualized in Figure 3 (Lotka's Law Analysis), demonstrating conformance to the expected inverse square relationship between author productivity and frequency.

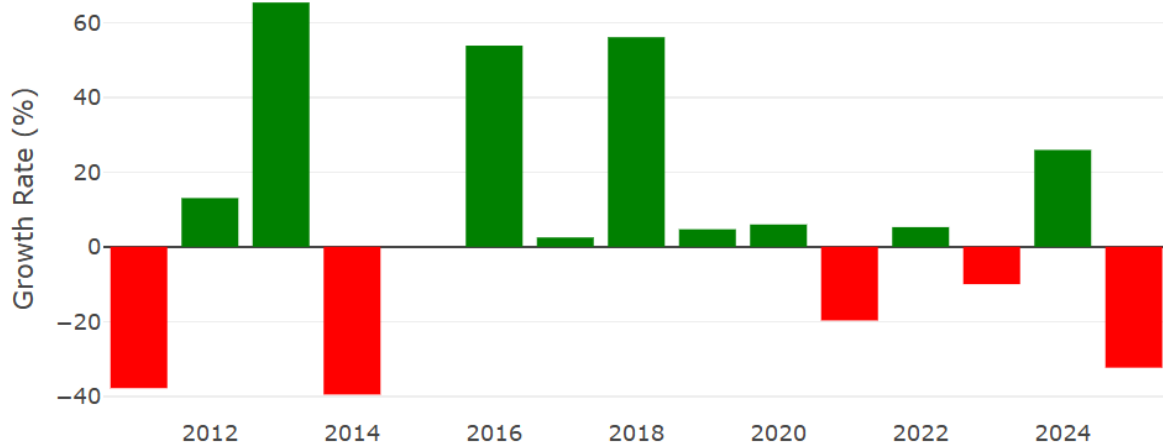


Figure 1. Growth Rate Analysis (2011-2025)

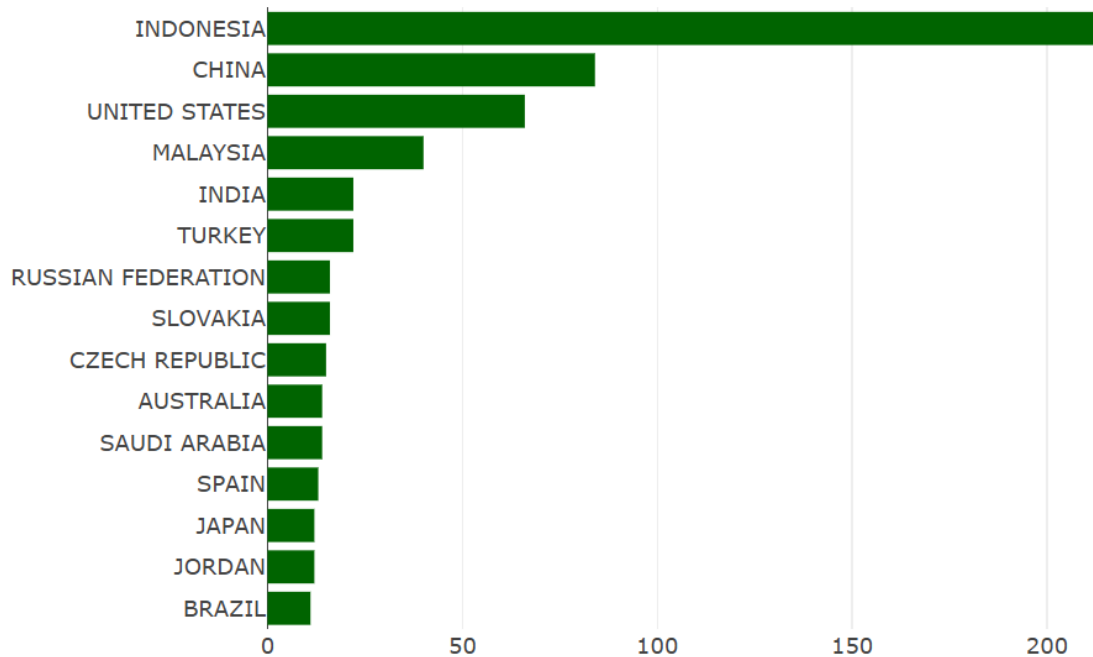


Figure 2. Geographic Distribution of Publications

Table 3. Top Authors by Publication Count and Impact

Author	Publications	Total Citations	H-Index	Avg Citation
Rochimah S	11	53	3	4.82
Krogstie J	6	235	5	39.17
Andreswari R	6	20	3	3.33

Author	Publications	Total Citations	H-Index	Avg Citation
Hendayun M	6	29	3	4.83
Moravčík O	6	14	3	2.33
Svetsky S	6	14	3	2.33
Bydžovská H	5	42	3	8.40
Akbar RJ	5	9	2	1.80

Collaboration statistics revealed robust multi-author research practices, as summarized in Table 4.

Table 4. Collaboration Statistics

Metric	Value
Single author publications	126 (16.8%)
2 authors	193 (25.8%)
3-5 authors	368 (49.1%)
>5 authors	62 (8.3%)
Mean authors per document	3.03
Collaboration Index	3.0347
Degree of Collaboration	0.8318

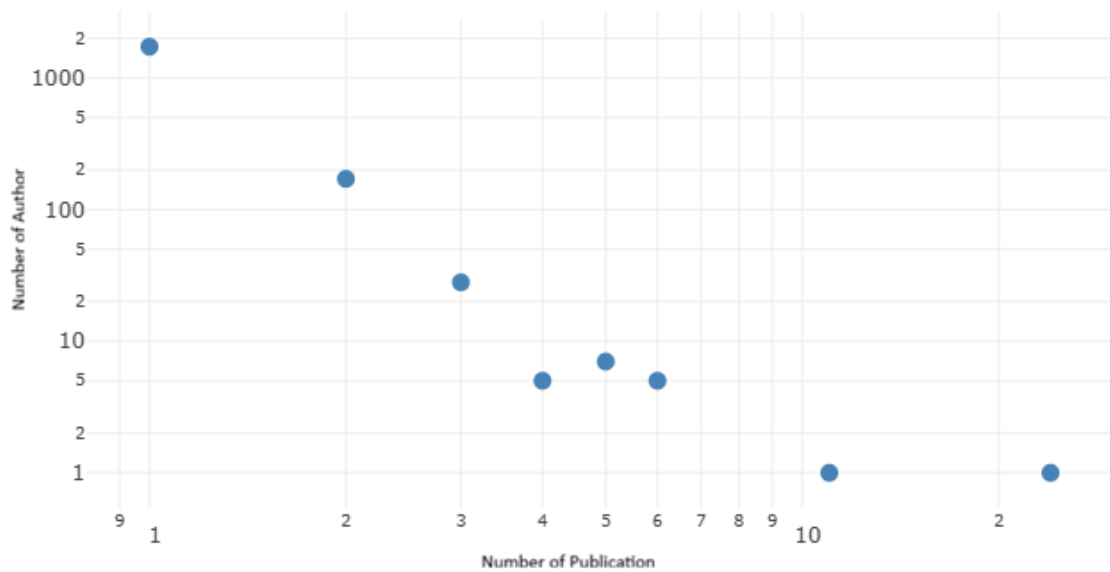


Figure 3. Lotka's Law Analysis of Author Productivity

The Degree of Collaboration at 0.8318 indicates that 83.18% of publications involved collaborative authorship, reflecting the interdisciplinary nature of campus information systems research requiring expertise spanning computer science, education, and organizational management.

4.5. Source Analysis and Bradford's Law

Bradford's Law analysis classified journals into three zones of productivity, with results visualized in Figure 4 (Bradford's Law Analysis). The characteristic S-shaped curve confirms expected literature scattering patterns.

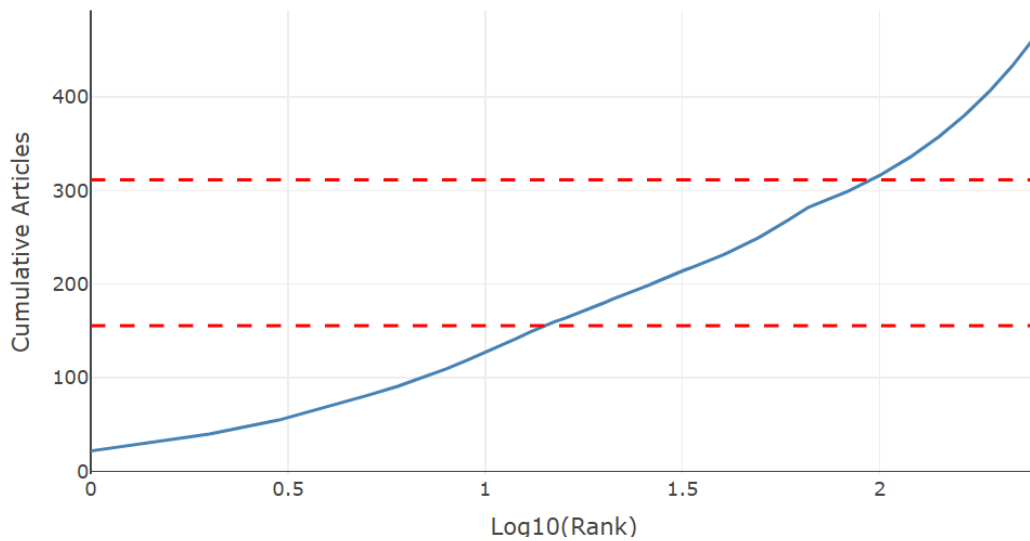


Figure 4. Bradford's Law Analysis of Journal Distribution

The Bradford Multiplier of 5.79 confirms expected scattering patterns, indicating that each successive zone requires approximately 5.79 times as many journals to produce equivalent article counts.

Table 5. Top Publication Sources by Article Count and Impact

Source	Articles	Total Citations	Avg Citations	Max Citations
Journal of Physics: Conference Series	22	91	4.14	34
AIP Conference Proceedings	18	—	—	—
IOP Conference Series: Materials Science	15	86	5.73	15
ACM International Conference Proceedings	14	142	10.14	66
Lecture Notes in Networks and Systems	12	—	—	—
IEEE Access	6	116	19.33	50
Education and Information Technologies	3	180	60.00	105
Mobile Information Systems	3	172	57.33	103

Conference proceedings dominated publication venues, consistent with the applied nature of information systems research. However, journal articles in IEEE Access and Education and Information Technologies achieved substantially higher citation impacts despite lower publication volumes.

4.6. Citation Analysis

The most highly cited publications addressed behavioral aspects of technology use rather than technical system implementations.

Table 6. Top Cited Publications

Authors	Year	Title	Source	Citations
Samaha M	2016	Relationships among smartphone addiction, stress, academic performance	Computers in Human Behavior	883
Hawi NS	2016	To excel or not to excel: Strong evidence on smartphone addiction	Computers and Education	284
Hasan R	2020	Predicting student performance using video learning	Applied Sciences	156
Gašević D	2013	Choose your classmates, your GPA is at stake!	American Behavioral Scientist	127
Tasley	2017	Student facing dashboards: One size fits all?	Technology, Knowledge and	122

Authors	Year	Title	Source	Citations
SD			Learning	

Correlation analysis between total citations and article age yielded $r = 0.2761$ ($p < 0.001$), indicating a weak but statistically significant positive relationship. The R^2 of 0.0762 suggests article age explains only 7.62% of citation variance, implying that factors beyond publication timing substantially influence citation accumulation.

4.7. Keyword Analysis and Thematic Clustering

Keyword frequency analysis identified dominant research themes. The intellectual structure is visualized through Figure 5 (Thematic Map), which positions research clusters across quadrants based on centrality (relevance to the field) and density (development maturity).

The temporal evolution of key research themes is illustrated in Figure 6 (Keyword Trend Over Time), revealing the emergence of machine learning as a growing research focus since 2018 while traditional information systems topics maintain steady presence.

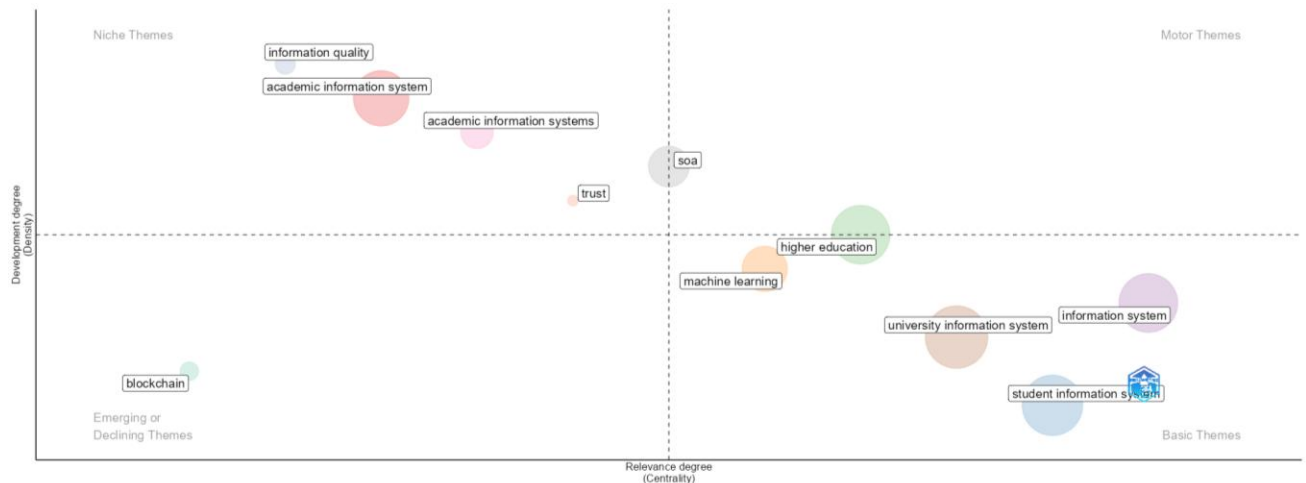


Figure 5. Thematic Map of Research Clusters

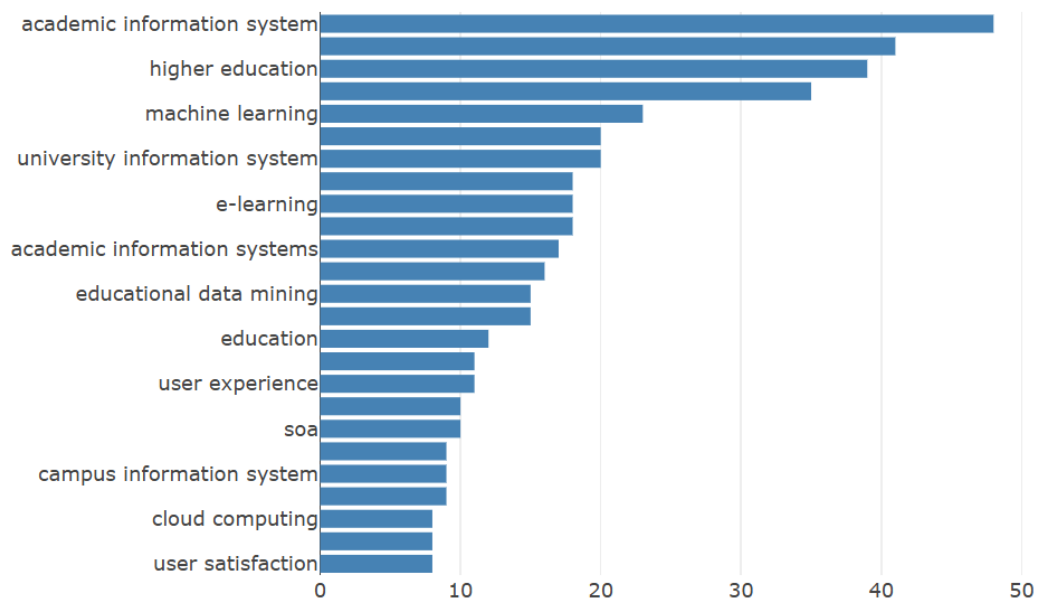


Figure 6. Keyword Trend Over Time (2010-2025)

K-means clustering with k=9 (determined via elbow method as shown in Figure 7) produced the thematic structure presented in Table 8. The silhouette score of 0.2147 indicates weak-to-moderate cluster separation, suggesting overlapping research themes.

Table 7. Top Keywords by Frequency

Rank	Keyword	Frequency	Percentage
1	academic information system	48	3.70%
2	student information system	41	3.16%
3	higher education	39	3.00%
4	information system	35	2.70%
5	machine learning	23	1.77%
6	information systems	20	1.54%
7	university information system	20	1.54%
8	data mining	18	1.39%
9	e-learning	18	1.39%
10	student information systems	18	1.39%

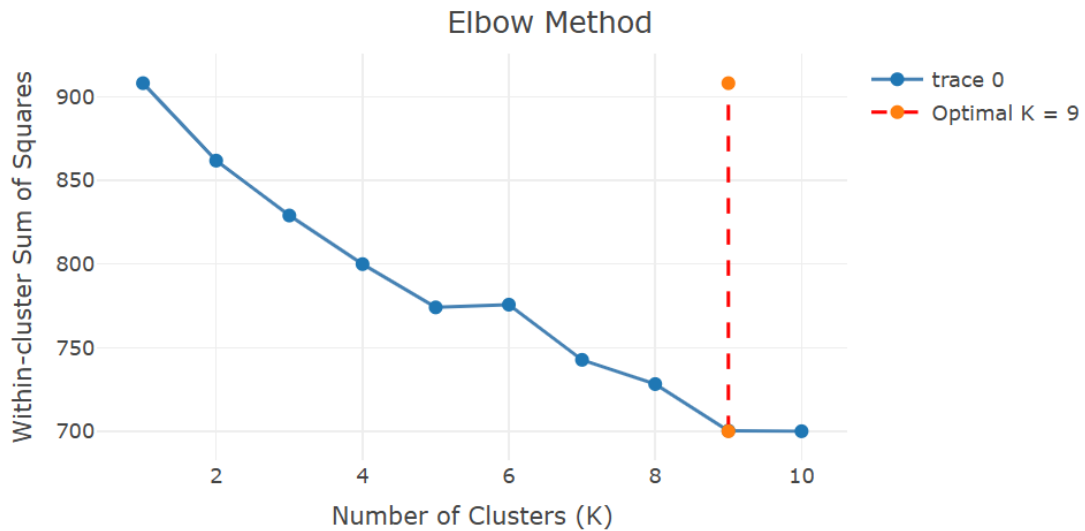


Figure 7. Elbow Method for Optimal Cluster Determination

Table 8. Thematic Cluster Characteristics

Cluster	n	Key Themes
1	20	University information system, prediction, social network analysis, student performance, data mining
2	23	Machine learning, higher education, computer vision, education, prediction
3	31	Information system, university, web application, software development, web service
4	415	Information systems, academic information systems, student information systems, data mining, e-learning
5	14	Educational data mining, classification, learning analytics, e-learning, higher education
6	34	Higher education, learning analytics, student information system, artificial intelligence
7	48	Academic information system, software metrics, maintainability, usability, information system
8	30	Student information system, web application, learning management system, registration, information quality
9	12	Usability, user experience, student information system, efficiency, satisfaction

The dominance of Cluster 4 (n=415) underscores the concentration of research on traditional information systems topics. Notably, clusters addressing advanced analytics (Clusters 2, 5, and 6) remain substantially smaller, collectively accounting for only 71 documents (9.5% of total).

5. Discussions

5.1. Interpretation of Results

The bibliometric analysis reveals a maturing but geographically concentrated research domain. The statistically significant positive trend ($\beta = 2.54$, $p = 0.00135$) supports Hypothesis 1, confirming sustained scholarly interest in campus information systems over the fifteen-year study period. With $R^2 = 0.5317$, the linear model explains a majority of variance in annual publication counts, though fluctuations—particularly the 2016 citation spike and 2020–2021 pandemic effects—indicate sensitivity to external factors and breakthrough publications.

The publication trajectory demonstrates resilience rather than explosive growth. A CAGR of 1.46% suggests steady accumulation rather than paradigm-shifting expansion. This pattern aligns with the applied nature of the field, where incremental improvements to existing systems generate more publications than revolutionary reconceptualizations. Practically speaking, this means researchers entering the field can expect consistent publication opportunities without facing the competitive pressures characteristic of rapidly expanding domains.

The geographic concentration warrants careful consideration. Indonesia's dominance (26.1% of publications) reflects that country's substantial investment in higher education digitization and the proliferation of academic information systems across its numerous universities. This aligns with specific Indonesian policy initiatives including the NeoFeeder centralized reporting system documented by Rozas et al. (2025). However, this concentration raises generalizability concerns. Are findings from Indonesian contexts transferable to institutions in North America, Europe, or sub-Saharan Africa? The underrepresentation of African and Latin American perspectives represents not merely a bibliometric curiosity but a substantive gap limiting the field's global applicability.

Thematic cluster analysis partially supports Hypothesis 2 regarding temporal evolution. The emergence of machine learning (Cluster 2, n=23) and learning analytics (Clusters 5 and 6) as distinct clusters indicates growing attention to analytical capabilities—yet these clusters remain substantially smaller than the dominant Cluster 4 (n=415) focused on traditional information systems, e-learning, and data mining. The positioning of “machine learning” as an emerging/declining theme on the thematic map (Figure 5) suggests this topic has not yet achieved mainstream integration within campus information systems research.

Hypothesis 3 receives strong support from the findings. Keywords directly related to statistical dashboards and business intelligence appear with minimal frequency across the dataset. Terms like “dashboard,” “business intelligence,” “real-time analytics,” “data visualization,” and “decision support” did not rank among top keywords. The dominance of technical implementation terms—“web application,” “web service,” “software development”—confirms that the literature emphasizes system construction over analytical capability deployment. This gap represents both a limitation of current scholarship and an opportunity for future research.

The citation distribution reveals characteristic patterns of scientific impact concentration. With 32.6% of publications receiving zero citations and only 2.8% exceeding 50 citations, the field exhibits typical bibliometric inequality. Notably, the most-cited works (Samaha, 2016; Hawi, 2016) address smartphone addiction and its effects on academic performance—topics tangentially related to campus information systems per se. This suggests that the field's highest-impact contributions emerge at intersections with behavioral and psychological research rather than from purely technical system studies.

The correlation between citations and article age ($r = 0.2761$, $R^2 = 0.0762$) indicates that publication timing explains less than 8% of citation variance. This weak relationship suggests that intrinsic article quality, topic relevance, and author networks substantially influence citation accumulation beyond mere temporal availability for citing.

5.2. Theoretical Implications

The findings carry implications for theoretical frameworks guiding campus information systems research. The Technology Acceptance Model and its variants feature prominently in the literature (Wandira et al., 2024; Daim et al., 2024; Netinant et al., 2025), yet the thematic clusters suggest opportunities for integrating theories from adjacent domains.

First, the emergence of learning analytics clusters indicates potential for incorporating learning sciences frameworks into campus information systems research. Theories of self-regulated learning, as Liu and Hung (2025) begin to explore, could inform dashboard design principles that support student metacognition rather than merely reporting performance metrics.

Second, the security and governance literature (Utama & Nurhadi, 2024; Destriani & Putra, 2025; Nurbojatmiko et al., 2024) operates largely independently from user experience studies (Almseidein, 2024; Pritalia et al., 2025). Theoretical frameworks bridging these domains—perhaps drawing on sociotechnical systems theory—could illuminate how security requirements interact with usability to shape overall system effectiveness.

Third, the weak silhouette score (0.2147) for thematic clustering suggests that research streams remain insufficiently differentiated. The field would benefit from more explicit theoretical positioning distinguishing studies focused on technical architecture, user behavior, institutional governance, and analytical capabilities. Currently, these concerns intermingle in ways that impede cumulative knowledge building.

5.3. Integration with Previous Literature

The findings align with and extend previous systematic reviews while revealing distinctive patterns. Consistent with Das and Chakraborty (2025), this analysis confirms that information systems have fundamentally transformed educational information management, storage, retrieval, and dissemination. The collaboration index of 3.03 authors per document reflects the interdisciplinary nature Das and Chakraborty emphasize, requiring expertise spanning computer science, education, and organizational management.

The dominance of conference proceedings (58.3%) over journal articles (34.0%) diverges from patterns in more established information systems research domains, where journal publication typically predominates. This distribution more closely resembles emerging technology fields where rapid dissemination through conferences takes priority over the slower journal review process. As the field matures, a shift toward journal publication might be expected—and would likely increase citation impacts given the higher average citations observed for journal articles in this dataset.

The geographic findings complement Daim et al.'s (2024) Turkish context study by demonstrating that campus information systems research extends far beyond Western contexts. The Indonesian dominance particularly resonates with studies by Iskandar et al. (2024) on Indonesian vocational school registration systems and Rozas et al. (2025) on Indonesian higher education data reporting processes. These works illustrate how national policy initiatives can catalyze substantial research output.

However, the comparative absence of business intelligence and statistical dashboard research stands in tension with the growing emphasis on data-driven decision-making that Taufik et al. (2025) and Fatkuroji et al. (2025) advocate. This disconnect between practitioner needs and scholarly attention constitutes perhaps the most significant finding of this bibliometric review.

5.4. Practical Implications

For university administrators, the findings suggest that while technical expertise for implementing academic information systems is widely available in the literature, guidance on deploying analytical dashboards remains scarce. Institutions seeking to enhance decision-support capabilities cannot simply adopt approaches validated in peer-reviewed research—such approaches remain largely undeveloped. This implies either need for internal innovation or engagement with vendors whose products incorporate business intelligence features not yet extensively studied in academic literature.

For information technology professionals developing or maintaining campus systems, the thematic clusters highlight proven approaches to technical implementation, user experience optimization, and security hardening. The concentration of publications in conference proceedings indicates that professional conferences represent valuable venues for accessing cutting-edge implementation knowledge.

For researchers, the identified gaps suggest promising directions for future scholarship. Studies examining dashboard design for academic decision-making, real-time analytics integration with student information systems, and predictive modeling for resource allocation would address underexplored areas while meeting evident institutional needs. The weak thematic cluster separation further suggests opportunities for synthesis studies bridging currently disconnected research streams.

6. Conclusion

This bibliometric analysis of 749 publications from 2010 to 2025 unveils critical insights into the evolution of campus information systems research—and exposes a troubling disconnect. The field demonstrates statistically significant growth ($\beta = 2.54$, $p = 0.00135$, $R^2 = 0.5317$) with geographic concentration in Indonesia (26.1%), robust collaborative practices (83.2% multi-author publications), and accumulated scholarly impact totaling 6,039 citations. Nine thematic clusters emerged from k-means analysis, revealing mature research streams in technical implementation, user experience, and notably, system security. Studies employing PTES, OWASP, COBIT, and ISO 27001 frameworks demonstrate that security-conscious scholarship has advanced considerably—achieving intrusion detection accuracies of 83% and establishing governance benchmarks for protecting sensitive academic data.

Yet here lies the paradox. Monolithic architectures—which remain prevalent across university information systems worldwide—offer inherent security advantages that microservices-based alternatives struggle to match: centralized authentication eliminates credential fragmentation, unified access control simplifies policy enforcement, and consolidated data repositories enable comprehensive audit trails. These architectural characteristics make monolithic systems naturally suited for safeguarding sensitive student records. However, fewer than 10% of reviewed publications address how institutions can leverage these security strengths while simultaneously deploying statistical dashboards and business intelligence capabilities. The research community has, in effect, solved the security puzzle but left the analytics integration challenge largely untouched.

This study contributes a comprehensive bibliometric foundation for understanding the intellectual structure of campus information systems research. The quantitative characterization of publication trends, geographic distributions, author productivity, source patterns, and thematic clusters provides researchers with an objective map of the field's development through 2025. The identification of statistical dashboard and business intelligence as underexplored areas directs attention toward gaps warranting future investigation. Methodologically, the integration of Bradford's Law, Lotka's Law, and k-means clustering demonstrates how multiple bibliometric techniques can be combined to yield rich characterizations of research domains.

Several limitations warrant acknowledgment. First, reliance on Scopus as the sole data source may exclude relevant publications indexed only in Web of Science, Google Scholar, or regional databases. Second, the search query—while comprehensive—may miss studies using alternative terminology for campus information systems. Third, the 2025 publication count remains partial due to the October retrieval date. Fourth, citation counts for recent publications have not yet stabilized, potentially underestimating the impact of newer works. Fifth, the weak silhouette score (0.2147) for thematic clustering indicates moderate cluster quality, suggesting alternative clustering approaches might yield different thematic structures.

Future scholarship must urgently address how secure monolithic campus information systems can incorporate real-time analytical dashboards without compromising data protection frameworks. Empirical studies examining dashboard deployment within security-hardened architectures, comparative analyses of analytics integration approaches across monolithic versus distributed systems, and longitudinal tracking of institutions balancing security compliance with business intelligence adoption would substantially advance both theory and practice. The ultimate goal remains clear: transforming accumulated academic data into actionable strategic insights while preserving the trustworthiness that makes these systems worthy repositories of sensitive information.

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