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Developing an Integrated Quality Assurance Information System Framework for High Schools: A Systematic Literature Review

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Abstract: Quality assurance (QA) in high schools increasingly depends on digital information systems; however, fragmented processes, limited interoperability, and inadequate data integration constrain evidence-based decision-making and continuous improvement. This study aimed to develop an integrated Quality Assurance Information System (QAIS) framework to support digital quality assurance and continuous improvement in high schools. A systematic literature review (SLR) was conducted following PRISMA 2020 guidelines. Twenty-six peer-reviewed studies published between 2020 and 2025 were selected from six databases. Data were extracted using a structured matrix and analyzed through thematic synthesis to identify recurring challenges, requirements, and design principles. The synthesized findings were subsequently translated into functional requirements, organized into ten integrated components, and mapped onto a five-layer system architecture. The findings revealed six major challenges: fragmented information systems, manual QA procedures, limited interoperability, inadequate digital infrastructure and competencies, weak data governance, and insufficient use of advanced analytics. In response, the proposed framework integrates QA processes, institutional information systems, centralized data management, interoperability, governance, and AI-assisted decision support. Its main contribution is a unified, modular, and scalable architecture that connects the entire QA lifecycle, from quality planning and monitoring to evaluation and continuous improvement. The framework provides a conceptual and practical foundation for data-driven quality assurance in high schools, particularly in resource-constrained contexts. However, it has not yet been empirically validated and requires prototype development, pilot implementation, and evaluation in authentic educational settings.

Keywords: Artificial intelligence; High school; Information system; Interoperability; Quality assurance

Introduction

Quality assurance (QA) is an essential component of high-school management because it supports accountability, institutional effectiveness, and continuous improvement. Effective QA depends on structured processes for planning, monitoring, evaluation, and improvement across academic and administrative activities (Fransistya, Hadi, & Sulaiman, 2022; Widodo, Riyanto, & Roesminingsih, 2020). Widodo et al. (2020) emphasized that leadership commitment, collaborative planning, curriculum review, and regular monitoring strengthen internal academic QA in secondary education, whereas Fransistya et al. (2022) reported that documented standards, systematic supervision, and self- and peer-evaluation are required in vocational schools.

Digital transformation has also reshaped how high schools manage information. Educational information systems (EIS), including the Educational Management

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Information System (EMIS), Student Information System (SIS), School Management Information System (SMIS), and Learning Management System (LMS), support the management of institutional data, student records, administration, and learning activities (Pushpakumara, Prasad, & Wanniarachchige, 2020; Rahmatullah & Mubarok, 2025). EMIS in particular provides information for planning, resource allocation, and performance monitoring (Mbawala, Lestari, & Mwakalindile, 2024; Rahmatullah & Mubarok, 2025), while web-based school information systems reduce manual record keeping and accelerate access to information (Firmansyah, Setiyawan, & Turmudi, 2024; Lontaan & Sinadia, 2024).

Despite these developments, quality assurance (QA) in high schools often remains fragmented and insufficiently integrated with institutional information systems. Previous studies have identified several barriers, including inadequate ICT infrastructure, limited technical capacity, poor connectivity, insufficient user training, incomplete data, and weak system integration (Ariko, 2024; Leta et al., 2024; Mbawala et al., 2024). In addition, institutions frequently operate multiple independent applications that maintain overlapping records, resulting in data duplication, inconsistent information, and limited data sharing (Pushpakumara et al., 2020; Sunarjo et al., 2024). These challenges indicate that the availability of educational information systems does not necessarily ensure their effective integration into institutional quality assurance processes.

A closer examination of previous studies reveals important differences in their scope and contributions. Research on internal quality assurance in secondary and vocational education has primarily emphasized institutional planning, standards, supervision, self-assessment, monitoring, and evaluation (Fransistya et al., 2022; Widodo et al., 2020). Although these studies provide valuable insights into QA practices, their primary focus is on quality management processes rather than the development of an integrated digital information system connecting these activities. Similarly, research on educational management information systems (EMIS) has demonstrated their contribution to institutional planning, resource management, administrative efficiency, and performance monitoring (Mbawala et al., 2024; Rahmatullah & Mubarok, 2025). However, the reviewed studies do not establish how these functions can be systematically connected to the complete QA lifecycle. School information systems (SIS/SMIS) and web-based administrative applications primarily facilitate student records, institutional administration, communication, and information management (Firmansyah et al., 2024; Lontaan & Sinadia, 2024; Sunarjo et al., 2024). Likewise, learning management systems (LMS) mainly support teaching, learning activities, and learning-related data. Consequently, although these systems provide important institutional information, their individual functional scopes do not necessarily encompass quality planning, standards management, self-assessment, evidence management, accreditation, corrective actions, and continuous improvement within a unified QA environment.

Enterprise architecture approaches provide another relevant perspective. For example, Pushpakumara et al. (2020) applied the TOGAF approach to quality assurance architecture in higher education institutions, demonstrating the relevance of architectural principles for integrating institutional processes, applications, and data. Nevertheless, this work addresses a higher education context and does not establish a comprehensive, high-school-specific architecture integrating the full QA lifecycle with EMIS, SIS, LMS, and AI-assisted decision support. Similarly, digital transformation frameworks emphasize organizational readiness, leadership, governance, infrastructure, and digital competencies (Mabotha & Ngcamu, 2025; Shafiq & Jan, 2025; Tiwari, 2024), but their general orientation provides limited specification of the functional requirements and operational architecture of an integrated QAIS for high schools. Furthermore, although artificial intelligence offers opportunities for predictive analytics, trend identification, and risk detection, its systematic integration into the complete institutional QA process remains insufficiently addressed in the reviewed literature (Mbawala et al., 2024; Rahmatullah & Mubarok, 2025).

Taken together, these studies provide important but complementary contributions to educational quality assurance, institutional information management, enterprise architecture, and digital transformation. However, within the scope of the literature reviewed in this study, no single identified approach sufficiently brings these dimensions together in a unified, modular, and interoperable QAIS framework specifically designed to support the complete quality assurance lifecycle in high schools. This conclusion does not imply that individual elements are absent from previous research; rather, it reflects the lack of their comprehensive integration within the reviewed studies. Accordingly, five interconnected research gaps are identified: (1) fragmentation between QA processes and institutional information systems; (2) insufficient consolidation of functional and non-functional requirements for an integrated QAIS; (3) the absence of a comprehensive, high-school-oriented architectural framework connecting QA processes, institutional databases, and existing educational information systems; (4) limited integration of AI-assisted analytics

and decision support into the complete QA lifecycle; and (5) insufficient implementation guidance for schools operating under different levels of digital infrastructure and institutional capacity. These gaps are derived from the comparative synthesis of the reviewed literature and are further operationalized through the pr

Research on digital transformation describes it as a continuous, strategic institutional process that integrates people, processes, technologies, and data rather than a technology project (Roy, 2025; Shafiq & Jan, 2025; Sharipova, 2025). It improves administrative efficiency, institutional responsiveness, and data-driven management (Ilyas, Wahab, Imran, Mahluddin, & Asmawati, 2025; Mabotha & Ngcamu, 2025), and supports adaptability, collaboration, and continuity during crises (Alsulami, 2025; Lyngdorf, Jiang, & Du, 2024; Zhang & Rathakrishnan, 2024). However, transformation is constrained by limited infrastructure, scarce resources, insufficient digital competencies, resistance to change, and cybersecurity concerns (Shafiq & Jan, 2025), and existing transformation frameworks rarely address QA specifically (Mabotha & Ngcamu, 2025; Tiwari, 2024).

Artificial intelligence (AI) offers further opportunities for predictive analytics, trend analysis, anomaly detection, and risk identification using the data that EIS generate (Mbawala et al., 2024; Rahmatullah & Mubarok, 2025). The reviewed studies indicate, however, that current QA practice remains largely descriptive and retrospective and that AI is rarely integrated into QA systems. Successful adoption depends on reliable data, interoperable systems, adequate infrastructure, skilled personnel, and data governance (Mbawala et al., 2024; Rahmatullah & Mubarok, 2025).

Overall, the reviewed studies examine QA, EIS, enterprise architecture, and digital transformation largely as separate domains, and none proposes a comprehensive information system that integrates QA processes, institutional data, interoperability, governance, digital technologies, and intelligent decision support for high schools (Fransistya et al., 2022; Pushpakumara et al., 2020; Widodo et al., 2020). This produces five research gaps: fragmentation, requirements integration, architectural integration, intelligent decision support, and contextual implementation guidance for resource-constrained settings (Table 1).

Therefore, this study aims to develop an evidence-based and integrated Quality Assurance Information System (QAIS) framework specifically designed to support digital quality assurance and continuous quality improvement in high schools. Unlike approaches that address quality assurance, educational information systems, and digital transformation as separate domains, this study focuses on systematically integrating their requirements into a unified architecture that supports the complete QA lifecycle.

Table 1. Research gaps identified in the reviewed literature and the corresponding QAIS framework responses

Identified research gap	QAIS framework response
Fragmentation of QA processes and educational information systems	Integrated QA workflow
Lack of consolidated functional and non-functional requirements	Systematic requirement identification and consolidation
Absence of an integrated architectural framework	Modular, scalable, and interoperable QAIS architecture
Limited use of AI and predictive analytics in QA	AI and Decision Support Layer
Limited guidance for resource-constrained contexts	Comprehensive evidence-based QAIS framework

Note. Developed by the authors based on the thematic synthesis of the 26 reviewed studies.

The specific objectives are: (1) to identify and synthesize QA practices, educational information systems (EIS), digital transformation approaches, implementation challenges, and research gaps reported in the literature; (2) to derive and consolidate the functional and non-functional requirements of an integrated QAIS; (3) to develop a modular, scalable, and interoperable architecture that connects high-school QA processes with existing institutional information systems, centralized data management, governance, and digital infrastructure; and (4) to incorporate data analytics and AI-assisted decision support into the QA lifecycle while maintaining human oversight.

Four research questions guide the study: (RQ1) What QA practices, EIS, digital transformation approaches, challenges, and research gaps are reported in the literature? (RQ2) What functional and non-functional requirements can be derived from the reviewed studies for an integrated QAIS? (RQ3) How can these requirements be organized into a unified architecture that connects QA processes, institutional information systems, data management, interoperability, governance, and digital infrastructure in high schools? (RQ4) How can data analytics and AI-assisted decision support be integrated into the proposed framework to strengthen evidence-based decision-making and continuous quality improvement?

The main scientific contribution of this study is the systematic translation of literature-derived quality assurance requirements into a unified, high-school-oriented Quality Assurance Information System (QAIS) architecture. Rather than introducing entirely new

technologies or architectural principles, the proposed framework distinguishes itself through the integration of established approaches into a coherent structure specifically organized around the complete QA lifecycle in high schools.

Its distinctive contribution lies in four aspects. First, it connects quality planning, standards management, self-assessment, monitoring, accreditation, evidence management, corrective actions, and continuous improvement within one integrated digital environment. Second, it establishes a structured relationship between these QA functions and existing educational information systems, including EMIS, SIS, SMIS, and LMS, allowing institutions to use their existing data sources rather than replace their operational systems. Third, it combines centralized data management, interoperability, institutional governance, and digital infrastructure within a five-layer architecture. Fourth, it incorporates AI-assisted analytics and decision support as an additional capability for identifying trends, detecting anomalies, predicting risks, and recommending improvements, while retaining human authority over institutional decisions.

Compared with traditional QA models, general enterprise architecture approaches, and operational educational information systems, the proposed framework provides a more comprehensive integration of QA requirements, institutional data, and intelligent decision support within a single high-school-oriented architecture. Practically, it offers a modular implementation roadmap that can be adapted to different levels of institutional readiness and digital infrastructure. The framework is conceptual and represents a basis for subsequent prototype development, pilot implementation, and empirical evaluation.

Method

Research Design

This study combined a systematic literature review (SLR) with conceptual framework development. The design was selected because the aim was not to evaluate an existing system but to synthesize existing knowledge into an evidence-based framework. The review was reported following the PRISMA 2020 statement (Page et al., 2021), which provides a transparent and reproducible procedure for identifying, screening, assessing the eligibility of, and including studies. As shown in Figure 1, the research proceeded in four phases: (1) problem identification and research planning; (2) the SLR, including study selection and data extraction; (3) data synthesis and requirement analysis; and (4) framework development, in which the identified requirements were integrated into a modular QAIS framework.

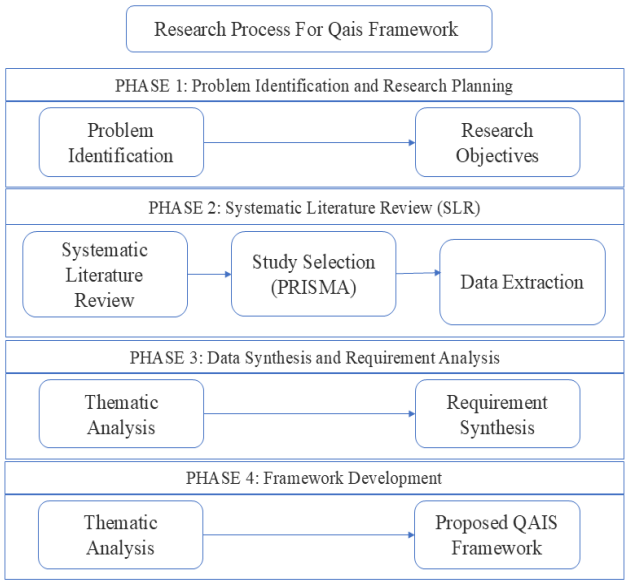


Figure 1. Overall research process adopted to develop the proposed QAIS framework

Search Strategy and Study Selection

The systematic search across six electronic databases identified 60 records for potential inclusion in the review. Following the screening process and assessment of eligibility against the predefined criteria, 26 studies were retained for the final synthesis. These studies constituted the evidence base for identifying and examining the challenges associated with the research topic. The remaining records were not included in the final synthesis because they did not meet the established eligibility requirements or were otherwise excluded during the screening process. To improve transparency and reproducibility, the selection process should be presented in a PRISMA flow diagram, specifying the number of records identified, duplicates removed, records excluded during title and abstract screening, full-text articles assessed, and full-text articles excluded with reasons.

The review period was defined as 2020–2025. Accordingly, publications dated 2026 were not considered eligible for inclusion in the 26-study review corpus. Any 2026 publications cited in the manuscript were used only as supplementary contextual references and were not included in the systematic data extraction or thematic synthesis. The final evidence base therefore comprised 26 eligible studies published within the specified review period.

Selection followed the four PRISMA stages of identification, screening, eligibility assessment, and inclusion (Figure 2). The initial search retrieved 60 records. After duplicates were removed, titles and

abstracts were screened, and publications unrelated to high-school QA, EIS, digital transformation in education, or framework development were excluded. Full texts were then assessed, and articles were excluded if they did not address the research objectives, lacked sufficient methodological quality, were not peer-reviewed journal articles, or were published outside 2020–2025. In total, 26 studies met all criteria and were included in the qualitative synthesis. They covered five domains (Table 2), with digital transformation in education (eight studies) and EMIS (seven studies) the most frequent.

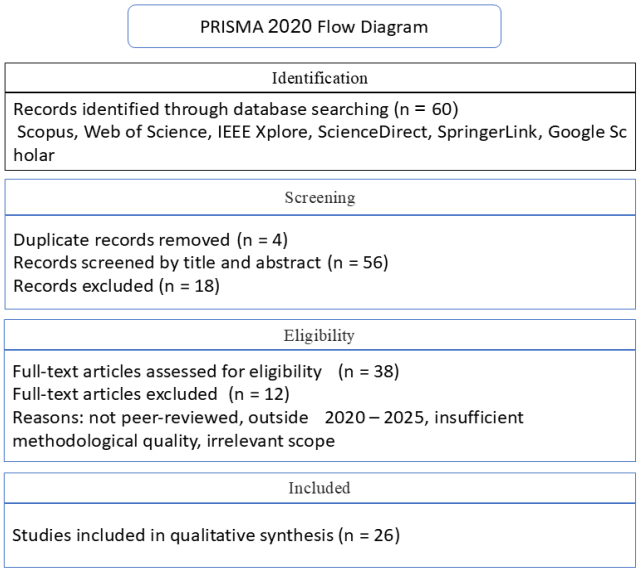


Figure 2. PRISMA 2020 flow diagram of the study selection process (identification, duplicate removal, screening, eligibility assessment, and inclusion of 26 studies)

Table 2. Distribution of the selected studies by research domain

Research domain	Studies	Paper IDs
Quality assurance in education	4	P01–P04
Educational management information systems (EMIS)	7	P05–P11
School information systems (SIS/MIS)	3	P12–P14
Digital transformation in education	8	P15–P22
Digital transformation frameworks	4	P23–P26
Total	**26**	**P01–P26**

Note. Developed by the authors based on the systematic literature review.

Data Extraction and Analysis

Each included study was analyzed using a structured extraction form (Table 3), and the data were organized in Microsoft Excel for systematic comparison. Studies were coded P01–P26 for traceability. Thematic synthesis was then applied to identify recurring concepts, which yielded four dimensions that informed the framework: technology (digital infrastructure, EIS, interoperability, cloud computing, data analytics, and AI); human (digital literacy, staff training, leadership commitment, and stakeholder participation); process (quality planning, monitoring, evaluation, documentation, and continuous improvement); and governance (institutional policies, standards, cybersecurity, accountability, and strategic management).

Table 3. Data extraction matrix used in the systematic literature review

Paper ID	Research domain	Extracted functional requirements supported by the manuscript	Requirement category
P01	Quality assurance in education	User and access management; quality planning; self-assessment; monitoring; accreditation; document management; continuous improvement	Functional
P02	Quality assurance in education	User and access management; quality planning; continuous improvement	Functional
P03	Quality assurance in education	User and access management; quality planning; self-assessment; accreditation; continuous improvement	Functional
P04	Quality assurance in education	Accreditation management; document and evidence management; system integration; continuous improvement	Functional
P05	EMIS	Monitoring and performance measurement; reporting and dashboards; system integration; AI-assisted decision support	Functional
P06	EMIS	Monitoring and performance measurement; reporting and dashboards	Functional
P07	EMIS	Reporting and dashboards; system integration; AI-assisted decision support	Functional
P08	EMIS	No individual framework component is explicitly mapped to this study in the manuscript	Not individually specified

Paper ID	Research domain	Extracted functional requirements supported by the manuscript	Requirement category
P09	EMIS	Monitoring and performance measurement	Functional
P10	EMIS	Document and evidence management; system integration	Functional
P11	EMIS	System integration and interoperability	Functional
P12	School information systems (SIS/MIS)	No individual framework component is explicitly mapped to this study in the manuscript	Not individually specified
P13	School information systems (SIS/MIS)	AI-assisted analytics and decision support	Functional
P14	School information systems (SIS/MIS)	System integration; AI-assisted decision support	Functional
P15	Digital transformation in education	No individual framework component is explicitly mapped to this study in the manuscript	Not individually specified
P16	Digital transformation in education	AI-assisted analytics and decision support	Functional
P17	Digital transformation in education	No individual framework component is explicitly mapped to this study in the manuscript	Not individually specified
P18	Digital transformation in education	No individual framework component is explicitly mapped to this study in the manuscript	Not individually specified
P19	Digital transformation in education	AI-assisted analytics and decision support	Functional
P20	Digital transformation in education	System integration and interoperability	Functional
P21	Digital transformation in education	User and access management; reporting and dashboards	Functional
P22	Digital transformation in education	User and access management; quality planning; reporting and dashboards; AI-assisted decision support	Functional
P23	Digital transformation frameworks	AI-assisted analytics and decision support	Functional
P24	Digital transformation frameworks	No individual framework component is explicitly mapped to this study in the manuscript	Not individually specified
P25	Digital transformation frameworks	Self-assessment; monitoring; accreditation; document management; continuous improvement	Functional
P26	Digital transformation frameworks	No individual framework component is explicitly mapped to this study in the manuscript	Not individually specified

Note. Developed by the authors based on the data extraction of the 26 selected studies.

Validity and Reliability

The methodological rigour of this study was supported by a predefined review protocol covering the search strategy, inclusion and exclusion criteria, study selection, and standardized data extraction procedures. Reliability was enhanced by applying consistent extraction categories (Table 3) to all 26 included studies and conducting thematic synthesis and comparative analysis to identify recurring patterns. However, these procedures establish consistency in the review process rather than independently demonstrating the

methodological quality of the included studies. Accordingly, the methodological quality of the selected studies should be assessed using an appropriate critical appraisal tool, with the assessment criteria and results reported transparently. The proposed framework was developed by translating recurring findings from the reviewed literature into functional and non-functional requirements. Mapping its components to published evidence establishes literature-based justification and conceptual traceability, but does not constitute independent or empirical validation. Therefore, the framework should be regarded as a literature-grounded conceptual model requiring prototype development, expert assessment, pilot implementation, and empirical evaluation in real high-school settings.

Result and Discussion

Synthesis of the Review Findings

The synthesis of the 26 included studies revealed several interconnected challenges affecting the implementation of quality assurance (QA) and digital information systems in educational institutions. Although the reviewed studies addressed educational QA, educational management information systems (EMIS), school management information systems (SMIS), student information systems (SIS), learning management systems (LMS), and digital transformation, their contributions were generally concentrated on individual processes or technological components rather than an integrated architecture supporting the complete QA lifecycle in high schools.

Six major challenges emerged from the thematic synthesis: (1) fragmentation of institutional information systems; (2) reliance on manual and partially digital QA procedures; (3) limited interoperability and data integration; (4) inadequate ICT infrastructure and digital competencies; (5) weaknesses in data governance and information security; and (6) limited application of advanced analytics and artificial intelligence in QA decision-making.

These challenges are interconnected rather than independent. Fragmented information systems and limited interoperability restrict the availability and consistency of institutional data. Similarly, inadequate infrastructure and insufficient digital competencies constrain the effective adoption of integrated systems. Weak data governance creates additional concerns regarding information reliability, security, and accountability. Consequently, the limited availability of integrated and reliable data also restricts the application of advanced analytics and evidence-based decision-making.

A comparative examination of the reviewed literature indicates that educational QA studies primarily emphasize planning, supervision, evaluation, accreditation, and continuous improvement (Fransistya et al., 2022; Widodo et al., 2020). In contrast, studies focusing on EMIS and related information systems emphasize institutional data management, reporting, and administrative efficiency (Mbawala et al., 2024; Rahmatullah & Mubarok, 2025; Sunarjo et al., 2024). Digital transformation studies further highlight organizational readiness, infrastructure, digital competencies, governance, and leadership as important conditions for successful technology adoption (Ariko, 2024; Leta et al., 2024; Shafiq & Jan, 2025). This comparison suggests that the principal research gap is not the absence of individual QA or information system solutions, but the limited integration of these capabilities into a unified framework for high-school quality management.

Table 6 summarizes the major challenges, their supporting literature, the nature of the evidence, and their implications for the proposed framework. The distinction between directly reported findings and authors' interpretations is maintained to avoid presenting analytical conclusions as findings explicitly established by individual studies.

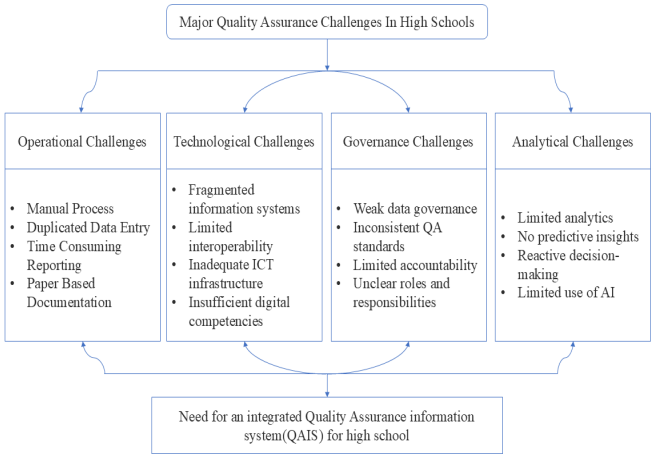


Figure 3. Major QA challenges in high schools and the need for an integrated QAIS

Framework Development Process

The framework was developed in six phases (Figure 4). First, the SLR established the theoretical foundation. Second, information was extracted using the standardized matrix. Third, thematic synthesis and comparative analysis organized recurring concepts into six domains: QA processes, governance, interoperability, digital infrastructure, data management, and decision support. Fourth, the extracted requirements were translated into functional modules. Fifth, the modules were integrated into a unified architecture that supports the QA lifecycle from planning to continuous improvement. Finally, the

framework was conceptually validated by mapping each component to evidence in the reviewed studies, which ensures consistency between the literature and the design. This procedure is transparent and reproducible, but it does not replace empirical validation.

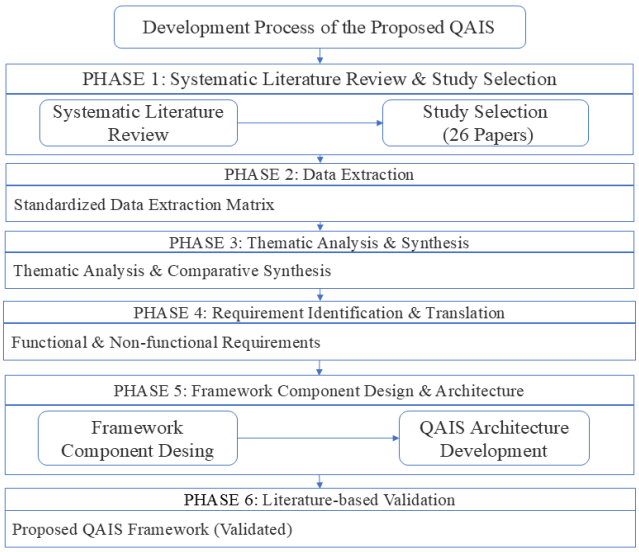


Figure 4. Development process of the proposed QAIS framework

Design Principles

Seven complementary principles guided the design (Figure 5). Quality-centered design places the QA cycle of planning, implementation, monitoring, evaluation, reporting, and improvement at the center, so that the system acts as a quality management platform rather than only an administrative system. Data-driven decision making relies on centralized quality indicators, records, assessment results, and performance data. Integration and interoperability address fragmented systems by connecting EMIS, SIS, LMS, and other databases. User-centered design supports role-based access, collaborative workflows, and intuitive interfaces for administrators, teachers, QA committees, students, and external reviewers. Scalability and flexibility allow gradual, modular implementation in schools with different capacities. Security and governance provide authentication, authorization, audit trails, role-based access control, and data governance. AI-assisted decision support complements, rather than replaces, human expertise by identifying trends, detecting anomalies, supporting prediction, and recommending improvements.

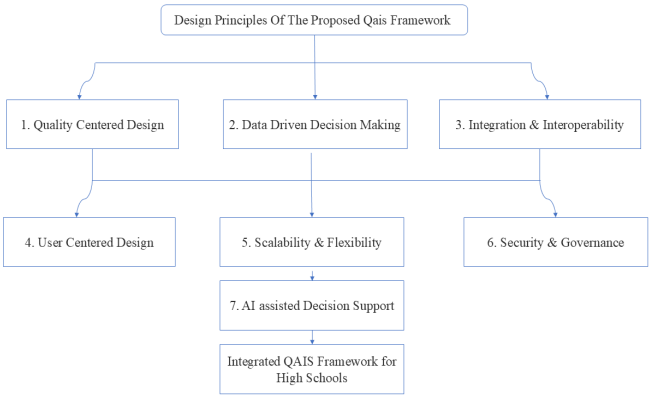


Figure 5. Design principles of the proposed QAIS framework

Layered Architecture

The proposed QAIS adopts a five-layer architecture (Figure 6). The Presentation Layer gives role-based access to school leadership, the QA office, teachers, departments, students, external reviewers, and system administrators through dashboards, web portals, and mobile interfaces. The Application Layer contains the functional modules for quality planning, standards management, self-assessment, monitoring, evaluation, accreditation, corrective actions, document management, and reporting. The Data Management Layer is the centralized repository that integrates QA records with academic, student, staff, financial, and document databases, which improves consistency, integrity, and traceability. The Integration Layer links QAIS with SIS, LMS, EMIS, human resource management systems (HRMS), financial systems, and other databases to minimize duplicate data entry. The AI and Decision Support Layer converts institutional data into actionable knowledge through predictive analytics, performance analysis, quality indicators, risk prediction, recommendation services, and business intelligence, while human decision-makers retain authority.

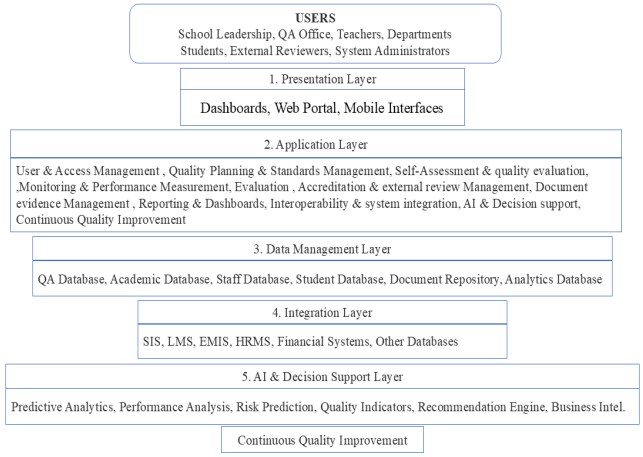


Figure 6. Layered architecture of the proposed QAIS framework

Functional Components

The framework comprises ten integrated components derived from the functional requirements identified in the review.

1. User and access management. Provides authentication and role-based authorization for school leadership, the QA office, teachers, administrators, students, and external reviewers, which improves security, accountability, and participation.

2. Quality planning and standards management. Manages quality objectives, standards, indicators, and accreditation requirements and aligns internal processes with national regulations and school policies.

3. Self-assessment and quality evaluation. Allows departments to evaluate performance against predefined criteria, identify strengths and weaknesses, and prepare for external review.

4. Monitoring and performance measurement. Records quality indicators, tracks progress toward objectives, and enables early corrective action.

5. Accreditation and external review management. Handles evaluation schedules, compliance monitoring, evidence submission, reviewer comments, and accreditation reports.

6. Document and evidence management. Provides a centralized repository with version control for policies, procedures, reports, minutes, and supporting evidence.

7. Reporting and dashboards. Transforms institutional data into interactive dashboards, visualizations, and automated reports.

8. Interoperability and system integration. Connects SIS, LMS, EMIS, HRMS, financial systems, and other databases to improve data consistency.

9. AI and decision support. Performs predictive analytics, trend analysis, anomaly detection, risk prediction, and recommendation generation under human oversight.

10. Continuous quality improvement. Consolidates monitoring results, evaluation findings, stakeholder feedback, accreditation recommendations, and AI-generated insights into improvement plans whose implementation is monitored over time.

Table 4. Comparative Synthesis of Major Challenges and Their Implications for QAIS

Major challenge	Supporting studies	Evidence classification	Implication for QAIS development
Fragmented information systems and duplicated data	Pushpakumara et al. (2020); Sunarjo et al. (2024); Rahmatullah and Mubarok (2025)	Reported findings and cross-study synthesis	Centralized data management and integration of existing institutional systems
Manual and partially digital QA procedures	Fransistya et al. (2022); Widodo et al. (2020); Firmansyah et al. (2024)	Partly reported; broader interpretation by the authors	Digital QA workflows, automated documentation, and continuous monitoring
Limited interoperability and data integration	Ariko (2024); Leta et al. (2024); Mbawala et al. (2024); Sunarjo et al. (2024)	Reported findings and cross-study synthesis	Interoperability mechanisms and integration with EMIS, SIS, LMS, and HRMS
Inadequate ICT infrastructure and digital competencies	Ariko (2024); Leta et al. (2024); Mbawala et al. (2024); Shafiq and Jan (2025)	Reported findings	Scalable architecture, user training, and gradual implementation
Weak data governance and information security	Mbawala et al. (2024); Shafiq and Jan (2025); Rahmatullah and Mubarok (2025)	Reported concerns and authors' synthesis	Data governance policies, role-based access, privacy, and security controls
Limited use of advanced analytics and AI in QA	Mbawala et al. (2024); Rahmatullah and Mubarok (2025)	Reported limitations and authors' synthesis	AI-assisted analytics, predictive monitoring, and decision support under human oversight

Source: Developed by the authors based on the thematic synthesis of the reviewed literature.

The findings presented in Table 4 informed the development of the proposed QAIS framework. Specifically, the identified challenges were translated into functional requirements covering quality planning, self-assessment, performance monitoring, accreditation management, document and evidence management, reporting, system integration, decision support, and continuous improvement. Non-functional requirements included interoperability, security, data governance, scalability, reliability, and usability.

Importantly, the framework represents the authors' systematic interpretation and consolidation of requirements identified in the literature; it does not demonstrate that the proposed system has already resolved the reported challenges. Its effectiveness and practical applicability require subsequent prototype development, expert assessment, pilot implementation, and empirical evaluation.

Table 5 maps each component to the literature-derived requirements and supporting studies, which provides traceability between the review and the design.

Requirements repeated across several studies were treated as core design priorities. The mapping shows that the framework addresses the major requirements and the research gaps in Table 1 by combining QA, information systems, and digital transformation in one architecture.

Table 5. Mapping of QAIS components to literature-derived requirements

QAIS component	Literature-derived requirements	Supporting studies
1. User and access management	Leadership commitment; role-based access; stakeholder participation	P01, P02, P03, P21, P22
2. Quality planning and standards management	Quality planning; standards definition	P01, P02, P03, P22
3. Self-assessment and quality evaluation	Self-assessment; internal evaluation	P01, P03, P25
4. Monitoring and performance measurement	Continuous monitoring; performance measurement	P01, P05, P06, P09, P25
5. Accreditation and external review management	Accreditation; external evaluation	P03, P04, P25
6. Document and evidence management	Evidence management; document management	P01, P04, P10, P25
7. Reporting and dashboards	Data visualization; automated reporting	P05, P06, P07, P21, P22
8. Interoperability and system integration	System integration; interoperability; centralized data management	P04, P05, P07, P10, P11, P14, P20
9. AI and decision support	AI; predictive analytics; data security and privacy	P05, P07, P13, P14, P16, P19, P22, P23
10. Continuous quality improvement	Corrective actions; continuous improvement	P01, P02, P03, P04, P25

Note. Developed by the authors based on the requirements extracted from the 26 reviewed studies.

Operational Workflow

QAIS operates through a continuous, evidence-based workflow in which the output of each stage becomes the input of the next (Figure 7). The cycle starts with quality planning, where objectives, standards, accreditation requirements, and key performance indicators (KPIs) are set. In implementation and data collection, academic, administrative, financial, human resource, and student data are gathered from integrated systems into the central database. Self-assessment and monitoring then track performance against indicators, followed by evaluation and performance analysis that compare achievements with objectives.



Figure 7. Operational workflow of the proposed QAIS framework

The AI and decision-support stage identifies trends, predicts risks, detects anomalies, and generates recommendations. School leaders use these outputs for decision-making and corrective actions, including approving improvement plans and allocating resources. Continuous quality improvement monitors whether the actions are effective, and the final stage updates plans, standards, and KPIs, which starts a new cycle. The workflow thus converts QA from a periodic evaluation into a continuous, data-driven management process.

Main Findings and Comparison with Previous Studies

This study developed a conceptual QAIS framework from the synthesis of 26 peer-reviewed studies. The review shows that educational QA approaches concentrate on accreditation, compliance, and continuous improvement, whereas EIS mainly support administrative and operational functions. Although these systems generate valuable data, they are not designed to link QA processes with performance management and strategic decision-making in high schools. The challenges identified (Figure 1) and the research gaps (Table 1) are consistent with this picture.

These findings agree with previous research and extend it. Studies on educational QA emphasize planning, monitoring, evaluation, accreditation, and continuous improvement through approaches such as the Plan–Do–Check–Act (PDCA) cycle and internal QA systems (Fransistya et al., 2022; Widodo et al., 2020), but give limited attention to integration with information systems. Research on EMIS, SIS, and related systems demonstrates the value of centralized data management

and reporting (Mbawala et al., 2024; Pakaya et al., 2026; Rahmatullah & Mubarok, 2025), yet these systems mainly serve operational functions, so schools continue to face duplicated data and weak integration (Sunarjo et al., 2024). Digital transformation research shows that technology adoption alone is insufficient: organizational readiness, governance, digital competencies, stakeholder participation, and leadership are decisive (Ilyas et al., 2025; Mabotha & Ngcamu, 2025; Shafiq & Jan, 2025). Finally, although AI attracts growing attention for educational analytics, its integration into institutional QA remains limited (Rahmatullah & Mubarok, 2025).

Compared with these streams, the proposed framework adopts a broader perspective. Rather than treating QA, information systems, governance, interoperability, and AI separately, it combines them in a modular and scalable architecture in which existing systems become interconnected data sources within one QA ecosystem instead of being replaced.

Comparison with Existing Approaches and Information Systems

Traditional QA models such as the PDCA cycle and the Structure–Process–Outcome (SPO) model guide continuous improvement and evaluation but do not define a digital system architecture. Enterprise architecture approaches such as TOGAF offer principles for integrating processes, applications, data, and technology (Pushpakumara et al., 2020), although they are not designed specifically for educational QA. Digital transformation frameworks emphasize readiness, governance, and innovation (Tiwari, 2024), and AI-based educational systems demonstrate predictive analytics but are rarely integrated into the full QA process (Table 6).

Table 6. Comparison of the proposed QAIS framework with existing QA approaches

Approach	Main limitation	Contribution to QAIS
PDCA	Does not define a digital system architecture	Continuous improvement workflow
SPO model	Limited system and technology specification	Quality evaluation dimensions
TOGAF / enterprise architecture	Not designed specifically for educational QA	Layered architecture and interoperability
Digital transformation frameworks	General focus; limited QA specialization	Digital readiness and transformation principles
AI-based educational systems	Limited integration with complete QA processes	AI and decision-support layer
Proposed QAIS	Requires empirical implementation and validation	Unified evidence-based QA ecosystem

Note. Developed by the authors based on the review and comparative analysis.

Similarly, EIS provide valuable institutional data but are designed for specific operational functions (Table 7). QAIS is intended to complement rather than replace them by integrating their data into a centralized QA ecosystem, so that schools can use their existing digital infrastructure while gaining continuous quality monitoring and evidence-based decision support.

Table 7. Comparison of existing educational information systems with the proposed QAIS framework

System	Main limitation for QA	Role within QAIS
EMIS	Limited support for the complete QA lifecycle	Institutional data source
SMIS	Limited systematic quality evaluation	Operational data source
SIS	Narrow functional scope	Student performance data source
LMS	Limited institutional QA coverage	Learning analytics source
Integrated institutional IS	QA is not the primary objective	Institutional information source
Proposed QAIS	Requires empirical implementation and validation	Centralized QA ecosystem

Note. Developed by the authors based on the comparative synthesis of the reviewed studies.

Contributions and Implications

Scientifically, the study contributes an evidence-based conceptual framework that integrates QA processes, EIS, governance, interoperability, and AI in one architecture for high schools. It extends existing knowledge by combining educational QA and information systems, demonstrates how systematic synthesis can ground a conceptual architecture in published evidence, and provides a theoretical basis for future research on QAIS in high-school digital transformation. Technologically, the framework extends traditional QA systems with centralized data management, interoperability, dashboards, business intelligence, and an AI layer that preserves human oversight.

Practically, QAIS offers high schools a roadmap for digitalizing planning, monitoring, evaluation, accreditation management, document management, reporting, and improvement. Expected benefits include greater efficiency through less manual work and duplicated data entry, more consistent and reliable data, evidence-based decisions, improved transparency and accountability through centralized records and dashboards, and stronger collaboration among school leadership, the QA office, departments, teachers, students, and external reviewers. Its modular design lets schools with different capacities adopt components progressively.

For implementation, schools should treat QAIS as an institutional transformation initiative supported by leadership commitment, clear quality objectives, policies, and defined stakeholder responsibilities, together with appropriate infrastructure, secure data management, interoperability, cybersecurity, and integration with EMIS, SIS, LMS, and HRMS. The framework supports a shift from periodic assessment to a continuous cycle in which institutional data are collected, integrated, analyzed, and turned into corrective actions whose effectiveness is monitored and fed into the next planning cycle (Figure 7). Successful implementation, however, depends on institutional readiness and adaptation to the school context.

Limitations and Future Research

This study has four main limitations. First, the framework is conceptual and has not been implemented or empirically validated, so its effectiveness, usability, scalability, and feasibility remain untested. Second, it is based on 26 studies, so its scope reflects the contexts, methods, and limitations of that literature, which may not represent all high-school contexts. Third, schools differ in governance, policies, infrastructure, culture, human capacity, and digital maturity, so contextual adaptation may be required. Fourth, the practical value of AI depends on the availability, quality, security, and governance of institutional data and on technical infrastructure and human expertise.

Future research should develop a functional prototype and pilot it in selected high schools to evaluate usability, effectiveness, scalability, interoperability, and organizational feasibility. Studies should also investigate AI for predictive quality analytics, anomaly detection, risk identification, automated reporting, and improvement recommendations, with attention to data quality, privacy, transparency, fairness, explainability, and ethical governance. Comparative case studies across schools and contexts are recommended to examine adaptability and generalizability and to identify additional requirements.

Conclusion

This study developed an integrated conceptual Quality Assurance Information System (QAIS) framework for high schools through a systematic review of 26 peer-reviewed studies. The findings revealed that the effective implementation of digital quality assurance is constrained by fragmented information systems, manual procedures, limited interoperability, inadequate ICT infrastructure, weak data governance, insufficient digital competencies, and limited use of advanced analytics. These challenges highlight the need to integrate institutional information systems with systematic quality assurance processes.

The principal scientific contribution of this study is an evidence-based conceptual framework that consolidates literature-derived functional and non-functional requirements into a unified five-layer architecture comprising ten functional components. By connecting QA processes with existing systems, centralized data management, interoperability, institutional governance, and AI-assisted decision support, the framework provides a structured foundation for digital quality management and continuous improvement in high schools.

From a practical perspective, the proposed framework offers educational institutions a conceptual roadmap for strengthening quality monitoring, evidence management, institutional accountability, and data-informed decision-making. Its modular architecture also provides a basis for adapting implementation to different institutional capacities and technological environments.

Nevertheless, the framework remains conceptual, and its effectiveness has not yet been established. Future research should focus on prototype development, expert assessment, pilot implementation in selected high schools, and empirical evaluation. Such investigations are necessary to determine its usability, feasibility, scalability, and actual contribution to institutional quality assurance. Further research should also examine AI integration while addressing data quality, privacy, transparency, fairness, explainability, and ethical governance.

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Author Contributions

Conceptualization, N.K. and K.N.; methodology, N.K. and K.N.; investigation, N.K. and K.N.; writing—original draft preparation, N.K. and K.N.; writing—review and editing, N.K. and K.N. All authors have read and agreed to the published version of the manuscript.

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