



Design, Implementation, and Preliminary Evaluation of a Workflow-Oriented Information System for University Second-Classroom Aesthetic Education

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Abstract. University second-classroom aesthetic education often suffers from fragmented activity management, weak workflow traceability, and discontinuous participation records. To address these issues, this paper proposes a workflow-oriented information system for university second-classroom aesthetic education. Based on the requirement analysis of students, teachers, administrators, and student organizations, the proposed system adopts a three-layer architecture consisting of a presentation layer, a service layer, and a data layer. It integrates key functions including activity management, workflow control, participation recording, resource sharing, portfolio accumulation, and feedback support. A prototype system is implemented using a browser/server architecture with modular front-end interaction, RESTful service communication, relational data storage, and external media resource management. The system supports the full lifecycle of second-classroom activities, including submission, approval, publication, registration, attendance recording, artifact upload, and portfolio generation. A preliminary pilot evaluation is further conducted to examine process efficiency, participation effectiveness, system performance, and user experience. The results indicate that the proposed system improves workflow traceability, reduces coordination fragmentation, and strengthens the continuity of participation records. This study provides an implementation-oriented reference for the digital transformation of university aesthetic education.

Keywords: university aesthetic education; second-classroom activities; information system; workflow management; prototype implementation

1 Introduction

University aesthetic education is increasingly extending beyond formal classroom teaching into diversified second-classroom activities, such as exhibitions, workshops, lectures, competitions, student clubs, and community-based cultural practice. These activities play an important role in cultivating students' aesthetic literacy, artistic perception, cultural participation, and creative expression. However, in many universities, the

organization and digital support of second-classroom aesthetic education remain fragmented. Key processes, including activity submission, approval, publication, registration, attendance recording, resource sharing, outcome submission, and publicity dissemination, are often distributed across disconnected tools, temporary communication channels, and separate administrative procedures. As a result, workflow continuity is weak, participation records are difficult to accumulate, and the linkage between classroom teaching and extracurricular aesthetic practice remains limited^{[1][2]}.

From an information-system perspective, the core challenge is not simply the absence of digital tools, but the lack of an integrated platform capable of coordinating users, resources, processes, and data in a structured manner. In existing practice, students often face scattered participation entrances and discontinuous records of their aesthetic activities. Teachers lack efficient mechanisms for resource release, activity guidance, and classroom-extension management. Administrators and student organizations frequently rely on repeated manual confirmation for approval, scheduling, and supervision^[3]. These problems reduce management efficiency and weaken the long-term educational value of second-classroom activities because participation outcomes, submitted works, and reflective records are not effectively transformed into persistent digital assets.

Existing studies have discussed the educational value of second-classroom activities, collaborative education mechanisms, and the digital transformation of higher education. Nevertheless, relatively limited attention has been paid to the concrete design and implementation of information systems for university second-classroom aesthetic education. In particular, current research rarely provides an explicit computing-oriented description of system architecture, role-based interaction, workflow control, data organization, portfolio accumulation, and deployable service integration. As a result, many studies remain at the level of educational concepts or management discussion, while the role of computer technology in supporting process governance, data persistence, service coordination, and platform deployment is not sufficiently specified^[4].

To address this gap, this paper proposes a workflow-oriented information system for university second-classroom aesthetic education and studies it from the perspectives of requirement analysis, system design, prototype implementation, and preliminary evaluation. Based on the analysis of practical educational scenarios, the study identifies four major stakeholder groups, namely students, teachers, administrators, and student organizations, and abstracts their core service requirements in activity organization, process supervision, participation management, resource sharing, and outcome accumulation. On this basis, the paper designs a three-layer architecture composed of a presentation layer, a service layer, and a data layer, and implements key modules for identity and role governance, resource management, workflow orchestration, participation logging, portfolio generation, and feedback support^[5].

The main contributions of this paper are as follows. First, it translates practical problems in university second-classroom aesthetic education into computable system requirements from the perspectives of users, processes, resources, and data. Second, it designs and implements a workflow-oriented information system with layered architecture and role-based service modules to support activity management, participation tracking, and digital portfolio accumulation. Third, it provides a prototype-based

preliminary evaluation to verify the feasibility of the proposed system in improving workflow traceability, reducing coordination fragmentation, and enhancing the continuity of participation records. The remainder of this paper is organized as follows. Section 2 reviews the related work. Section 3 presents the methodology. Section 4 describes the system design. Section 5 reports the system implementation. Section 6 presents the experimental evaluation. Section 7 concludes the paper^[6].

2 Related Work

Research on university second-classroom aesthetic education and its digital support can generally be grouped into three streams: studies on the educational value and practice of second-classroom aesthetic education, studies on digital transformation and educational platforms, and studies on workflow-oriented information systems. Although these studies provide useful foundations, their integration in the context of university second-classroom aesthetic education remains limited. In particular, existing research still lacks a sufficiently explicit system-level description of how computer technology can support role coordination, workflow control, data persistence, and platform implementation in this domain^[7].

The first stream focuses on the educational significance, practical forms, and improvement paths of second-classroom aesthetic education. Existing studies generally agree that exhibitions, lectures, workshops, student clubs, competitions, and community-based cultural practice are important carriers for cultivating students' aesthetic literacy and creative ability. However, most of these studies emphasize pedagogical value and organizational experience rather than the technical mechanisms required for activity coordination, process management, and digital record accumulation^[8].

The second stream concerns digital transformation in higher education and the use of digital platforms to support teaching, management, and student services. Prior studies have shown that digital technologies can improve resource access, communication efficiency, and online-offline integration. Nevertheless, digital support is often discussed only as a general reform direction, while concrete issues such as system architecture, service modules, data organization, workflow realization, and prototype deployment are rarely specified in sufficient detail^[9].

The third stream is related to information systems, workflow management, and platform-based coordination. In general information-system research, workflow mechanisms, role-based access control, process traceability, and structured data organization are widely recognized as effective means for coordinating multi-actor services. These concepts are particularly relevant to second-classroom aesthetic education, which involves multiple stakeholders, repeated approval procedures, dynamic participation records, digital artifacts, and cross-stage output accumulation. However, such concepts have seldom been translated into a domain-specific platform for university aesthetic education^[10].

Therefore, a clear gap remains between educational digitalization research and implementation-oriented information-system design for second-classroom aesthetic education. To address this gap, the present study proposes a workflow-oriented information

system and emphasizes the computable translation of educational scenarios into system requirements, role logic, service modules, workflow structures, and deployable technical realization^{[11][12]}.

3 Methodology

3.1 Problem Analysis and Design Objectives

The methodological starting point of this study is the identification of operational bottlenecks in university second-classroom aesthetic education. In many universities, activities such as exhibitions, lectures, workshops, and club events are managed through fragmented channels, where proposal submission, approval, scheduling, registration, attendance, and publicity are handled separately. This fragmentation reduces management efficiency, weakens workflow traceability, and makes it difficult to accumulate long-term participation records. In addition, the lack of structured digital support limits the integration of classroom teaching resources with extracurricular aesthetic practice.

Based on this problem analysis, the study defines three design objectives. The first is to establish a unified workflow mechanism for the full lifecycle of second-classroom activities. The second is to support role-based coordination among multiple stakeholders through a common platform. The third is to enable the persistent storage and reuse of participation records, submitted works, feedback data, and dissemination traces, so that second-classroom aesthetic education can be managed as a continuous digital service process rather than as isolated extracurricular events.

3.2 Stakeholder and Scenario Abstraction

To support requirement elicitation, the study abstracts four stakeholder groups from actual educational practice: students, teachers, administrators, and student organizations. Students are the main participants and are involved in activity browsing, registration, attendance, artifact submission, and portfolio viewing. Teachers are responsible for resource provision, activity guidance, and feedback review. Administrators manage approval, scheduling, supervision, and platform governance. Student organizations act as important initiators and coordinators of activities.

Based on these stakeholders, the methodology further abstracts several core service scenarios: activity drafting and submission, review and approval, activity publication, participant registration, attendance confirmation, artifact upload, portfolio generation, feedback collection, and media dissemination. These scenarios are treated as the primary units for workflow modeling and function decomposition.

3.3 System Modeling and Architecture Mapping

After stakeholder and scenario abstraction, the identified requirements are mapped into a workflow-oriented information system with layered architecture, modular services, and structured data entities. The presentation layer supports role-oriented access and

interaction. The service layer implements the core business logic of the platform. The data layer stores structured and unstructured records related to activities, participation, and educational outputs.

To make the methodology implementation-oriented, the system is further decomposed into workflow states, role-permission relations, service modules, and core data entities. In this way, the methodology connects educational problems with concrete computing structures and provides a basis for later system design and implementation.

3.4 Prototype-Oriented Validation Design

To avoid staying at the level of conceptual system description, the methodology also includes a prototype-oriented validation step. The proposed framework is intended to be realized through a prototype system that supports the full lifecycle of second-class-room aesthetic education activities. In addition, the methodology introduces a preliminary evaluation perspective to assess whether the system can improve workflow traceability, reduce coordination fragmentation, and strengthen the continuity of participation records. Accordingly, the later evaluation focuses on process efficiency, participation effectiveness, system performance, and user experience.

4 System Design

4.1 Overall Architecture

The proposed system adopts a three-layer architecture consisting of a presentation layer, a service layer, and a data layer. . The overall structure and layer relationships are illustrated in Figure 1.

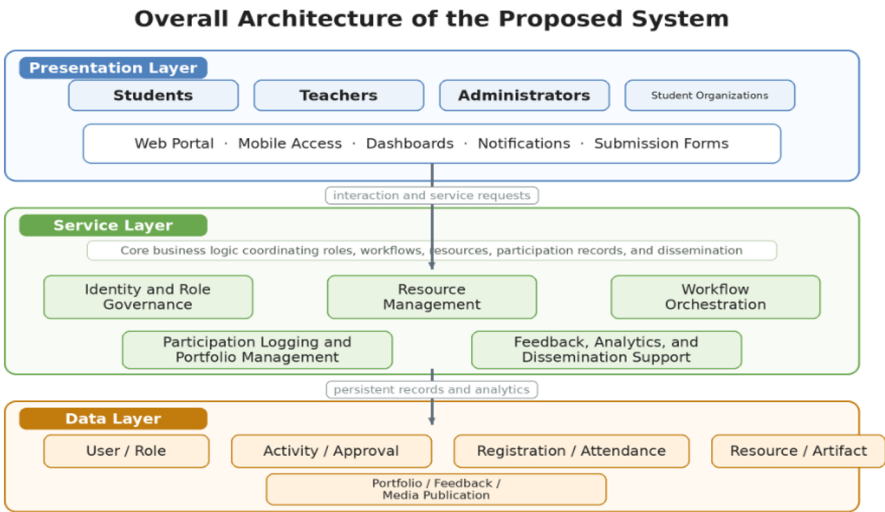


Fig. 1. Overall architecture of the proposed system

The presentation layer provides access interfaces for students, teachers, administrators, and student organizations. It supports web-based and mobile-friendly interaction for activity browsing, application submission, registration, attendance confirmation, artifact upload, feedback submission, and dashboard viewing. The service layer implements the core business logic of the system. It is responsible for identity and role governance, resource management, workflow orchestration, participation logging, portfolio generation, feedback processing, and dissemination support.

The data layer stores and manages user profiles, role information, activity records, approval history, registration records, attendance logs, resource metadata, submitted artifacts, portfolio data, feedback entries, and media publication traces.

4.2 Functional Module Design

Table 1. Core functional modules of the proposed system

Module	Main Functions	Key Inputs/Outputs	Main Users
Identity and Role Governance	User authentication, role assignment, permission control, and access routing.	User profiles, role information, and access logs.	Students, teachers, administrators, and student organizations.
Resource Management	Resource upload, classification, storage, retrieval, and reuse.	Teaching materials, activity resources, metadata, and digital files.	Teachers, students, and student organizations.
Workflow Orchestration	Activity submission, review, approval, publication, scheduling, and archival.	Activity forms, workflow states, review records, and schedules.	Administrators, teachers, and student organizations.
Participation Logging and Portfolio Management	Registration, attendance recording, artifact upload, reflection input, and portfolio generation.	Registration records, attendance logs, submitted works, and portfolio data.	Students and teachers.
Feedback and Dissemination Support	Feedback collection, questionnaire management, statistical summaries, and dissemination preparation.	Survey data, feedback records, analytics results, and media publication traces.	Teachers, administrators, and student organizations.

To support the core service requirements, the system is decomposed into five functional modules. The main functions, inputs/outputs, and user groups of the five modules are summarized in Table 1. The identity and role governance module is responsible for user authentication, role assignment, permission control, and access routing. The resource management module supports the upload, classification, storage, retrieval, and reuse of digital resources related to aesthetic education, including teaching materials, event notices, thematic content, visual media, lecture recordings, and student-generated works. The workflow orchestration module manages the full lifecycle of activities, including drafting, submission, review, approval, publication, execution, completion, and archival. The participation logging and portfolio management module records user participation data such as registration, attendance, artifact upload, reflective input, and

longitudinal participation history. Based on these records, the system can generate digital portfolios that preserve students' aesthetic practice outcomes over time.

The feedback and dissemination support module collects questionnaire responses, stores feedback records, supports statistical summaries, and assists content dissemination across campus media channels.

4.3 Workflow Design

Workflow design is the central mechanism of the proposed system. A typical activity workflow begins with activity drafting by a student organization or teacher. After the draft is completed, the activity enters the submission stage and is routed to the relevant reviewer. Administrators or authorized teachers then perform review and approval, after which approved activities move to the publication stage and become visible to target participants. Students may then complete registration and later attendance confirmation during activity execution. After the activity is finished, users may upload related outputs such as images, reports, works, or reflections through the artifact submission function. Finally, the system archives activity records and links valid outputs to personal or group portfolios for later retrieval and display. The complete activity workflow is illustrated in Figure 2.

This workflow design provides three advantages. First, it improves process clarity by assigning explicit responsibilities to different user roles. Second, it increases traceability because key operations are recorded within a unified system. Third, it provides a basis for later performance analysis, since workflow data can be used to measure processing time, participation continuity, and record integrity.

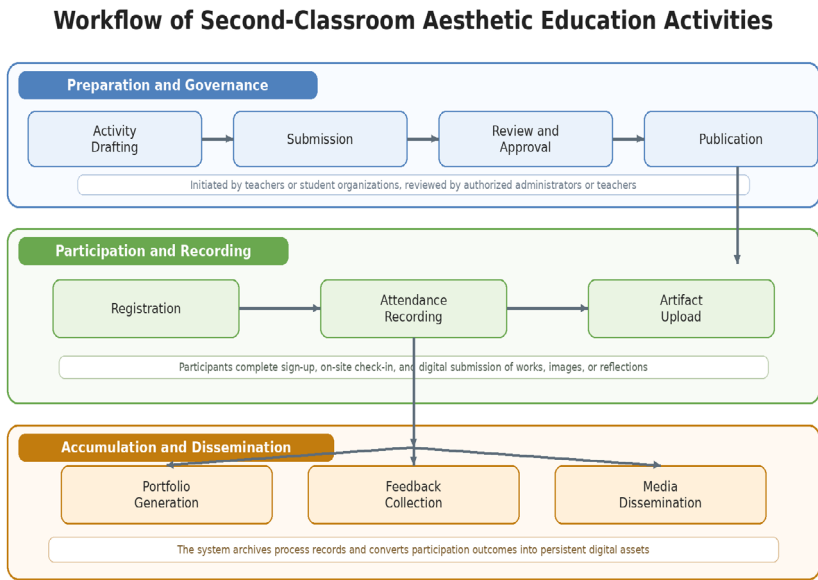


Fig. 2. Workflow of second-classroom aesthetic education activities

4.4 Data Entity Design

To support the service logic described above, the system defines a set of core data entities that connect users, activities, participation, and digital outputs. The main entities include User, Role, Activity, ApprovalRecord, Registration, Attendance, Resource, Artifact, Portfolio, Feedback, and MediaPublication. The relationships among the core data entities are presented in Figure 3.

The User and Role entities describe identity and permission relations. The Activity entity stores core information about second-classroom events, including title, organizer, category, schedule, location, and status. The ApprovalRecord entity preserves process history, including reviewer, timestamp, and review result. The Registration and Attendance entities record student participation behavior before and during activity execution. The Resource entity manages reusable materials and their metadata. The Artifact and Portfolio entities preserve student outputs and support longitudinal accumulation of aesthetic practice records. The Feedback and MediaPublication entities support evaluation and dissemination-related functions after activity completion.

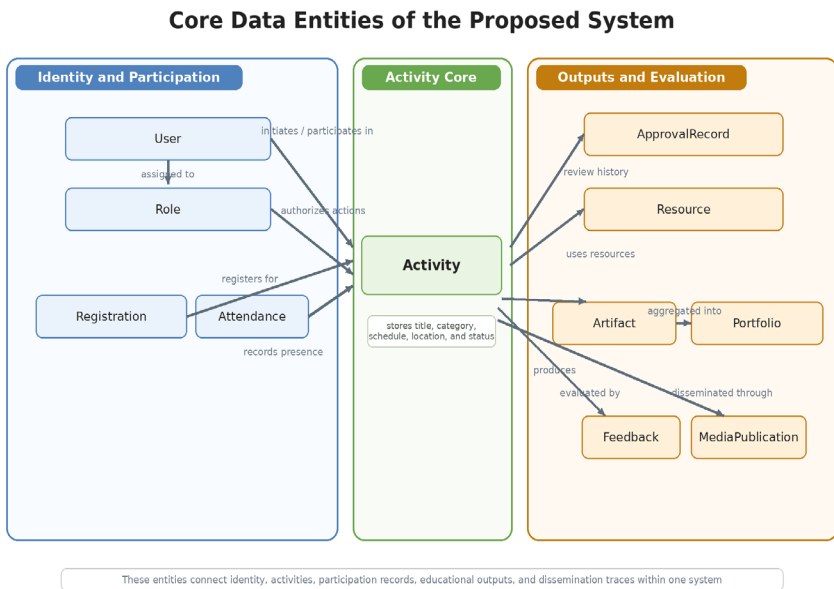


Fig. 3. Core data entities of the proposed system

4.5 Interface and Role-Oriented Interaction Design

Because system usability directly affects participation and operational efficiency, the proposed design adopts a role-oriented interaction strategy.

For students, the interface emphasizes activity discovery, registration, attendance confirmation, artifact upload, and portfolio viewing.

For teachers, the interface focuses on resource release, activity guidance, classroom linkage, and feedback review.

For administrators and student organizations, the interface provides approval queues, process tracking, scheduling support, and dissemination preparation.

In addition, the system adopts a responsive interaction design to support both desktop and mobile access. This is especially important in second-classroom aesthetic education, where attendance recording, documentation, and media upload often occur in dynamic offline environments.

4.6 Design Summary

The proposed system design transforms university second-classroom aesthetic education into a workflow-oriented digital platform with layered architecture, modular services, explicit workflow control, and structured data support. By integrating users, resources, processes, and records within a unified framework, the design provides a clear technical foundation for prototype implementation and later empirical evaluation.

5 System Implementation

5.1 Implementation Architecture

The prototype adopts a browser/server architecture to support centralized management, cross-device access, and unified service control. In this implementation mode, the front end is responsible for interface rendering and user interaction, while the back end provides business services, workflow processing, and data access. Persistent storage is used to manage both structured operational data and multimedia resources generated during aesthetic education activities.

5.2 Back-End Service Realization

The back end is implemented as a set of modular services corresponding to the main business functions of the system. These services communicate through RESTful interfaces so that front-end interaction and back-end logic remain decoupled.

The core back-end services include identity and role management, activity lifecycle management, workflow control, participation recording, resource management, portfolio aggregation, and feedback processing. Workflow control is the most critical service because it manages state transitions such as draft, submitted, under review, approved, published, ongoing, completed, and archived. Each state transition is triggered by role-authorized operations and recorded in the system for later supervision and analysis.

To support secure collaboration among multiple user groups, the prototype applies role-based access control in the service layer. Different roles are granted different permissions for creating activities, reviewing submissions, publishing notices, recording participation, uploading artifacts, and viewing portfolio data.

5.3 Database and Data Storage Design

To support structured operation and persistent record accumulation, the prototype adopts a relational data model centered on users, activities, participation, and educational outputs.

In the relational database, User and Role tables support identity management and permission mapping. Activity and ApprovalRecord tables store activity descriptions, workflow states, and review history. Registration and Attendance tables support participation tracking before and during activity execution. Resource stores reusable teaching and activity materials with metadata such as category, topic, and media type. Artifact and Portfolio preserve student-submitted works and longitudinal records of aesthetic practice. Feedback and MediaPublication support post-activity evaluation and dissemination tracing.

Besides relational data storage, the prototype also supports external file storage for multimedia resources such as images, posters, documents, videos, and student works. The combination of relational data storage and external file management improves both data organization and resource scalability.

5.4 Front-End Interface Realization

The front end is implemented with a modular interaction structure to support different user tasks in a unified visual framework. The design emphasizes interface clarity, low-friction operation, and role-oriented access. Representative prototype interface examples for the main user roles are shown in Figure 4.

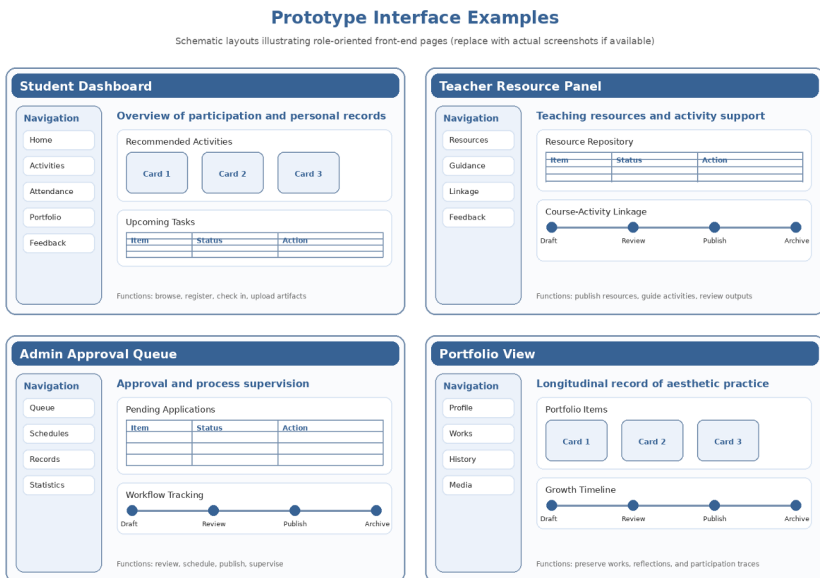


Fig. 4. Prototype interface examples

For students, the front end mainly provides activity discovery, registration management, attendance confirmation, artifact upload, and personal portfolio viewing. For teachers, the interface supports resource publication, activity guidance, classroom linkage, and feedback review. For administrators and student organizations, the main functions include activity submission, approval processing, publication management, schedule adjustment, and dissemination preparation.

To support real participation scenarios, the interface adopts responsive layouts for desktop and mobile access. This is particularly important because many aesthetic education activities take place in offline environments where attendance confirmation, media upload, and result submission require timely interaction through lightweight devices.

5.5 Workflow Engine and Process Recording

A central implementation feature of the prototype is the workflow-oriented control mechanism. In the system, each activity is treated as a process object with an explicit lifecycle. Workflow states are managed by the back-end service and exposed to users through front-end interfaces. All key operations in this process are logged, including operator identity, execution time, workflow status, and result information.

Such process recording serves two purposes. First, it improves transparency and traceability for activity management. Second, it provides a direct data basis for later evaluation, such as measuring approval time, participation continuity, record completeness, and other efficiency indicators.

5.6 Prototype Deployment and Operational Support

In deployment terms, the prototype can be operated in a campus intranet environment or a hybrid cloud environment according to institutional conditions. Front-end pages are delivered through a web server, while back-end services are centrally deployed for unified access and management. Database and file resources are maintained through persistent storage services, and access permissions are controlled through the system's identity and role mechanism.

From an operational perspective, the prototype supports the full service cycle of second-classroom aesthetic education activities, from preparation and review to participation, feedback, and archival. Therefore, the implementation not only verifies that the proposed design can be realized as a working platform, but also provides an engineering basis for later performance observation and user-oriented evaluation.

6 Experimental Evaluation

6.1 Evaluation Setup

The prototype system was piloted in a university second-classroom aesthetic education scenario over a period of [three months]. During the pilot, the platform supported the

full lifecycle of aesthetic education activities, including activity submission, review, approval, publication, registration, attendance recording, artifact upload, portfolio accumulation, and feedback collection. The evaluation involved [400] students, [52] teachers, [24] administrators organization members. A total of [33] activities were managed through the system during the pilot period.

To ensure that the evaluation reflected actual platform operation, data were collected from three sources: system logs, activity records, and user feedback questionnaires. System logs were used to measure workflow efficiency and service performance. Activity records were used to analyze participation continuity and output accumulation. Questionnaires were used to collect perceptions of usability, convenience, and operational support from different user groups.

6.2 Evaluation Metrics

To provide a structured assessment, the evaluation defined four categories of indicators.

The first category is process efficiency, including average approval time, average publication time, average registration processing time, average attendance recording time, and average artifact archival time.

The second category is participation effectiveness, including activity browsing volume, registration rate, attendance rate, artifact submission rate, portfolio generation rate, and feedback completion rate.

The third category is system performance, including average API response time, file-upload success rate, record persistence success rate, and concurrent access stability.

The fourth category is user experience, including perceived ease of use, interface clarity, process convenience, and overall satisfaction.

6.3 Results and Analysis

Process Efficiency.

The pilot results show that the proposed system improved the efficiency of activity organization and workflow control. Compared with the conventional management mode, the average activity approval time decreased from [6] to [4], while the average attendance recording time decreased from [4] to [2.5]. The average artifact archival time was reduced from [1] to [0.5]. These results suggest that the workflow-oriented design can effectively reduce fragmented manual coordination and improve traceability in activity operation.

Participation Effectiveness.

In terms of participation effectiveness, the platform improved the visibility and continuity of student engagement. During the pilot period, the activity registration rate reached [89]%, the attendance rate reached [85.3]%, and the artifact submission rate reached [90.11]%. In addition, [99.8]% of completed activities generated corresponding portfolio records, showing that the system was able to transform scattered participation outcomes into persistent digital assets.

System Performance.

From the perspective of technical performance, the prototype maintained stable operation under ordinary usage conditions. The average API response time was [2] ms, the file-upload success rate was [98]%, and the record persistence success rate was [96]%. No critical data-loss event was observed during the pilot period.

User Experience.

Questionnaire and feedback results showed generally positive user responses to the prototype system. The average overall satisfaction score was [3]/5 among students, [2]/5 among teachers, [3]/5 among administrators, and [3]/5 among student organizations. Most users agreed that the system improved process clarity, reduced communication cost, and made participation records easier to view and preserve. Students particularly valued the portfolio function, while administrators emphasized the convenience of unified approval and process supervision.

6.4 Discussion

The preliminary evaluation indicates that the proposed workflow-oriented information system has practical value in improving the digital operation of university second-classroom aesthetic education. First, the workflow mechanism improves process standardization and reduces coordination fragmentation. Second, structured data support strengthens the continuity of participation records and portfolio accumulation. Third, the prototype demonstrates that aesthetic education activities can be managed through a unified digital service environment rather than through disconnected administrative tools and temporary communication channels.

However, the present evaluation still has some limitations. The pilot scale is limited to [single institution / limited user groups], and the evaluation period is relatively short. In addition, the current results mainly reflect preliminary operational feasibility rather than long-term educational impact. Future work should therefore expand the deployment scope, introduce larger-scale comparative data, and further evaluate how the system affects participation quality, educational continuity, and management efficiency over a longer period.

7 Conclusion

This paper presented a workflow-oriented information system for university second-classroom aesthetic education. In response to practical problems such as fragmented activity management, weak workflow traceability, discontinuous participation records, and insufficient digital coordination, the study transformed second-classroom aesthetic education from a loosely connected extracurricular practice into a structured digital service process. Through requirement analysis, the study identified the core stakeholders and service scenarios of university aesthetic education and translated them into a computable system framework with layered architecture, modular functions, workflow control, and structured data support.

On this basis, the paper designed and implemented a prototype system consisting of presentation, service, and data layers, together with key modules for identity and role governance, resource management, workflow orchestration, participation logging, portfolio accumulation, feedback collection, and dissemination support. The implementation further demonstrated how computer technology can be made explicit in role-based coordination, process-state control, interface support, structured data organization, and deployable platform realization.

The preliminary evaluation results indicate that the proposed system has practical feasibility in improving workflow traceability, reducing coordination fragmentation, and strengthening the continuity of participation records. Therefore, the main contribution of this study lies not only in proposing a domain-specific digital platform, but also in demonstrating an implementation-oriented approach for applying information-system methods to university aesthetic education.

Nevertheless, the current study still has some limitations. The prototype evaluation is preliminary and conducted within a limited application scope. Some quantitative indicators and comparative results still need to be expanded through broader deployment and longer-term observation. In addition, more advanced functions, such as intelligent activity recommendation, adaptive resource matching, and deeper analytics for participation behavior, have not yet been fully incorporated into the current version of the system. Future work will therefore focus on larger-scale validation, richer empirical data support, enhanced visual analytics, and further optimization of workflow and interface design.

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