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Implementation of the Scrum Method in a Senior High School Academic Information System

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Delays in system completion, continuously evolving requirements, and ineffective communication between developers and users are common challenges in information system development. This study aims to implement the Scrum method in the development of an Academic Information System for Senior High Schools (SMA) to address these issues. Scrum was selected as an agile software development framework that emphasizes iterative, adaptive, and collaborative processes. The research methodology employed is Action Research, in which system development is conducted through multiple sprints, each consisting of planning, execution, review, and retrospective phases. The implementation results indicate that the Scrum method successfully increased development progress transparency by 40% and reduced feature deviation from user requirements (scope creep) by 30%. In addition, the developed system was completed 25% faster than the estimated timeline using the waterfall method. The resulting system has been integrated with core academic modules, including student admission (PPDB), scheduling, grade processing, and reporting. This study concludes that Scrum is not only effective in accommodating dynamic requirement changes but also enhances stakeholder satisfaction—particularly among school administrators and staff—through their continuous involvement in sprint review activities. Overall, the implementation of Scrum proves to be a viable solution for information system development in educational institutions.
Keywords: Scrum Method, Academic Information System, Agile Software Development, Action Research, Senior High School

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1. Introduction

An academic information system in senior high schools is an integrated system designed to manage various processes and data related to students' academic activities. According to Laudon and Laudon (2020), the success and progress of educational institutions depend on the effective utilization of information technology across all internal operations. Therefore, it is essential to have an effective and efficient system that not only stores and processes academic data but also provides accurate information to students, teachers, and administrative staff. This system is designed to prevent potential problems in the future.

An academic information system enables the recording of grades, the management of lesson schedules, and better supervision of student learning progress. In addition, this system facilitates communication between students and schools, resulting in positive synergy in the educational process. Turban, Volonino, and Wood (2019) explain that information technology refers to technologies used to process data, including data collection, processing, and storage in various forms. This technology produces high-quality information that is relevant, accurate, and timely, which can then be used for decision making and to meet the needs of businesses, governments, and individuals. Therefore, a strategic step to improve the quality of education in senior high schools is the development of an integrated and user-friendly academic information system.

Information systems that are capable of organizing data into easily understandable information are required to ensure that information is properly managed and communicated. In various fields, including education,

information systems are widely used due to the large volume of data generated in schools, which often changes rapidly and must be managed in a structured manner so that academic information can be delivered accurately and clearly. Consequently, manual methods of managing students' academic data are no longer necessary.

With the support of information and communication technologies, ideal learning environments become broader and more flexible, enabling individuals to access sustainable educational settings. Castells (2021) emphasizes that contemporary society experiences rapid information advancement due to technological progress and the expansion of communication and information facilities. The ability to transmit and receive digital data quickly across different locations, along with the use of compatible technologies, has become integral to personal, social, educational, and commercial activities.

A well-designed academic information system enables real-time monitoring of student development, allowing schools to make better decisions to improve educational quality. However, developing academic information systems in senior high schools remains challenging, as it requires addressing various issues such as data security, human resource training, and technological infrastructure limitations. Therefore, conducting a comprehensive analysis of user needs, preferences, and constraints is essential when developing academic information systems for senior high schools. With proper understanding and implementation, such systems are expected to contribute positively to improving the quality of education in Indonesia.

2. Literature Review

Information System

An information system can be simply defined as the collection, processing, storage, and dissemination of data. According to Stair and Reynolds (2020), an information system consists of several main components, including data, hardware, software, procedures, and users. Information systems help improve productivity, operational efficiency, and service quality, while also providing comprehensive analysis through managed data. By utilizing information systems, organizations are able to adapt more effectively to changes in the market environment.

Every information system is composed of components, which are the elements that form the system or product. These components may include hardware or interaction mechanisms, and when they function together, they create a complete and integrated system. A system itself is defined as a set of interrelated components designed to achieve specific objectives. Information systems may be physical, such as machines or buildings, or non-physical in nature. The core components of an information system include software, hardware, data, procedures, and users. Software refers to programs used to operate applications and manage hardware, while hardware includes all physical equipment, such as computers and servers. Data must be accurate and relevant to support decision making. Procedures consist of established steps and policies that ensure the proper operation of the information system. Finally, users are individuals or groups who utilize information systems to obtain the information they require.

Within organizations, information systems play a crucial role in improving operational efficiency, accelerating decision making processes, and enhancing service quality. Through the use of data analytics, organizations can identify trends and patterns that support strategic planning. O'Brien and Marakas (2019) emphasize that well-managed information systems enable organizations to transform raw data into valuable information for managerial decision making.

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Academic Services

Academic services refer to efforts to fulfill needs in the form of service activities that involve teaching and learning interactions between teachers and students, as well as the management of academic administrative processes related to documentation, registration, and daily operational activities in academic administration. According to Tjiptono (2018), service quality can be understood as the degree of excellence expected to meet user expectations. Academic services represent a systematic educational process that assists students in understanding the curriculum through learning activities, enabling them to achieve standard competencies while efficiently and effectively meeting their academic needs.

3. Method

Scrum Method

This study adopts a qualitative approach using a case study method to implement the Scrum framework in the development of an Accounting Information System for a sports equipment retail store. The research process follows the Scrum framework, which emphasizes iterative development, collaboration, and continuous improvement through structured sprint cycles (Anoesyirwan et al., n.d.). The development process consists of four sprints, each lasting two weeks. The process begins with the formulation of a product backlog derived from user requirements, which were identified through in-depth interviews with the store owner and accounting staff.

Each sprint includes the stages of planning (*sprint planning*), implementation (*sprint execution*), result review (*sprint review*), and process evaluation (*sprint retrospective*), in accordance with the fundamental Scrum framework.

Figure 1. The Basic Scrum Framework
Source: Anoesyirwan et al.

Data collection was conducted through participatory observation over 4 sprints, semi-structured interviews with 5 informants (the store owner, 2 cashiers, a warehouse administrator, and an accounting staff member), and documentation studies of financial reports from the most recent 3 months. The collected qualitative data were analyzed using reflexive thematic analysis techniques as proposed by Braun and Clarke (2019), which involve systematic coding, theme development, and interpretation to identify meaningful patterns within the data.

To ensure data validity and trustworthiness, this study applied source triangulation and member checking, allowing participants to confirm the accuracy of the interpreted findings (Braun & Clarke, 2019).

The study was conducted from February to April 2024 and involved all relevant stakeholders as members of a collaborative Scrum team throughout the system development process.

Figure 2. The Thematic Analysis Technique
Source: Braun and Clarke (2019)

4. Results And Discussion

Product Backlog

The Student Academic Information System website is a crucial tool for managing academic data in senior high schools. The website is managed by school administrative staff, academic affairs units, and curriculum coordinators, and also serves as an information source for teachers and students. It enables effective communication between schools and students while supporting academic information needs and administrative priorities.

Within the Scrum framework, the school or system development team determines the priority order of system features. This prioritized list of features is referred to as the product backlog. After the academic information system backlog is defined, the system administrator or development team collaborates with the school to estimate the time required to complete each feature included in the website.

Table 3. Product Backlog of the Senior High School Academic Information System

No	Priority	Product Backlog Item	User Story (Summary)	Acceptance Criteria (Summary)	Estimated Story Points
1	Must	Login	Users can log in using a username and password	Input validation; redirect to main page after successful login	Three
2	Should	Student Dashboard	Students can view a summary of academic activities	Schedule widget; grades widget; announcement widget	Five
3	Could	View Profile	Users can view their profile information	Displays name, email, and profile photo	One
4	Must	Examination Page	Displays a collection of examination questions	Examination questions are displayed properly	Not specified
4.1	Must	Start Examination	Students can start an available examination	Start button available; examination timer begins	Three
4.2	Must	Answer Questions	Students can answer and navigate examination questions	Displays one question at a time; multiple-choice options; next and previous navigation buttons	Eight

The product backlog presented in this table serves as the foundation for defining system features and priorities, which are subsequently elaborated into the sprint backlog and implementation plan in the following table.

Sprint Backlog

The purpose of the sprint backlog is to determine the time required to complete the Student Academic Information System website for senior high schools in an efficient manner while ensuring that the system is developed in accordance with the approved design. The sprint backlog breaks down prioritized product backlog items into technical tasks that can be implemented, monitored, and evaluated during each sprint.

Table 3. Sprint Backlog of the Senior High School Academic Information System

Task ID	Product Backlog Item	Task (Technical Breakdown)	Assigned To	Estimated Hours	Status	Story Points
		AUTHENTICATION MODULE				
T001	Login	Develop login page user interface including form, buttons, and styling	Front-end	8	Completed	3
T002	Login	Develop login application programming interface and token generation	Back-end	6	Completed	–
T003	Login	Implement password hashing and validation	Back-end	4	Completed	–
T004	Login	Conduct unit testing and integration testing	Quality Assurance	4	In Progress	–
T005	Logout	Implement logout endpoint and clear authentication token	Back-end	2	To Do	1
T006	Logout	Develop logout button and handler on the front-end	Front-end	2	To Do	–
		DASHBOARD MODULE				
T007	Student Dashboard	Design dashboard layout and user interface components	UI/UX	6	Completed	5
T008	Student Dashboard	Develop upcoming schedule widget	Front-end	8	In Progress	–
T009	Student Dashboard	Develop latest grades widget	Front-end	6	To Do	–
T010	Student Dashboard	Develop application programming interface for student dashboard data	Back-end	6	In Progress	–
T011	Teacher Dashboard	Design teacher dashboard user interface	UI/UX	4	Completed	5
T012	Teacher Dashboard	Develop created examinations widget	Front-end	6	To Do	–
T013	Teacher Dashboard	Develop application programming interface for teacher dashboard data	Back-end	6	To Do	–
		EXAMINATION MANAGEMENT MODULE				
T014	Create Examination	Develop examination creation form	Front-end	8	In Progress	8
T015	Create Examination	Design database schema for examinations	Back-end	4	Completed	–

Task ID	Product Backlog Item	Task (Technical Breakdown)	Assigned To	Estimated Hours	Status	Story Points
T016	Create Examination	Develop examination creation application programming interface with validation	Back-end	4	In Progress	–
T017	Add Questions	Develop multiple-choice question creation form component	Front-end	8	To Do	5
T018	Add Questions	Develop application programming interface for question creation with answer options	Back-end	6	To Do	–
T019	Start Examination	Develop examination lobby with countdown timer	Front-end	6	To Do	3
T020	Start Examination	Implement time validation and user authorization	Back-end	4	To Do	–
T021	Submit Examination	Develop examination submission confirmation modal	Front-end	4	To Do	5
T022	Submit Examination	Develop application programming interface for exam submission and score calculation	Back-end	8	To Do	–
T023	Submit Examination	Implement automatic submission when time expires	Back-end	4	To Do	–
		INFRASTRUCTURE AND OTHER TASKS				
T024	–	Set up database and initial migration	DevOps	4	Completed	–
T025	–	Set up authentication middleware	Back-end	4	Completed	–
T026	–	Conduct code review and prepare technical documentation	All Teams	8	To Do	–
T027	–	Perform bug fixing and system optimization	All Teams	10	To Do	–
Total Estimated Effort				150/250		42

The sprint backlog detailed in this table outlines the technical tasks and effort distribution for system development, which are further evaluated and summarized through sprint progress and outcome metrics in the following table.

Implementation

The Academic Information System in senior high schools is a system designed to manage and process academic data in an integrated and computer-based manner in order to improve the efficiency and effectiveness of academic services within schools. This system is generally web-based and covers various essential functions, including the management of student data, teacher data, subjects, class schedules,

attendance records, grades, and student report cards. Planning of the Academic Information System in Senior High Schools:

a. Identification of Needs and Problems
   The first stage of system planning begins with identifying user needs and problems in the existing manual system or the currently implemented system. For example, many schools still rely on manual techniques or simple applications such as Microsoft Excel. This practice often results in unintegrated data, data duplication, and delays in producing accurate and timely information.
b. User Requirements Analysis
   This stage involves various system users, including administrative staff, teachers, students, and prospective students, to gain a comprehensive understanding of business processes and the core features required by the system. The objective is to ensure that the developed system effectively addresses the needs of all stakeholders involved in academic processes at the senior high school level.
c. System Design
   At this stage, system modeling is conducted using methodologies such as the Unified Modeling Language, which includes the development of use case diagrams, activity diagrams, and class diagrams for database design. The system design also incorporates the creation of a database model that illustrates relationships among data entities, enabling structured data management and easier access to academic information.

Use Case Diagram of the Online Examination System

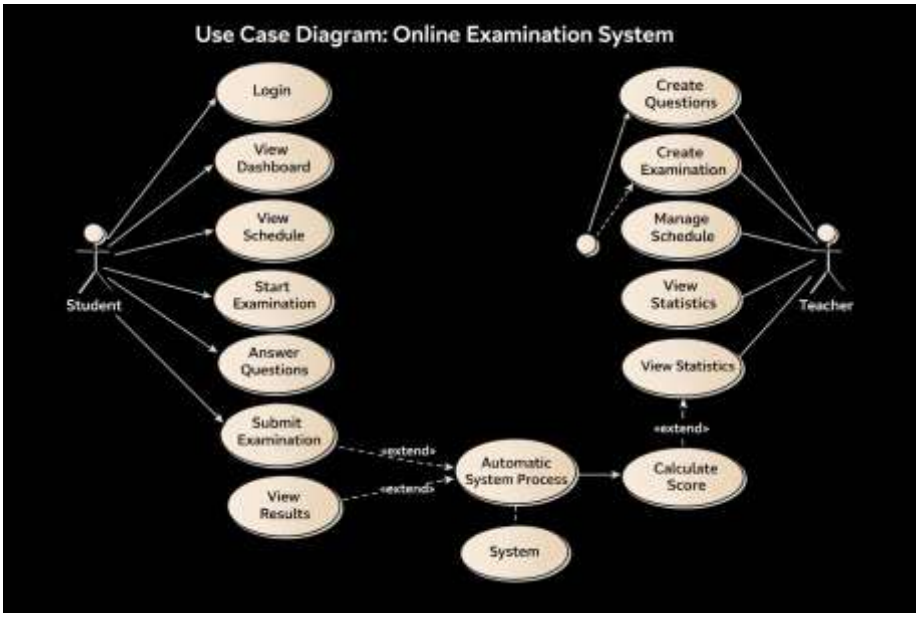

Figure 3. Use Case Diagram of the Online Examination System

This figure illustrates the interactions between students, teachers, and the system in conducting online examinations, including authentication, examination management, automated scoring, and result visualization.

Table 5. Login Use Case Scenario

Item	Description
Actors	Student, Teacher, Administrator
Description	The user logs into the system
Pre-condition	The user is already registered in the system

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Item	Description
Basic Flow	One, the user accesses the login page. Two, the user enters a username and password. Three, the system validates the credentials. Four, the user is redirected to the dashboard based on their role.
Alternative Flow	Login failure: the system displays an error message
Post-condition	The user successfully logs in and is directed to the appropriate dashboard

This table describes the login use case scenario, outlining the sequence of actions, alternative conditions, and system responses during the authentication process.

Table 6. Answering Questions Use Case Scenario

Item	Description
Actor	Student
Description	The student answers examination questions
Pre-condition	The examination has started
Basic Flow	One, the system displays the questions. Two, the student selects an answer. Three, the system automatically saves the answer. Four, the student navigates to the next question.
Alternative Flow	The student marks a question for later review
Post-condition	The answers are successfully saved

This table presents the use case scenario for answering examination questions, detailing the interaction flow between the student and the system during the examination process.

Activity Diagram of the Online Examination System

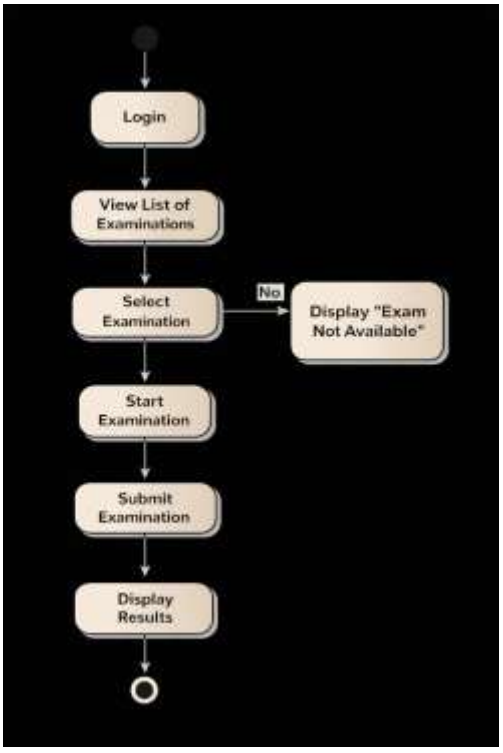

Figure 4. Activity Diagram of the Online Examination System

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This figure illustrates the sequential flow of activities performed by students during the online examination process, from login and exam selection to submission and result display.

Sequence Diagram of the Online Examination System

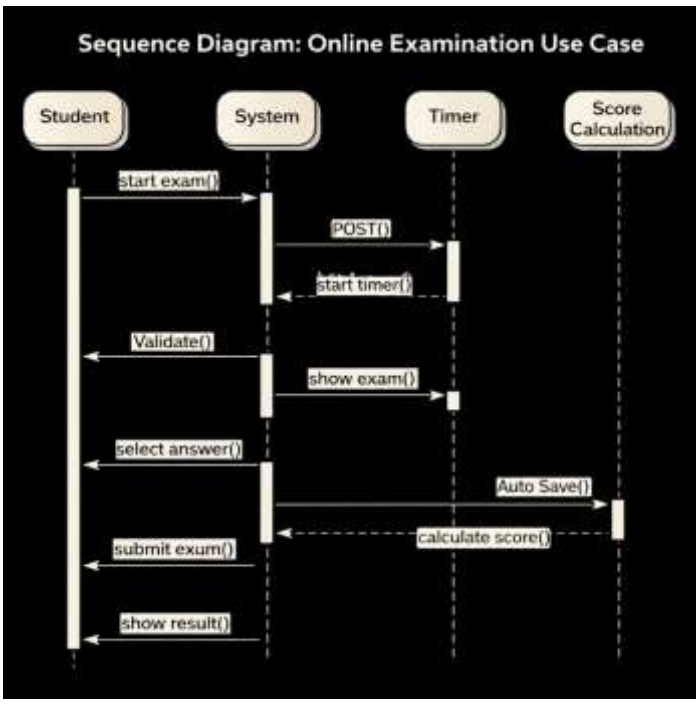

Figure 5. Sequence Diagram of the Online Examination System

This figure illustrates the sequence of interactions between the student, the system, and supporting components such as the timer and scoring module during the online examination process, from exam initiation to result display.

Academic Information System Interface for Senior High Schools

Figure 6. Main Page of the Senior High School Academic Information System Website

This page provides an overview of school activities by presenting a summary of important information, announcements, and access to other system features.

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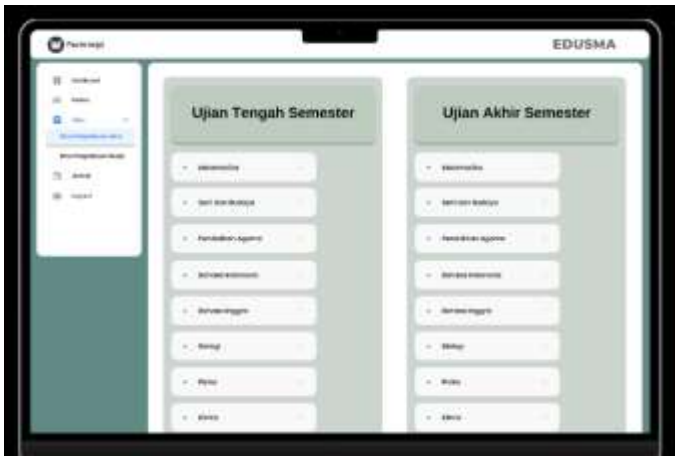

Figure 7. Examination Page of the Senior High School Academic Information System Website

This page supports the academic evaluation process by providing access to examination materials, examination schedules, and assessment results.

5. Conclusion

This study demonstrates that the implementation of the Scrum method in the development of an academic information system for senior high schools provides a flexible and effective approach to addressing the complex needs of academic administration. By applying iterative development cycles, the system was able to evolve in alignment with user requirements, allowing continuous refinement based on feedback from administrators, teachers, and students. The use of Scrum artifacts such as product backlogs and sprint backlogs supported transparent planning and clear task prioritization, which contributed to improved coordination among development team members. The findings indicate that the developed system successfully integrates key academic functions, including student data management, examination administration, and real-time information access, into a unified web-based platform. This integration reduces reliance on manual processes, minimizes data duplication, and enhances the accuracy and timeliness of academic information. Furthermore, the application of agile practices encouraged active stakeholder involvement throughout the development process, strengthening system usability and acceptance within the school environment. Despite the positive outcomes, the study also highlights ongoing challenges related to data security, user readiness, and technological infrastructure, which must be addressed to ensure long-term system sustainability. Overall, this research confirms that Scrum is a suitable development framework for educational information systems, particularly in dynamic school settings, and offers valuable insights for future system enhancement and broader implementation in similar educational institutions.

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