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Developing an Inclusive ICT-Based Academic Information System Using REST API to Promote Sustainable Development Goals (SDGs) in Higher Education

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A B S T R A C T

This study aims to design and evaluate a user-centered academic information system based on REST API architecture to promote inclusive digital services and support student motivation in higher education. Using the Design Thinking approach, the system was developed through five iterative stages involving students and faculty, including individuals with disabilities. The prototype integrated academic features, such as course registration, grades, and notifications, into a single platform with accessibility enhancements, including screen reader compatibility and visual customization. Testing revealed improved usability, autonomy, and satisfaction among users, as the system simplified access, ensured consistency across devices, and addressed diverse user needs. These outcomes highlight the impact of inclusive digital systems in fostering equitable learning environments aligned with SDG 4 and SDG 10. The research suggests that combining science-based technological design with user empathy can enhance both the quality and fairness of academic services in universities.

A R T I C L E   I N F O

1. INTRODUCTION

Advances in information and communication technology (ICT) have transformed academic and student service systems within higher education, especially through the shift toward digital platforms. Many reports regarding ICT have been well-developed [1-12]. Recent studies emphasize that digital transformation, supported by self-efficacy and active learning strategies, increases students' engagement and motivation to achieve academic success [13, 14]. Integrated service ecosystems and responsive administrative support are now essential to sustain students' participation in learning. However, accessibility remains a critical barrier (particularly for students with disabilities) due to fragmented service structures, limited interoperability, and non-inclusive system interfaces. These challenges hinder progress toward inclusive education as outlined in the Sustainable Development Goals (SDGs).

Digital platforms in many Indonesian universities remain siloed across different departments, resulting in duplicated data entry, delayed access, and confusion among users [15, 16]. This structural inefficiency not only limits the overall user experience but also reduces students' motivation to engage with academic services. Faculty-level systems, in particular, have not fully addressed the needs of students with diverse learning profiles. Furthermore, there is limited implementation of REST API-based system integration to ensure data interoperability across devices and platforms, despite evidence showing that such architectures improve speed, reliability, and accessibility [17, 18]

This study aims to design and test an inclusive academic information system at the faculty level using REST API architecture and the Design Thinking approach. The system is intended to provide seamless access to academic services (including course registration, transcripts, schedules, and announcements) while supporting accessibility features such as screen readers and contrast customization. The novelty of this study lies in its emphasis on integrating universal design principles and student self-regulation theory into the system's technical and pedagogical framework. Its impact is twofold: first, it enhances motivation and autonomy among students, especially those with disabilityies; and second, it contributes to institutional efforts to realize the targets of SDGs (i.e., SDG 4 (quality education) and SDG 10 (reduced inequalities)) through technological innovation grounded in empathy-driven design. This study also has a novelty in patching current challenges for improving progress toward inclusive education, in which research in this area has been well-developed [19-31].

2. METHODS

This study used the design thinking process to develop and evaluate a REST API-based integrated academic information system prototype with inclusive features at the faculty level. The method was selected for its capacity to bridge user needs with technological development through an iterative and participatory approach. Detailed information regarding this method is explained elsewhere [32].

Figure 1 illustrates the development stages of a REST-integrated academic information system, emphasizing a participatory and user-centered model. The research design followed five main stages: Empathize, Define, Ideate, Prototype, and Test.

This approach emphasizes a comprehensive understanding of the context and needs of end users, including students, lecturers, and academic staff. In addition, it prioritizes active user participation and continuous refinement throughout the development process. The following section outlines each stage of the research process:

(i) Empathize. This stage aims to explore users' experiences and perceptions of the existing academic information system at the faculty level. Data were collected through in-depth interviews and surveys involving lecturers and students, including those with special needs, to gain insights into the challenges related to accessing and utilizing academic services.

(ii) Define. Based on the findings from the previous stage, we identified key problems related to limited student access to information, system fragmentation, and the lack of inclusive features. This process was further enriched through focus group discussions aimed at informing the development of an integrated academic information system.

(iii) Ideate. In this phase, we designed a conceptual model for an integrated information system based on REST API, incorporating academic service workflows and digital accessibility features. Design evaluations were conducted collaboratively with experts, including user interface designers, lecturers, and student representatives. The design process was directed to ensure user responsiveness, efficiency, and ease of integration with existing systems.

(iv) Prototype. This stage involved the initial development of system features, embedding of Pusdatin service modules into the faculty website, and reinforcement of REST API integration functions. The prototype was tested in a controlled environment (Educational Technology Laboratory) to assess technical stability, accessibility, and feature integration.

(v) Test. System testing was carried out at two levels: limited-scale testing and large-scale implementation. Evaluation involved functionality testing, user interviews, and system use observation by students, including those with disabilities.
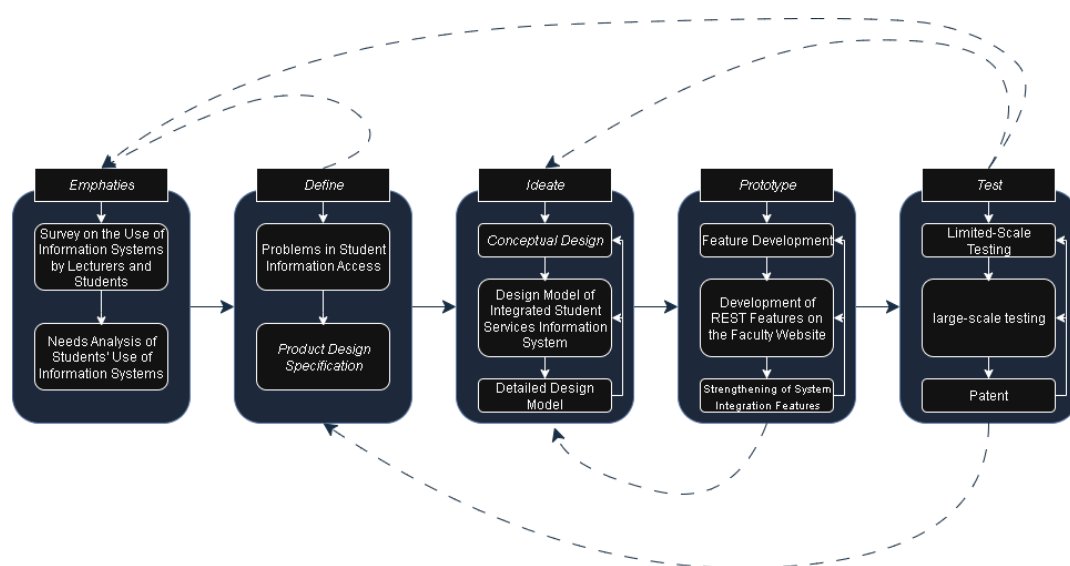

Figure 1. Phases of developing a REST API-Based academic information system.

3. RESULTS AND DISCUSSION
3.1. Empathize

The initial stage of the study employed a quantitative approach using a survey distributed randomly via Google Forms to a total of 903 participants across the university. The participants represented various university stakeholders and included 722 students (including 16 students with disabilities), 124 lecturers, 26 members of the information system management team, and 31 academic service staff. The distribution of respondents is shown in **Figure 2**.
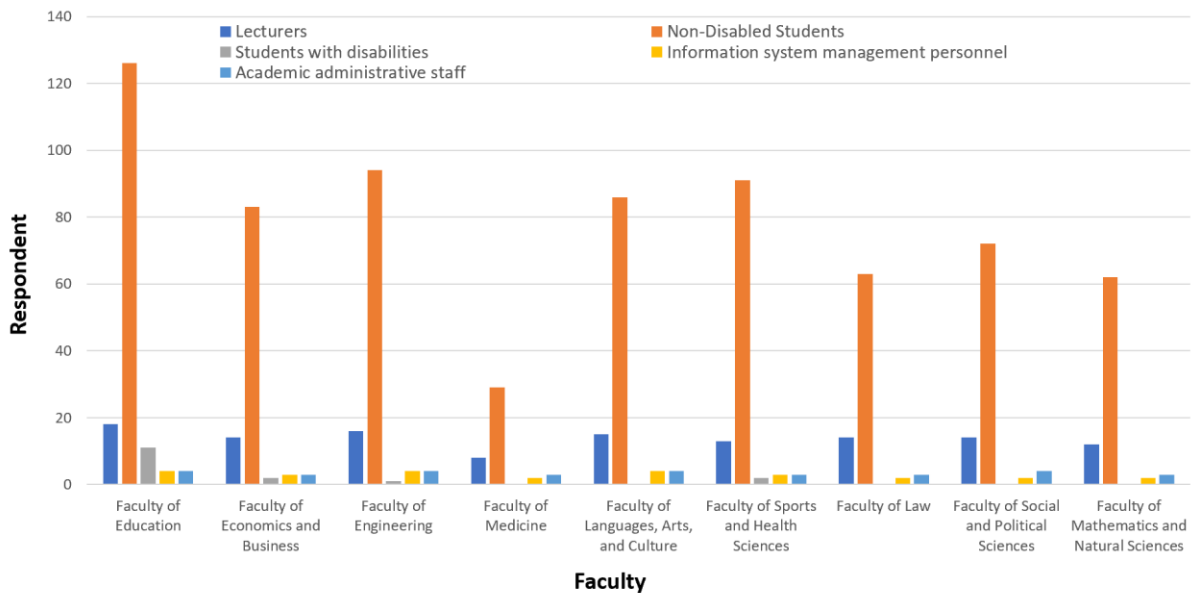
Figure 2. The demographic breakdown of respondents.

The purpose of the survey was to explore users' needs, perceptions, and experiences with the current academic information system. The instrument consisted of both closed- and open-ended questionnaires designed around five key indicators: ease of access, information integration, service responsiveness, support for special needs, and perceived satisfaction with the information system services. Each item was rated using a 5-point Likert scale (from strongly disagree to strongly agree), with additional open-ended questions included to capture participant feedback.

Figure 3 illustrates that the average scores given by all respondents across the five indicators of the academic information system remain below 3. Although improvements were noted in information integration and service responsiveness, accessibility and support for students with special needs continue to pose significant challenges. Faculty members assigned the highest score to Ease of Access (2.74), whereas students with disabilities provided a notably lower score (2.375). A similar pattern emerged for Information Integration, indicating that the perceived benefits of system integration have not been fully experienced by the most affected user group. Service Responsiveness received relatively higher scores from academic staff and system administrators (2.74 and 2.73), yet remained moderate among students with disabilities (2.625). The greatest disparity appeared in the Support System for Special Needs Students, with students with disabilities rating it at 2.1375, compared to more favorable ratings by faculty and staff (2.69 and 2.68, respectively). Perceived Satisfaction was highest among faculty and staff (2.65), while students with disabilities reported the lowest score (2.4375), highlighting the need for a more equitable and inclusive user experience.

Based on open-ended responses, most students acknowledged the benefits of the faculty's academic information system, particularly for core services such as the Course Registration Form and Academic Transcript. However, several students with disabilities still encountered substantial accessibility barriers, including the absence of audio support, insufficient high-contrast display options, and a lack of alternative text for visual elements. These findings reflect the system's failure to fully incorporate the principles of Universal Design for Learning (UDL), which emphasize the integration of accessibility features from the initial design phase to ensure equitable participation in academic activities. Additionally, research indicates that students often experience frustration and a sense of alienation when educational systems do

not accommodate their emotional, cognitive, and physical needs. This issue is reflected in the responses of participants in this study, who reported difficulties with inefficient information retrieval and confusing user interfaces [33]. Moreover, technical problems such as server delays during course registration negatively influenced users' perceptions of system reliability, highlighting that technical performance is a critical factor influencing student satisfaction and the overall effectiveness of digital learning platforms.

The results of this phase revealed various complexities that have long hindered the effectiveness of the existing system, while simultaneously offering a foundational basis for designing a solution that is more adaptive and responsive to users' real needs. This stage plays a critical role by bringing together diverse perspectives in a simultaneous manner to ensure that the technological solutions developed are highly functional and capable of directly contributing to the improvement of service quality and students' academic motivation.
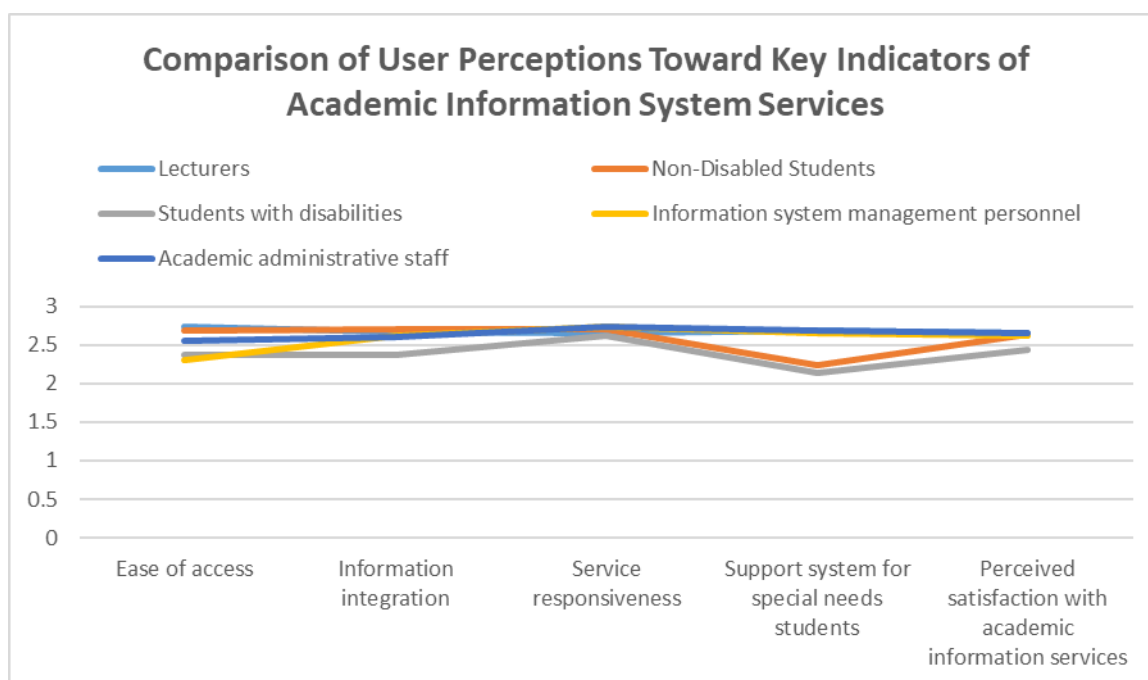

Figure 3. Comparative analysis of user perceptions on accessibility, integration, responsiveness, inclusivity, and satisfaction in the academic information system.

3.2. Define

The Define stage represents a continuation of the Empathize process, involving 903 respondents from various stakeholder groups. Quantitative data and open-ended responses revealed significant gaps between user needs and the current state of the academic information system, particularly regarding interface design, integration, and service speed. The central focus of this phase is to formulate system requirements based on user feedback rather than technical assumptions. The first identified need involves improving interface accessibility, particularly for students with disabilities. The absence of features such as screen readers and visual contrast options has emerged as a major obstacle. Therefore, the new system should adopt the principles of Universal Design for Learning, ensuring an inclusive interface and an intuitive user experience for all users. The second need relates to the integration of information across units. System fragmentation forces students to access multiple separate portals, resulting in data duplication and confusion. This stage recommends the development of an integrated system based on REST API to simplify access and ensure real-time synchronization across services. The third need reflects the importance of

responsive administrative services, as students and faculty frequently report delays and a lack of transparency. Accordingly, the system must provide automatic notifications, service tracking features, and a status dashboard to improve efficiency and build trust in academic services.

The fourth and fifth needs are closely tied to accessibility and user-driven data support, which remain limited, particularly for students with disabilities. These students have not been involved in system design, resulting in suboptimal accessibility features such as voice navigation, contrast settings, or alternative text. Excluding users from the design process often leads to alienation and discomfort when interacting with digital systems [33]. Furthermore, the absence of academic risk profiling mechanisms leads to reactive rather than proactive interventions. However, the use of digital data to identify risk and design personalized support has been shown to improve student engagement and academic performance [34-36]. Therefore, the system design must be grounded in a participatory, empathy-driven approach, supported by predictive analytics and inclusive of diverse user needs. In this way, the academic information system becomes responsive, proactive, and capable of holistically supporting students' motivation to achieve.

3.3. Ideate

The Ideate phase serves as a critical stage in the design of the integrated academic information system, during which innovative ideas are generated to address the problems identified in the Define phase. This stage represents a concrete response to users' psychosocial needs, particularly in fostering student achievement motivation.

3.2.1. Collaborative Workshop with Experts and End Users

The ideation workshop provided a platform for students to express their experiences and the obstacles they face in accessing academic services. Their direct involvement helped reinforce a sense of ownership over the system being developed. When students feel heard and valued, they are more likely to exhibit greater motivation to actively participate in academic processes. This aligns with the principle that participation in decision-making enhances perceived competence and autonomy, both of which are essential drivers of achievement motivation.

3.2.2. Development of Inclusive Design Concepts

The inclusive design concept developed during the ideation phase is not merely a functional approach but also represents a pedagogical strategy that places accessibility as a core principle. In the context of academic information systems, features such as streamlined navigation, customizable color contrast, adjustable font size, and screen reader support enable students, including those with disabilities, to access services based on their preferences. This principle aligns with the idea that digital inclusion in higher education requires active involvement from all stakeholders and the elimination of structural barriers at the initial stages of system design [37]. Systems with high accessibility also enhance students' sense of efficacy and autonomy in learning, both of which are key to fostering academic motivation. The integration of academic systems using REST API improves service speed and user satisfaction, particularly in the submission of course registration forms and access to class schedules [17]. The importance of incorporating stakeholder input, including from vulnerable groups, to create systems that are responsive to users' actual needs. In addition, user involvement in system development has been shown to strengthen technology acceptance and ensure alignment between digital interfaces and user contexts [38].

3.2.3. Development of Notification Features as a Self-Regulation Stimulus

The concept of real-time notification developed during the Ideate stage serves a strategic role in supporting students' self-regulated learning processes, functioning as an external stimulus that activates the entire cycle of self-regulation. In the forethought phase, academic notifications such as reminders for deadlines, exam schedules, or significant academic updates assist students in setting specific and proximal learning goals, anticipating outcomes, and formulating appropriate learning strategies. Prompt and contextualized information delivery enables students to initiate learning actions in a deliberate and structured manner from the outset. During the performance phase, the presence of notifications supports strategies related to time management, learning environment structuring, and the execution of self-monitoring, which are essential components for maintaining learning consistency. Students who regularly receive relevant notifications are more likely to engage in continuous monitoring of their learning processes and to adjust their strategies when necessary, thereby strengthening their internal control over academic achievement. Effective self-observation is influenced by timely feedback, and the notification system can serve as one of its key sources. In the self-reflection phase, the integration of notifications within academic information systems allows students to evaluate their learning achievements and the effectiveness of the strategies they have implemented. This reflection process enhances self-satisfaction and reinforces adaptive inference, which has a positive impact on sustaining long-term academic motivation. Therefore, the development of notification features in academic information systems extends beyond mere technical functionality. It operates as a pedagogical instrument that activates and strengthens each phase of students' self-regulation cycles in a sustainable manner.

3.2.4. System Integration as a Supporting Learning Environment

A fragmented system has been shown to cause confusion, frustration, and a decline in students' motivation to access academic services. Therefore, service integration emerged as a central idea during the Ideate stage. When a system is capable of providing consistent and reliable information, students are more likely to perceive their learning environment as structured and supportive. This perception constitutes one of the external determinants of achievement motivation, as posited by learning environment theories.

Based on several aspects identified for development, we constructed an initial prototype of the integrated academic information system. This prototype includes features for managing faculty data, student data, and the final examination system. The system visualization offers a concrete representation of the types of services accessible to students. A clear understanding of how the system supports academic activities can enhance goal orientation and increase the perceived utility of digital services among users. This clarity, in turn, contributes to shaping motivation for achieving optimal academic performance.

3.3. Prototype

The Prototype stage represents a logical progression from the Ideate phase, where ideas generated through workshops, inclusive design development, and the need for an integrated learning environment are transformed into a functional digital system ready for real-world testing. This phase focuses not only on technical aspects but also on the creation of user experiences that foster student achievement motivation. These experiences are shaped through the enhancement of self-regulation, perceived self-efficacy, and the overall quality of the academic learning environment.

(i) Initial Prototype Development. The initial prototype was designed based on collaboratively generated ideas from the previous stages. The interface was developed to be simple, intuitive, and customizable (see **Figure 4**). The visual design incorporates inclusive features such as high-contrast color options, screen reader compatibility, and adjustable text sizes. These elements aim to foster students' confidence in navigating academic services, which psychologically contributes to the strengthening of intrinsic motivation and perceived competence. Core features such as the submission of the Course Registration Form, real-time grade viewing, and access to academic announcements were designed to be easily accessible within a unified portal.

(ii) Prototype Testing and Evaluation. The prototype was tested directly with primary users, including students with special needs, to evaluate ease of use, functionality completeness, and perceived comfort. The results indicated that a user-friendly interface enhances engagement and efficiency in accessing academic information. Students reported that the integrated system enabled them to plan their studies more effectively, manage their time independently, and feel more prepared to meet academic tasks. These outcomes align with the principles of self-regulated learning, which is a critical component of achievement motivation.

(iii) Identification of problems in using the prototype. Several important observations emerged from the evaluation, including delayed notifications on mobile devices and difficulties related to repeated logins. Although relatively minor, these issues affected time regulation that the real-time alert feature was designed to support. In the context of achievement motivation, academic notifications serve as external prompts that activate students' initiative and self-control in completing tasks [35, 39]. Therefore, refining the notification system became a key priority for subsequent iterations. The accessibility features developed not only benefited students with disabilities but also created a more supportive and less intimidating learning experience. Students reported that customizable systems provided a comfortable and independent learning space. This contributed to the perception that the academic environment supports their success, consistent with learning environment theories, which assert that a well-structured external context plays a significant role in shaping motivation and achievement.
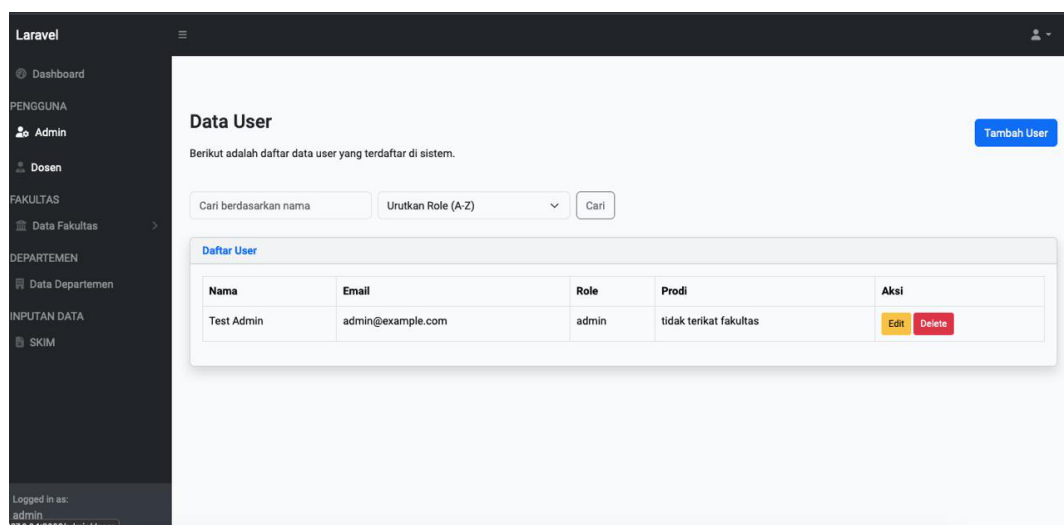

Figure 3. Prototype of the student information system development.

The system prototype's visual interface offered students a concrete understanding of how the platform can help them achieve academic goals. With greater clarity and ease of access,

the system fostered the development of positive goal orientation and enhanced the perceived usefulness of the digital platform. Alignment between system features and the actual needs of users forms a crucial foundation for long-term adoption and serves as a strategic medium for cultivating achievement motivation that is both sustainable and progressively strengthened over time.

3.4. Test

The test phase represents the final stage of this study, aiming to examine the validity and functionality of the student information system prototype developed during the previous prototype phase. In this phase, the system was evaluated by 19 primary users, consisting of 9 lecturers and 10 students, including 4 students with disabilities. The goal was to assess the extent to which the system met user expectations in terms of functionality, accessibility, and digital interaction experience. The evaluation was conducted comprehensively using predetermined assessment indicators, such as interface design quality, ease of use, technical stability, as well as user security and satisfaction. As shown in **Table 1**, the system demonstrated high-quality interface design, characterized by a clean layout, structured organization, and intuitive navigation. Students responded positively to the user-friendly interface, which helped reduce both technical and emotional barriers when accessing academic information. This condition contributed to an increased sense of self-competence, particularly in terms of confidence in independently operating the system. Such perceptions play a crucial role in strengthening student achievement motivation, especially concerning academic self-efficacy and the confidence needed to manage learning responsibilities [39, 40].

Table 1. User evaluation results on the design quality, functionality, and accessibility of the faculty academic information system.

No	Aspect	Indicators	Review Results
1	Interface Design Quality		
	Layout	a. Interface layout is neat and well-structured.	The system interface was evaluated as tidy and well-organized, allowing users to understand each element's function without confusion. The consistent layout enhanced readability and visual comfort across both desktop and mobile devices. Students, including those with special needs, responded positively as there were no visual disturbances that hindered access to information. This structure contributed to building user confidence and efficiency in system usage.
		b. Visual elements are easily recognizable and accessible.	Visual elements in the prototype were designed with consistent colors, icons, and clear labels, making it easy for users to identify the features quickly. Students reported that the symbols and buttons were prominently displayed and easy to find, both for general users and those with specific needs. This level of visual accessibility enhanced orientation and reduced the likelihood of user errors.
		c. Layout supports ease of navigation.	The interface layout was found to be effective in facilitating navigation, with primary features easily accessible and a logical flow of usage. However, evaluation results suggested optimizing the information hierarchy, particularly for additional features, by adding distinguishing icons and grouping categories to improve navigational efficiency, especially on mobile views.

Table 1 (Continue). User evaluation results on the design quality, functionality, and accessibility of the faculty academic information system.

No	Aspect	Indicators	Review Results
	Design Consistency	a. Consistent use of colors, fonts, and icons throughout the system.	The use of colors, fonts, and icons across the system is considered consistent, creating a cohesive and professional visual impression. This consistency supports users in quickly recognizing interface patterns, reducing confusion, and enhancing comfort when navigating various system features.
		b. Icons and visual elements assist in feature identification.	Icons and visual elements within the system have proven effective in helping users identify available features. The symbols used are intuitive and familiar to most users, facilitating faster search processes and enabling efficient interaction without the need to read detailed text. This enhances an overall user experience that is both efficient and responsive.
2	**Ease of Use**		
	Navigation	a. Users can easily locate the required features.	Users were able to easily find key features such as the Course Registration Form, grades, and class schedules due to the strategic placement of menus and the use of clear icons. However, some additional features were less visible within the menu structure. It is recommended to add a quick search function or shortcut to improve accessibility and efficiency, particularly for new users or students with special needs.
		b. Navigation menus and buttons are easy to use.	Navigation menus and buttons were considered easy to use due to their proportional size, clear labeling, and responsive design when clicked. Users felt comfortable accessing various features without confusion. Consistent navigation across all pages supported smooth user interaction and minimized errors.
		c. The information search process is intuitive and efficient.	The information search process was deemed intuitive and efficient, as the system provided results quickly and in a relevant manner. Users could locate academic data such as schedules, grades, or announcements without needing to go through complex steps. The search feature was particularly helpful in enabling students to access essential academic information promptly.
	Interaction	a. The system responds quickly without noticeable lag or delay.	The system demonstrated fast and stable performance during testing. No significant lag or delay was observed when users accessed key features such as completing the Course Registration Form, checking grades, or opening announcement pages. This responsiveness supports smooth interaction and enhances user comfort when navigating the system.
		b. Notifications appear in a timely and relevant manner.	The notification feature was considered relevant and informative, particularly in conveying academic announcements and schedule changes. Most users reported that notifications appeared promptly on desktop devices. However, a slight delay was noted on some mobile devices, indicating a need for improvement to ensure consistent delivery across platforms.

Table 1 (Continue). User evaluation results on the design quality, functionality, and accessibility of the faculty academic information system.

No	Aspect	Indicators	Review Results
3	**Accessibility**		
	Accessibility Features	a. The system provides accessibility features such as screen readers and color contrast options.	Accessibility features such as screen readers and color contrast settings in the system are considered effective in supporting students with disabilities, particularly those who are visually impaired or have other visual limitations. Users reported that these features enhance their independence and ease in accessing academic information. However, improvements are needed in the quality of the screen reader voice and the flexibility of speed control settings. In addition, color contrast options should be expanded to include a broader range of visual themes, such as dyslexia-friendly modes, to ensure an inclusive experience for all users.
		b. Options for large text and color customization are available.	Options for adjusting text size and color are available and function well in enhancing visual comfort, particularly for students with visual impairments. These settings allow users to customize the display according to individual preferences, which has a positive impact on user satisfaction and consistency when accessing information. However, some users suggested that these settings be accompanied by a preview display to help users make more accurate choices, and that additional color combinations be added to reduce the risk of visual fatigue and accessibility barriers.
		c. The system can be used by students with special needs without barriers.	The system is considered inclusive and accessible to students with special needs without significant obstacles. Users with visual impairments and mobility challenges were able to access key features such as the Course Registration Form, schedules, and announcements using screen readers and keyboard navigation. However, improvements are still needed in terms of interoperability with external assistive technologies such as NVDA and TalkBack, as well as refinement of audio narration. Further testing involving a wider range of disabilities is recommended to ensure the system is truly universal and does not impose unnecessary cognitive load.
	Device Support	a. The system is accessible on both mobile and desktop devices.	The system demonstrates strong compatibility across various devices, including both mobile and desktop platforms. Users reported a responsive interface, consistently intuitive navigation, and seamless operation of core features such as Course Registration Form submissions, grade access, and notifications without technical issues across devices. This enhances the flexibility of academic information access anytime and anywhere.
		b. The application runs smoothly across multiple operating systems (Windows, macOS, Android, iOS).	The application operates reliably across major operating systems such as Windows, macOS, Android, and iOS. Testing revealed no significant differences in performance or user interface across platforms. All essential features remained consistently accessible, with no system-specific bugs identified. This reinforces the application's portability and ensures a uniform user experience across devices.

Table 1 (Continue). User evaluation results on the design quality, functionality, and accessibility of the faculty academic information system.

No	Aspect	Indicators	Review Results
4	**Technical Quality**		
	System Stability	a. The system runs stably without crashes or critical errors.	The system operated stably without any crashes or errors that could disrupt the testing process.
		b. The system can handle high user loads without performance issues.	The system was able to handle multiple concurrent users without any significant performance degradation during the trial.
	Access Speed	a. Fast loading times, especially for core features such as the Course Registration Form and academic grading.	The loading time was considered fast, particularly when accessing core features like the Course Registration Form and grade reports, which support efficient system use.
		b. Notifications are received by users promptly.	The system successfully delivered notifications quickly and on time, allowing users to respond to important academic information without delay.
5	**Feature Completeness**		
	Core Features	a. Availability of access to Course Registration Form, Academic Transcript, class schedules, and announcements.	Core features such as access to the Course Registration Form, Academic Transcript, class schedules, and announcements are available and function as intended. Students found these features helpful for consolidating information in a single portal. However, it is recommended to add features such as class rescheduling and calendar integration to enhance the system's flexibility and adaptability.
		b. Features function reliably without issues.	All features performed well without any technical issues during the testing period.
	Supporting Features	a. The system includes notification and reminder functions.	Notification and reminder features were effective and responsive throughout the testing process.
		b. The system includes guidance documents and help content.	Documentation and guidance materials were prepared clearly, making it easier for users to understand how to operate each feature independently. This improved user autonomy and reduced dependency on technical assistance.
6	**Security and Privacy**		
	Login Security	a. The system implements two-factor authentication to ensure secure login.	The system applies two-factor authentication to enhance login security, preventing unauthorized access. However, the verification process should be optimized to ensure smooth operation across devices without login disruptions.
		b. Students' data is well-protected.	Students' personal information is securely protected through encryption and restricted access settings. Users expressed confidence that sensitive information was not easily accessible to unauthorized parties.
	Privacy Settings	Users can manage their privacy preferences within the system.	Users can manage their privacy settings independently in the system, such as hiding specific data from public view or selecting preferred communication channels.

Table 1 (Continue). User evaluation results on the design quality, functionality, and accessibility of the faculty academic information system.

No	Aspect	Indicators	Review Results
5	**User Needs**		
	User Satisfaction	a. Users feel the system supports their academic needs.	Users indicated that the system effectively supports their academic needs due to the availability of essential features such as the Course Registration Form, Academic Transcript, and Announcements, all of which are integrated into a single, easy-to-use platform.
		b. The system provides accurate and up-to-date information.	The system was evaluated as delivering accurate and up-to-date information, especially regarding class schedules and academic calendars. This supports students in managing academic activities more effectively.
		c. Users feel comfortable and secure when using the system.	Users reported feeling comfortable and secure when using the system. The clarity of layout, feedback during operations, and minimal technical issues contributed to a positive user experience and overall confidence in system reliability.

Based on the trial results conducted during the test phase, the student information system prototype demonstrated highly satisfactory performance in terms of functionality, accessibility, and user experience. The evaluation involving 19 participants (comprising lecturers, students, and students with disabilities) indicated that the intuitive, consistent, and responsive interface design facilitated efficient and inclusive digital interaction. The system successfully minimized both technical and emotional barriers typically encountered by users, particularly in accessing academic information such as the Course Registration Form, grades, and class schedules. This positive user experience is expected to directly contribute to the development of self-perceived competence, namely the users' belief in their ability to manage and access information independently. This is crucial, as perceived competence forms the foundation of academic self-efficacy, which in turn fosters learning motivation, persistence, and confidence in facing academic challenges.

System reliability aspects such as fast response time, accessible features for users with special needs, and the availability of real-time information further enhanced users' sense of control and self-confidence in the learning process. This aligns with the motivational components of self-determination theory, which emphasizes the importance of competence, autonomy, and relatedness as key drivers of intrinsic motivation [41, 42]. In addition to the system's improved reliability, it is also expected to have a significant psychological impact on enhancing students' academic motivation. Further recommendations include the development of personalization features, multilingual support, and the integration of reflective tools (e.g., academic achievement history) to further strengthen the system's role as a motivating learning support platform.

3.5. Relevance to Sustainable Development Goals (SDGs)

The implementation of inclusive and technology-driven academic information systems in higher education aligns significantly with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 4: Quality Education and SDG 10: Reduced Inequalities. These two global objectives emphasize the importance of equitable access to education and the need to

dismantle structural barriers that hinder participation from marginalized groups, especially persons with disabilities.

(i) Supporting SDG 4: Quality Education. SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. In this study, the development of a REST API-based academic information system directly supports this goal by integrating accessible features such as screen readers, high-contrast displays, adjustable font sizes, and cross-device compatibility. These features are grounded in Universal Design for Learning (UDL) principles and address the unique needs of students with diverse learning profiles. By providing a unified and easily navigable platform, the system reduces cognitive load and supports independent learning. As a result, it enhances student engagement, academic self-efficacy, and overall learning motivation, key indicators of quality education outcomes. Furthermore, the system encourages self-regulated learning by embedding real-time notifications, academic progress tracking, and intuitive access to academic services. These elements empower students to manage their academic responsibilities more effectively, aligning with SDG 4's focus on learner-centered, flexible, and adaptive education systems [13, 35].

(ii) Advancing SDG 10: Reduced Inequalities. SDG 10 focuses on reducing inequality within and among countries, including ensuring equal access to services and resources for persons with disabilities. This study addresses digital inequality at the institutional level by involving students with disabilities throughout the design process and validating system functionality based on their feedback. The inclusion of accessible features is not treated as an afterthought but as a fundamental design principle. By proactively involving underrepresented groups, the system exemplifies participatory ICT innovation that fosters institutional fairness and social equity [37]. The study's user-centered approach and its technical responsiveness reflect a commitment to breaking digital silos in higher education. System fragmentation often excludes vulnerable students, but REST-based integration ensures that all learners (regardless of their physical or cognitive conditions) can access academic resources equitably. In this way, the system serves as a model for reducing digital disparity and enhancing inclusion within academic institutions.

(iii) Broader Impact and Replicability. By aligning technological development with SDGs, this study offers a scalable framework for ICT-based educational reforms in higher education. The REST API architecture allows for adaptation across institutional contexts, making it possible for other faculties or universities to replicate the approach. Moreover, the pedagogical integration of accessibility, motivation, and administrative transparency addresses not only technological gaps but also systemic and attitudinal barriers to inclusive education.

The academic information system developed in this research contributes meaningfully to the global agenda of achieving inclusive, equitable, and quality education while actively reducing inequality in access to academic services. It reinforces the role of science and technology as catalysts for educational justice and sustainable development. Finally, this study adds new information regarding SDGs, as reported elsewhere (**Table 2**).

Table 2. Previous studies on SDGs.

No	Title	Reference
1	Low-carbon food consumption for solving climate change mitigation: Literature review with bibliometric and simple calculation application for cultivating sustainability consciousness in facing sustainable development goals (SDGs)	[43]
2	Towards sustainable wind energy: A systematic review of airfoil and blade technologies over the past 25 years for supporting sustainable development goals (SDGs)	[44]
3	Assessment of student awareness and application of eco-friendly curriculum and technologies in Indonesian higher education for supporting sustainable development goals (SDGs): A case study on environmental challenges	[45]
4	A study on sustainable eggshell-derived hydroxyapatite/CMC membranes: Enhancing flexibility and thermal stability for sustainable development goals (SDGs)	[46]
5	Integrating multi-stakeholder governance, engineering approaches, and bibliometric literature review insights for sustainable regional road maintenance: Contribution to sustainable development goals (SDGs) 9, 11, and 16	[47]
6	Computational engineering of malonate and tetrazole derivatives targeting SARS-CoV-2 main protease: Pharmacokinetics, docking, and molecular dynamics insights to support the sustainable development goals (SDGs), with a bibliometric analysis	[48]
7	Innovative nanofluid encapsulation in solar stills: Boosting water yield and efficiency under extreme climate, supporting sustainable development goals (SDGs)	[49]
8	Modernization of submersible pump designs for sustainable irrigation: A bibliometric and experimental contribution to sustainable development goals (SDGs)	[50]
9	Sustainable development goals (SDGs) in engineering education: Definitions, research trends, bibliometric insights, and strategic approaches	[51]
10	Sustainable packaging: Bioplastics as a low-carbon future step for the sustainable development goals (SDGs)	[52]
11	Production of wet organic waste ecoenzymes as an alternative solution for environmental conservation supporting sustainable development goals (SDGs): A techno-economic and bibliometric analysis.	[53]
12	Hazard identification, risk assessment, and determining control (HIRADC) for workplace safety in the manufacturing industry: A risk-control framework complete with bibliometric literature review analysis to support sustainable development goals (SDGs)	[54]
13	Techno-economic analysis of production ecobrick from plastic waste to support sustainable development goals (SDGs)	[55]
14	Techno-economic analysis of sawdust-based trash cans and their contribution to Indonesia's green tourism policy and the sustainable development goals (SDGs)	[56]
15	The influence of environmentally friendly packaging on consumer interest in implementing zero waste in the food industry to meet sustainable development goals (SDGs) needs	[57]
16	Implementation of Sustainable Development Goals (SDGs) no. 12: Responsible production and consumption by optimizing lemon commodities and community empowerment to reduce household waste	[58]
17	Analysis of the application of Mediterranean diet patterns on sustainability to support the achievement of sustainable development goals (SDGs): Zero hunger, good health and well beings, responsible consumption, and production	[59]
18	Efforts to improve sustainable development goals (SDGs) through education on diversification of food using infographic: Animal and vegetable protein	[60]
19	Safe food treatment technology: The key to realizing the Sustainable Development Goals (SDGs) zero hunger and optimal health	[61]
	Analysis of student's awareness of sustainable diet in reducing carbon footprint to support Sustainable Development Goals (SDGs) 2030	[62]

Table 2 (Continue). Previous studies on SDGs.

No	Title	Reference
16	The relationship of vocational education skills in agribusiness processing agricultural products in achieving sustainable development goals (SDGs)	[63]
17	Sustainable development goals (SDGs) in science education: Definition, literature review, and bibliometric analysis	[64]

4. CONCLUSION

This study demonstrates that the development of an integrated academic information system based on REST API through a design thinking approach successfully addresses the functional, technical, and psychosocial needs of users, particularly in supporting student achievement motivation. The prototype was tested by lecturers and students, including those with disabilities, and showed stable performance, high accessibility, and an intuitive interface design. Features such as real-time notifications, efficient navigation, and cross-device compatibility contributed to enhancing students' perceived control and academic self-efficacy. The system facilitates access to information while fostering an inclusive, safe, and self-regulated learning environment. This contributes directly to increased motivation and learning autonomy. These findings highlight the importance of user-centered digital innovation in improving the quality of academic services and learning outcomes in higher education. Future research is encouraged to explore the integration of artificial intelligence technologies to support more adaptive and predictive personalization of academic services.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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