Utilization of the Chemistry Instrument Booking Website System for Digitizing Services at the Chemistry Research Laboratory

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Abstract. One way to improve the quality of laboratory services in the era of the Fourth Industrial Revolution is by utilizing information and communication technology, referred to in this research as digitization. The use of this website will make it easier for students to quickly and easily access the necessary in-formation. So far, the process of booking equipment by students, especially those conducting research, has been done via WhatsApp chat with the laboratory technician or instrument operator, or by directly asking for permission on the day they want to use it. This research aims to understand the stages of creating a digital system for booking instrument equipment in the research laboratory of the Chemistry Department at Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya and to obtain user responses to the system/website. The method used is the 4D method. This research concludes that the use of a chemistry instrument booking website system can enhance laboratory services in research facilities. It can be seen from user satisfaction survey result are highly satisfied.

Keywords: Booking System, Digitalization, Laboratory Services.

1 Introduction

In the era of the Industrial Revolution 5.0, the use of technology, communication, and information is rapidly advancing and evolving. Brennen and Kreiss describe digitization as the growing accessibility of digital data enabled by advancements in the creation, transfer, storage, and analysis of such data. This process has the power to structure, shape, and influence the modern world [1]. It involves converting printed, audio, and video forms into digital formats [2]. Digitalization is the process of implementing or using digital systems. The use of these digital systems requires information and communication technology, which naturally comes with various rules and procedures for their operation, necessitating specific skills or expertise from the users. One of the most crucial sectors for the development of information and communication technology is education, particularly in higher education institutions.

In higher education institutions such as universities, academies, and other colleges, educational management is implemented differently from secondary or primary

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education institutions due to its greater complexity. To ensure effective management, efficiency in overall administration is necessary. The rapid development of technology can be utilized to support the management of higher education institutions. With the application of technology in these institutions, many roles and procedures can be automated. One example of the role of information and communication technology in the management of higher education institutions is in the service of chemistry laboratories at universities.

In order to facilitate the ongoing acquisition and application of chemical knowledge, it is crucial for educational institutions, particularly those offering higher education, to include chemistry laboratories [3]. An academic support unit inside an educational institution is an educational laboratory, henceforth simply called a laboratory. These labs may be either stationary or mobile, and they are designed to be systematically managed to conduct testing, calibration, and limited-scale production utilizing materials and equipment that are based on specified scientific methods. Teaching, research, and/or helping the local community are all part of what these labs do [4]. The laboratory's ability to provide assistance may be boosted by enhancing HR and service quality. Laboratory services may be enhanced via the use of information and communication technologies. First, information technology allows for more efficient and practical services; second, tracing is made easier and faster; third, time and labor are saved; fourth, users are motivated to make the most of the laboratory's facilities; and sixth, paper waste is reduced.

The process of booking equipment by students so far, especially those who conducting research, has been done via WhatsApp chat with the laboratory technician or instrument operator, or by directly asking on the day they want to use it. This booking process has several drawbacks, including: (1) data storage that is very prone to loss because the process is done through WhatsApp chat, and (2) if the booking process is done in person, there is a high possibility of confusion because the technician or instrument operator might forget that the equipment is already in use. Therefore, the use of a system for booking equipment and knowing the instrument schedule is very important to minimize data loss and booking errors between the technician or operator and the students.

This research aims to understand the stages of creating a digital system for booking instrument equipment in the research laboratory of the Chemistry Department at Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya and to obtain user responses to the system/website.

2 Methods

This research focuses on advancing the digitalization of services provided by analytical and inorganic laboratories, aiming to enhance the accessibility and user experience of these services for students. To achieve this goal, the development research model that used in this research is R&D method developed by Sugiyono [5].

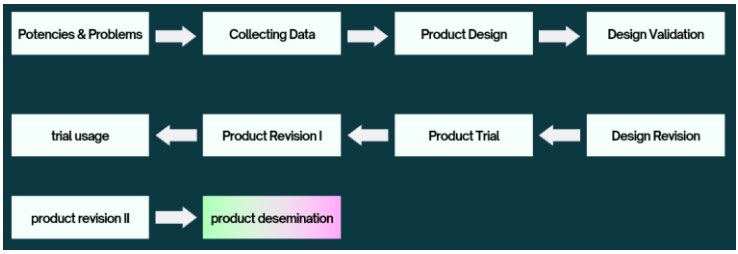

Fig 1. R&D Method developed by Sugiyono

The first step to do was identify potential and problems. The problem in chemistry department laboratory was the booking system for using instrumentation is still done manually. The Second step to do was collecting sources of information related to the research, it was done by literature study and giving questionaries to students, lecturers, and practitioners. The third step was designing the product, the booking website. The information obtained from sources collection was used to fill in the database, menu coding, website content and several features. After that, the booking website design was validated. The validator was chemistry lecturer and chemistry lecturer that also in charge for managing department website. The validity data was in the form of a score of 1-5 as in Likert scale. The validity data were analyzed descriptively and quantitatively, and its analyzed on each indicator using the mode, declared valid if the mode score was at least 4 [6].

The booking website design revision was done according to validation result. The trial of booking website design was done by researcher. The booking website, as the product, was undergo the revision. First product revision was done because there were some errors in the website. The product limited trial was done by students and lecturers' representative from chemistry department. Second product revision was done after getting feedback from trial participant.

The booking website dissemination was carried out by website user from lecturers, laboratory assistants, and chemistry department students. User response results are obtained from questionnaire results.

3 Results and Discussions

The digital system for booking chemical instruments in the Chemistry Research Laboratory at FMIPA UNESA can be accessed at https://sipinatru.labsivera.com/. This system was created using coding. Coding is one of the actions in programming, involving writing code or scripts in a programming language. In other words, coding is a way to communicate with computers. Generally, coding means writing a set of codes according to specific syntax rules of the programming language being used. There are various programming languages available. The programming language used for this website is HTML, where the coding remains simple. The booking system in this research is called "SIPINATRU". The coding for this booking system uses the PhpStorm application,

while its database uses MySQL. Currently, the inventory application runs offline for testing purposes, using the Xampp application.

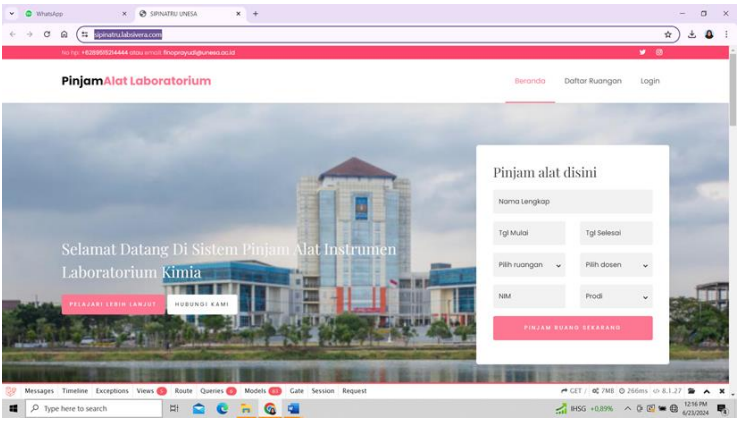

Fig. 2. Initial interface of the SIPINATRU system

Figure 1 is the initial interface of the SIPINATRU system. In this initial interface, borrowers need to fill in their information, including name, borrowing date, the equipment to be borrowed, and student identification number. This student identification number will be used as the username and password for logging into the system.

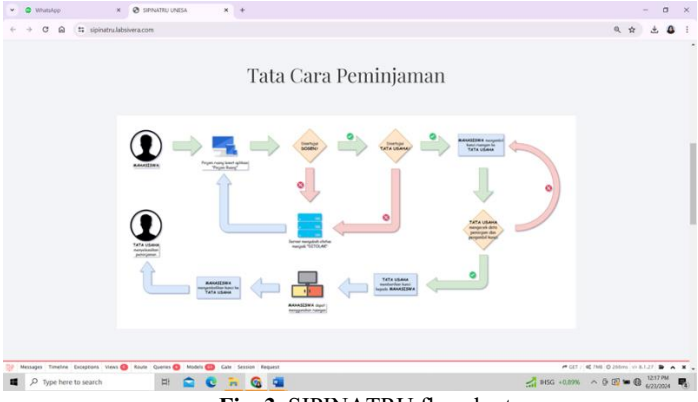

Fig. 3. SIPINATRU flowchart

The SIPINATRU system includes borrowing procedures in the form of a flowchart to help users understand and use the system more easily.

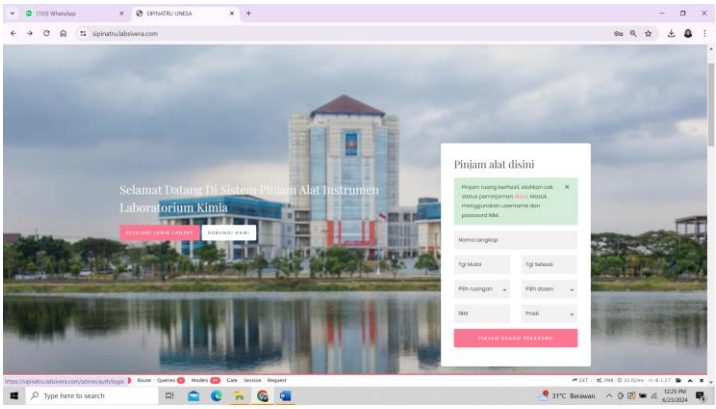

Fig. 4. Filling in username and password data

The image above shows the display of the system after entering the username and password. The borrowing status can be viewed after the user logs in with the username and password entered on the initial page. Upon entering the username and password on the initial page, the user will proceed to the dashboard where there is a borrowing menu to check the status of the instrument to be borrowed.

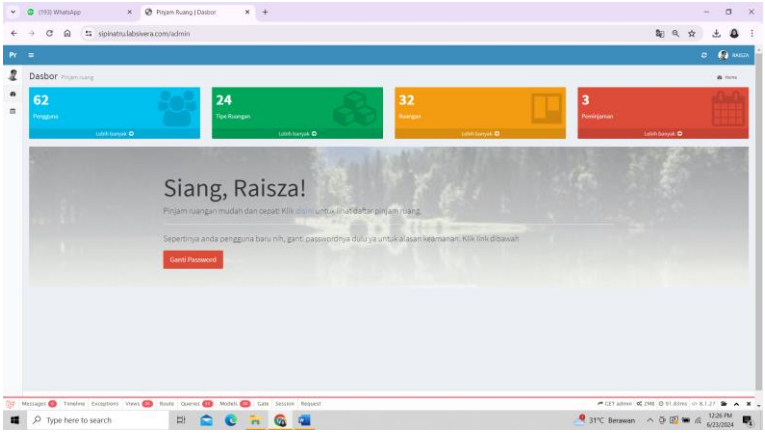

Fig. 5. Login page

There are several approval steps that users must go through when borrowing instrument equipment. The first approval is from the supervising lecturer so that they are aware of the equipment to be used by the user, in this case, the student. This ensures that if there is any damage, responsibility can be traced back to the appropriate person. The second approval is from the laboratory technician or relevant equipment operator. The borrowing status will change once it has been approved by both the supervising lecturer and the relevant technician.

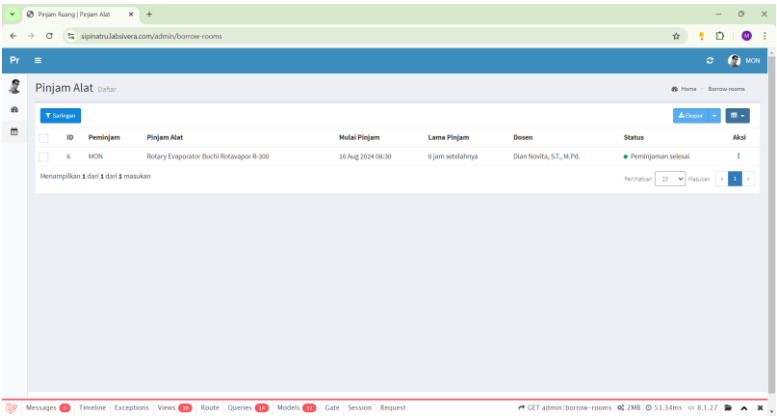

Fig. 6. Status page

The borrowing status will be marked as "completed" once both the supervising lecturer and the relevant technician have approved it, allowing the user to directly use the instrument at the scheduled time.

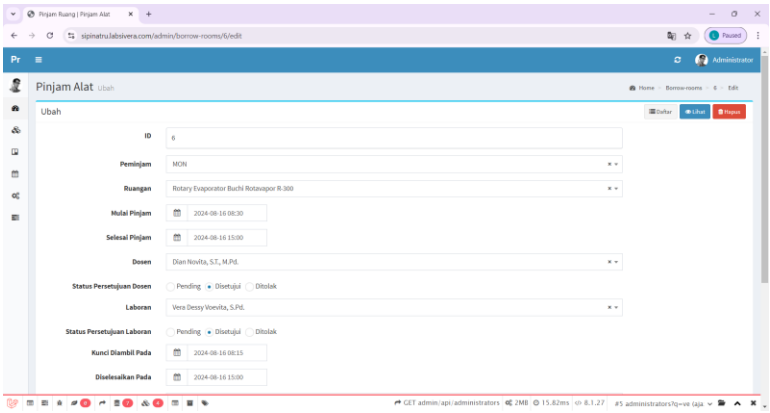

Fig. 7. Administrator interface

In operating this system, there is an administrator responsible for changing security settings, accessing all data on the website, and modifying borrowing statuses. Therefore, as an admin user, several menus are available on their dashboard, designed to facilitate system operations. Some of the functions available to the administrator include adding users, adding instrument equipment, and modifying borrowing statuses.

3.1 Data Analysis

a. Website Validation

Validation is conducted by 3 subject matter experts, 3 website experts, and 3 language experts. Website validation uses a Likert scale. To achieve accurate, efficient, and communicative results, variables measured with specific instruments are expressed in numerical form.

Table 1. Likert Scale

Category	Scale
Invalid	1
Less Valid	2
Quite Valid	3
Valid	4
Very Valid	5

Since the acquired validation data is ordinal and so not amenable to mathematical operations, the choice is made by mode, i.e., using the most common number. If a website meets at least three of the requirements, or falls into the "sufficiently valid" category, it is deemed legitimate. With a minimum score of 3 or above, a website is considered legitimate. The SIPINATRU content validation findings were deemed genuine since they achieved a mode of 4, which is considered excellent.

3.2 Result Analysis

a. Material Validation

Table 2. Material Validation Result

No	Statement	V1	V2	V3	Mode
1	Information about website is presented clearly	4	4	5	4
2	Instruments and instrument specifications are clearly presented	4	4	5	4
3	Information about instruments according to the needs for the course practicum	5	4	5	5
4	Information about the instrument according to the needs for research	5	4	5	5
5	Information about the equipment borrowing schedule is presented clearly	4	4	5	4
6	Website makes it easier for the chemistry academic community to book instruments	5	5	4	5

No	Statement	V1	V2	V3	Mode
7	The website provides up-to-date information	5	4	5	5

SIPINATRU got mode of 5 for material validation results, so it categorized as very valid.

b. Website Validation

Table 3 Website Validation Result

No	Statement	V1	V2	V3	Mode
1	The guide is presented clearly	4	4	4	4
2	The background color matches the text	4	5	5	5
3	The colors of the images and tables match	5	4	5	5
4	Font color, font size and font type are appropriate	4	4	5	4
5	The website responds quickly	5	4	4	4
6	Website runs smoothly when operated	4	4	4	4
7	Can be operated from different devices	5	5	5	5
8	The appearance of the website is attractive	4	4	4	4
9	Website navigation is easy to operate	5	5	4	5
10	Websites create positive experiences for users	4	5	4	4

SIPINATRU got mode of 4 for website validation results, so categorized as valid.

c. Linguistic Validation

Table 4 Linguistic Validation Result

No	Statement	V1	V2	V3	Mode
1	Writing on the website uses Indonesian writing rules and is good and correct	5	4	5	5
2	The writing on the website uses chemical terms that are easy to understand	5	4	5	5
3	Text in website used the effective and efficient lingustic	4	5	4	4
4	Text in website use suitable punctuation	5	5	5	5

SIPINATRU got mode of 5 for linguistic validation results, so it categorized as very valid.

The created SIPINATRU was tested to see whether it met the user's expectations by administering a satisfaction survey. Forty undergraduates who utilize the lab are the ones being mentioned here. Based on WebQual 4.0, a user satisfaction questionnaire was used [7][8][9]. Tabulated in table 5 are the findings from the customer satisfaction survey.

Table 5 Questionnaire Results

Validation by	Result	Information
Laboratory user (student)	83.4%	Very Satisfied

4 Conclusion

This research concludes that the use of SIPINATRU as chemistry instrument booking website system can enhance laboratory services in research facilities. The digitization achieved through this website was developed based on various types of analysis and student requests as lab users. Additionally, a user satisfaction survey indicates that students are highly satisfied with the digitization of laboratory services via this website.

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