

Development of Web-based Application for Laboratory Materials and Tools in Orthotics and Prosthetics Study Program

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ABSTRACT

Keywords:
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Practicum assignments in the laboratory are an essential component of learning, enabling students to apply theories learned in class to achieve learning objectives. In the Applied Orthotics and Prosthetics Undergraduate Study Program at the Ministry of Health Polytechnic Jakarta I, practicum activities carry greater weight than theoretical instruction. This aims to improve student competence in the management of orthotic and prosthetic devices directly. However, in practice, there are many obstacles to completing practicum activities, resulting in learning outcomes not being optimally achieved. Therefore, the purpose of this research is to develop a web-based application for laboratory materials and tools for the Orthotics and Prosthetics Study Program. The method used follows the Web Development Life Cycle (WDLC), namely planning, analysis, design and development, and functional testing. The results of the study show that the web-based application for laboratory materials and tools in the Department of Orthotics and Prosthetics at Jakarta I Polytechnic can facilitate the documentation of laboratory materials and tools entering and leaving the storage area. The results of black-box functional testing indicate that the system operates well according to the established criteria.

INTRODUCTION

Inventory of laboratory materials and equipment is a process used to manage, monitor, and recapitulate the inventory of materials and tools in a higher education laboratory. The inventory process can be conducted manually or electronically. However, the use of manual inventory processes for laboratory materials and equipment has many drawbacks, including the lack of real-time availability tracking, noncompliance in recording incoming materials and tools, and the risk of lost paper records or logbooks (Jansen et al., 2020; Liu et al., 2021). These issues can hamper practical activities in the laboratory (Smith & Brown, 2022).

Practicum assignments in the laboratory are part of the learning process, enabling students to apply the theories learned in class to achieve learning objectives. In the Applied Bachelor of Orthotics and Prosthetics Study Program at the Ministry of Health Jakarta I Polytechnic, practicum activities carry greater weight than theoretical instruction (Kurniawan, 2022). This aims to improve student competence in the direct provision of orthotic and prosthetic devices (Rahmawati & Iskandar, 2021). However, in practice, there are many obstacles in completing practicum activities, resulting in learning outcomes not being optimally achieved (Thompson et al., 2020; Li & Lee, 2021).

Entering the era of the Industrial Revolution 4.0, Indonesian society is required to be prepared to adopt science and technology (IPTEK) in daily life (Prabowo et al., 2020). The implementation of the Industry 4.0 era includes interoperability, where human communication is facilitated through internet-connected media, information transparency, and the utilization

of information systems to assist in performing complex tasks in the workplace (Müller et al., 2021). This shift calls for the integration of digital technologies in education and industrial sectors to improve efficiency and productivity (Shah & Gupta, 2021; Zhang et al., 2022).

Web-based applications can serve as a potential solution to overcome problems in recording materials and tools during laboratory practice. Through this digital platform, information about laboratory materials and tools can be presented in an organized, interactive, and accessible manner anytime and anywhere (Nguyen & Hoang, 2020). In addition, web-based applications can support student-centered learning and blended learning approaches, which align with the direction of vocational education transformation toward technology-based learning (Khan & Ali, 2021; Johnson et al., 2022). Several previous studies have shown that the use of interactive digital media can increase learning motivation, improve time efficiency, and enhance students' independence in understanding practical concepts (Smith et al., 2020; Li, 2021).

The urgency of this research is underscored by several factors. First, the orthotics and prosthetics profession addresses the needs of individuals with limb differences or mobility impairments, making the training of competent practitioners a matter of significant social importance (Lee & Kim, 2020). Second, the Ministry of Health Jakarta I Polytechnic, as a leading institution in this field in Indonesia, requires efficient laboratory management systems to maintain educational quality and meet accreditation standards (Bambang et al., 2021; Andriani & Susanto, 2022). Third, increasing student enrollment in the program—growing by approximately 15% annually—intensifies pressure on existing manual systems (Purwanto & Sari, 2021). Without systematic intervention, these pressures are likely to result in deteriorating practical training quality and compromised graduate competencies (Nguyen et al., 2020).

Web-based laboratory tools and materials information systems are highly beneficial for monitoring and managing tools and materials in real time. This system allows users, including lecturers and laboratory staff, to view the stock of materials and practical tools in advance, thereby reducing shortages during laboratory practice (Teguh et al., 2021; Harsono & Prasetyo, 2021). The application system to be developed will facilitate searching and reporting the use of materials and tools in real time (Yulianto et al., 2022). This can support practical activities by optimizing the use of tools and materials while preventing both shortages and overstocking of laboratory supplies (Setiawan et al., 2021; Sugiharto & Nugroho, 2022). Therefore, the purpose of this research is to develop a web-based application for laboratory materials and tools in the Orthotics and Prosthetics Study Program (Yusuf & Hadi, 2022).

The primary purpose of this research is to develop and evaluate a web-based application for managing laboratory materials and tools in the Orthotics and Prosthetics Study Program at the Ministry of Health Jakarta I Polytechnic. The specific objectives are: (1) to analyze user requirements for laboratory management through focus group discussions with stakeholders; (2) to design and develop a web-based application following the Web Development Life Cycle methodology; (3) to test the functional aspects of the application using black-box testing; and (4) to evaluate user acceptance and usability using the System Usability Scale. This research contributes to both theoretical knowledge and practical applications in educational technology and laboratory management.

METHOD

The study employed the Research and Development (R&D) method. This approach aimed to produce and evaluate a web-based application for managing laboratory tools and materials in orthotics and prosthetics laboratories in Indonesia. The research process included needs analysis, system design, implementation, and testing.

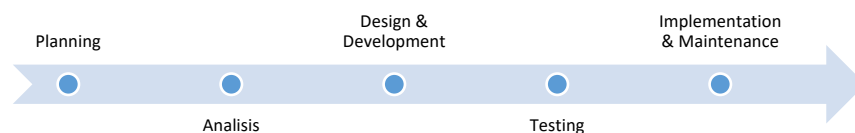


Figure 1. Stages of the WDLC Method

The web-based application system development model in this research used the Web Development Life Cycle (WDLC) method, in which the application development process began with system development and continued through to evaluation. The development of this web-based application utilized the Hypertext Preprocessor (PHP) programming language and MySQL as the database management system. The stages of development in the WDLC method are described as shown in Figure 1 [10].

- 1) Usability Test: In this aspect, the researchers used the System Usability Scale (SUS) questionnaire developed by John Brooke in 1986. SUS was used to obtain quick measurements of users' perceptions of the usability of a computer system. SUS has been proven to be a simple and reliable tool for evaluating usability [12], and it can also be used to compare different systems. Its advantages include: (1) it is reliable and effective for measuring the usability of various products and services; (2) analysis of nearly 1,000 SUS scores has shown that rating results are highly correlated with overall SUS scores; (3) SUS is valid, as it can effectively distinguish between usable and unusable systems; (4) SUS has been proven to be both valid and reliable; and (5) SUS demonstrates high reliability (0.91) and is freely available.
- 2) Functional Aspect (Black-Box Testing): After the system was developed using a programming language, it was tested to minimize errors and to ensure that it functioned as expected. System testing was carried out using the black-box testing method. Black-box testing was used to examine and evaluate the functionality of the developed system.

RESULT AND DISCUSSION

The final product of this research is in the form of a web-based application of prosthetic orthotic laboratory materials and tools developed to support the practicum learning process. This application is designed with a simple, interactive, and easily accessible interface through computer devices and gadgets. The main features of the application include: Catalog of laboratory materials and tools, containing descriptive information about the name, function, technical specifications, and images of each item, a quick search menu to make it easier for

users to find certain materials or tools, an admin dashboard that allows lecturers or laboratories to update information and add new content.

The application development process follows a user-centered design approach, so that users are actively involved in providing input during the trial phase. The designed system can view data on materials, tools, and make usage reports in the laboratory of the prosthetic orthotics department. Warehouse technicians can input incoming goods from the supplier to the web so that the amount of material stock can be seen directly by the super admin of the department to make it easier to find out the stock of consumables in the laboratory of the prosthetic orthotics department according to figure 5.





















No. #	ID Barang	Nama Barang	Jenis Barang	Stok	Stok (Min)	Satuan	
1	B000573	WD 40	Main Store	75	1	Botol	 
2	B000572	Silicon Spray	Main Store	74	1	Botol	 
3	B000571	Sewing Needle Jarum Jahit	Main Store	43	1	Pak	 
4	B000570	Masking Tape 2*	Main Store	74	1	Roll	 
5	B000569	Masking Tape 1*	Main Store	95	1	Roll	 
6	B000568	Double Tape 24mm	Main Store	118	1	Roll	 
7	B000567	Electrical Tape	Main Store	104	1	Roll	 
8	B000566	Double tape Nitto red	Main Store	2	1	Roll	 
9	B000565	Lakban Hitam 2*	Main Store	36	1	Roll	 
10	B000564	Lem Kuning 2.5 kg	Main Store	10	1	Kaleng	 

Figure 2. Item Data Page

System interface

The interface on the homepage can be seen in figure 6, the system can display the total amount of data on goods, incoming goods, and the number of users. In addition, on the homepage, a stock of goods that have reached the minimum limit is also made. The minimum stock is set according to the amount of need for prosthetic orthotic practice activities. The minimum stock table display aims for the smooth running of prosthetic orthotic practicum activities during learning. This helps the person in charge of the laboratory and the management team in monitoring when laboratory materials should be reordered so as not to interfere with laboratory activities.

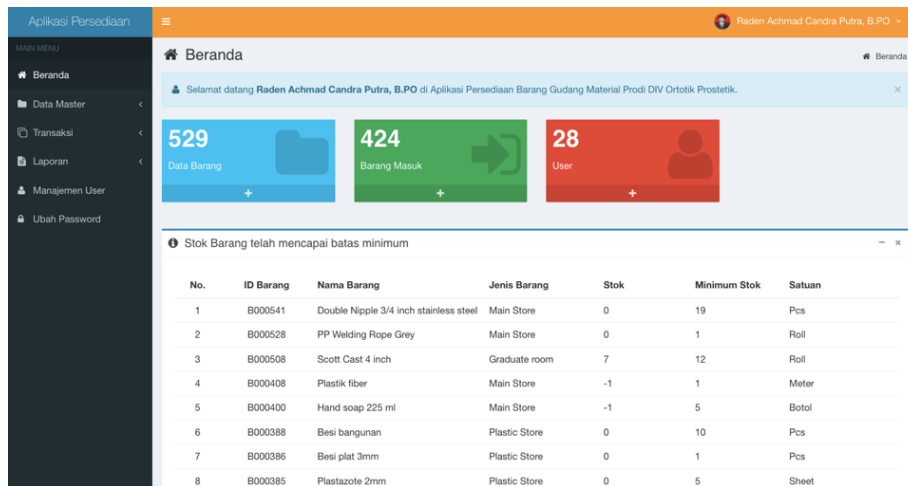


Figure 3. Dashboard Page

Goods report interface

The interface for the report can be seen in Figure 9. The system can automatically generate reports for incoming and outgoing goods. For outgoing goods reports, reports can be made specifically for the date period and the course.

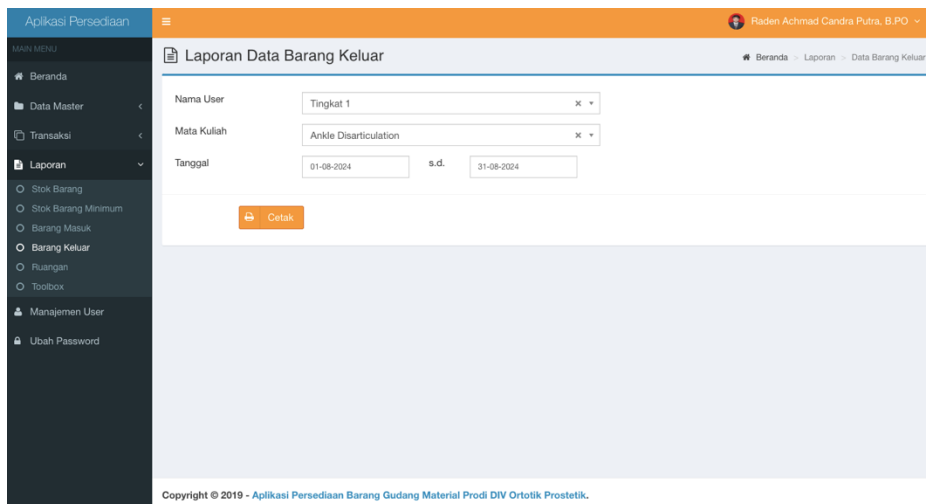


Figure 4. Laboratory Goods Report Page

Usability and Blackbox Test Results

Data were collected from 13 students and 2 members of the Applied Bachelor of Orthotic Prosthetics Study Program. Data collection was conducted using the System Usability Scale (SUS), with 10 statements on a 5-point Likert scale. The average SUS score of 72.16 is included in the acceptable category with a rating of 'Good' on the SUS scale [12]. This shows that the application is usable and user-friendly enough for the participants in learning activities in the laboratory.

Some respondents mentioned that the app helped them understand the characteristics of materials and tools before the practicum session and thus helped them make more effective use of lab time. In addition, other respondents also appreciated the system for facilitating

information updates and in their teaching activities, more technological integration and rational constructivist approaches became more visible.

Table 1 shows that the test results on the features in the inventory information system of the Laboratory of the Prosthetic Orthotics Department are functioning well because they are in accordance with table 1.

Table 1. Blackbox testing

No	Testing	Information
1	Log in to the app	Pass
2	Input data of goods	Pass
3	View item data	Pass
4	Display bar data with minimum stock	Pass
5	Create an incoming data report	Pass
6	Create an outbound data report	Pass

CONCLUSION

The developed web-based application system for managing laboratory materials and equipment in the Orthotics and Prosthetics Department at Jakarta I Polytechnic effectively facilitated the documentation of incoming and outgoing items within the storage system. The laboratory person in charge (PJ) primarily supervised the accuracy of incoming goods and ensured that consumable materials (BHP) were used according to required quantities, while warehouse staff handled the input of incoming items and the preparation of approved outgoing goods. Student representatives were responsible for submitting requests for materials based on agreements with course lecturers and collecting approved items from the warehouse. The results of black-box testing indicated that the system functioned properly according to the established criteria. For future research, it is recommended to integrate real-time tracking technologies, such as barcode or RFID systems, and to conduct broader usability and performance evaluations to further enhance system efficiency and scalability.

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