



Digitization in Inorganic Chemistry and Instrument Laboratory Services

Vera Dessy Noevita^(✉), Raisza Tarida Savana, and Moniqsa Purbo Syahrani

Universitas Negeri Surabaya, Surabaya, Indonesia
veranoevita@unesa.ac.id

Abstract. One of the ways to improve the quality of laboratory services in the Industrial Revolution 4.0 era is by utilizing information and communication technology or in this research it is called digitization. Digitization is the process of converting information available in paper into digital format, digitization can be in the form of a website. The use of this website will make it easier for students to access the required information quickly and easily. This research aims to determine the stages of making a website for the Laboratory of Inorganic Chemistry and Instruments at the Chemistry Department, Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya and how the user responds to the website. The method used in this research is 4D method (Define, Design, Develop, Disseminate). Website design begins by incorporating several features and design it so the website looks more attractive. The information that has been obtained is used for coding the menu and the content of the website. Coding and several features after that are tested if there is an error, if the error is not found, then a trial is carried out on the website user, namely student laboratory users. This response was obtained by filling out a questionnaire to the respondent. The results of the customer satisfaction questionnaire about overall site appearance are very satisfied with a percentage of 86.0%

Keywords: Digitization · Website · Laboratory service

1 Introduction

In the era of the Industrial Revolution 4.0, the use of technology, communication, and information is increasingly advanced and continues to grow. The development of technology, communication and information is indicated by digitization. According to Brennen & Kreiss, digitization is the increasing availability of digital data made possible by advances in creating, transferring, storing, and analysing digital data, and has the potential to structure, shape, and influence the contemporary world [1]. Printed, audio, and video form into digital form [2]. Meanwhile, according to the Gartner.com dictionary of terms, digitization is the use of digital technology to transform a business model and provide new revenue and value generating opportunities, and it is a process of moving to a digital business. This process can occur with digitization. Digitization is a conversion process from analogue to digital. This digitization aims to reduce costs by optimizing

internal processes, such as work automation, minimizing paper use, and so on. Therefore, digitization cannot occur without first digitizing because the use of digital technology must use data that has been digitized, such as documents that were originally written changed into electronic documents formats such as pdf, doc, etc.

One of the most important sectors for the development of information and communication technology with digitization is the education sector in this regard, especially in higher education institutions. The existence of a chemistry laboratory is very important in an educational institution, especially in universities to be able to realize the development and use of chemistry in a sustainable manner [3]. Educational laboratory, or in this research it called laboratory, is an academic support unit in an educational institution, it can be open or closed room, it can be permanent or mobile, systematically it managed for experimental things, calibration, or doing some production activities on a limited scale that used equipment and materials based on scientific methods. Certain, in the context of implementing education, research, and/or community service [4]. The carrying capacity of the laboratory can be realized through increasing human resources and improving service quality. Service in general is a sense of fun that is given to others with convenience and fulfils all their needs [5]. The advantages obtained by using digitization in the laboratory service process include: (1) faster, easier and more practical service, (2) faster and easier tracing, (3) saving time, (4) saving energy, (5) Motivating users /user to optimize existing facilities in the laboratory, and (6) help reduce paper waste. So far, laboratory services in the chemistry department have been carried out manually such as filling in information data if you want to do research, manually filling out the logbook when using the tool, looking for the Material Safety Data Sheet (MSDS) in the MSDS book which takes a lot of time, and many more are being done manually. This manual shift of services towards digitization is carried out by creating a site that will support some information and services that will be useful for the academic community of the Chemistry Department, Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya, from the statements above, it is necessary to conduct research for the digitization of chemical laboratory services at the Department of Chemistry, Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya.

2 Method

The research method are the strategies, processes or techniques utilized in the collection of data or evidence for analysis in order to uncover new information or create better understanding of a topic. The object of this research is digitization of inorganic and instrument laboratory services for students to reach to ease of the services. The method that will be used is the 4D method. This method uses 4 stages, namely Define, Design, Develop, Disseminate [7, 8].

2.1 Define

The initial stage in the 4D model is the definition of development requirements. In product development, the developer needs to refer to the development requirements, analyse and collect information on the extent to which development needs to be carried

out. At this stage there is a questionnaire distributed to laboratory users, about what data that will be included in the website.

2.2 Design

The next stage of the development of 4D learning media is the design stage. The purpose of this stage is to design the site to be developed. Media and format selection for materials and prototyping are major aspects of the design phase. The data that has been obtained in the previous stage is collected, then the supporting features on the website are designed.

2.3 Develop

The purpose of the develop stage is to realize a predetermined design, or it can also be done by completing a prototype that has been built previously. The supporting features on the website are implemented and then the website that has been completed is validated by experts. At this stage, trial and error was also carried out, some coding errors were revised.

2.4 Disseminate

The final stage of the development of 4D learning media is disseminated. The product can be said to have reached the final stage of production (development) when testing at the develop stage produces a product. After the trial was carried out and the test results were fixed without a hitch, the next stage was the dissemination website to the students that use inorganic and instrument laboratory services.

3 Result and Discussion

Initial data collection is done by answering several questions in the form of a questionnaire that must be filled out by students to find out what data will be included in the website. These questions include 1) Are you satisfied with the laboratory services? 2) do you agree if there is digitization of services in inorganic laboratories and instruments using the website? 3) What menus do you expect to have on the website?, from the questionnaire, data was obtained that most of the laboratory users were still dissatisfied with the manual laboratory services, laboratory users also felt that it was necessary to digitize the laboratory so that services could be carried out optimally and faster. The features that are expected to be included in the website by user include research permits, receipts for borrowing materials and equipment, laboratory discharge letter, equipment logbooks, and material safety data sheets (MSDS). The website for laboratory services that has been designed can be accessed on the www.bit.ly/laboratoriumkimiaunesa page. This website is designed to be easily accessible using a mobile phone, tablet or laptop. In this website there are several menus that can be accessed, the menus include: 1) laboratory administration consisting of a research permit, laboratory discharge letter, equipment and materials form, and laboratory entry requirements. 2) a menu that is connected to

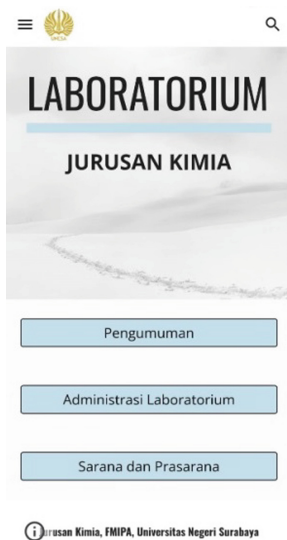


Fig. 1. Homepage/Start page website



Fig. 2. Three Lines at Homepage

other laboratories or in this research inorganic chemistry laboratory and instrument laboratory. This menu consists of an equipment logbook that can be filled in by students if they want to use the tools in the two laboratories and there is also a material safety data sheet (MSDS) which is very useful for laboratory activities. Further explanation will be explained in the pictures.

In Fig. 1 the start page of the website where there are menus including announcements, laboratory administration and infrastructure. Laboratory services are emphasized on the laboratory administration menu and the menus on the inorganic and instrument laboratory websites. On the home page, there are three lines (Figs. 2 and Fig. 3) which when clicked will lead to a certain menu and go to the websites of laboratories in the chemistry department Fig. 4.

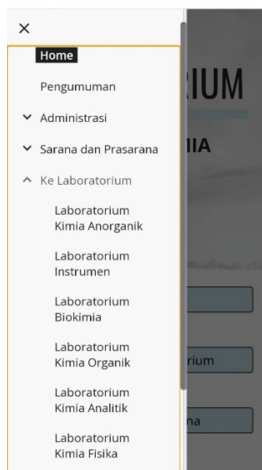


Fig. 3. Three Lines that Contain Menu and Other Websites

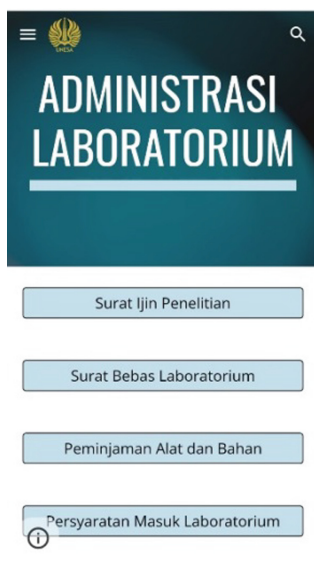


Fig. 4. Laboratory Administration Page

On the laboratory administration page there are several clickable menus, namely research permits, laboratory discharge letter, receipts for borrowing materials and equipment and laboratory entry requirements. On the research permit menu there is a flowchart so that students better understand the flow of administration of laboratory use permits which can be seen in Fig. 5.



Alur Pengajuan Surat Ijin Penelitian
di Jurusan Kimia
Bagi Mahasiswa dan Dosen



 Format surat ijin orang tua dapat diunduh pada link yang tersedia.

Fig. 5. Research Permit Page

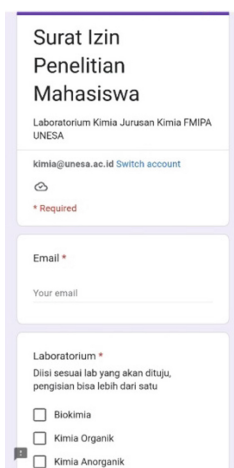


Fig. 6. Google Form of Research Permit

In the research permit menu, there are several button options where this letter is intended for students or lecturers as laboratory users. This button will lead to a google form that must be filled out by laboratory users as in Fig. 6 this data entry will automatically send a research permit which must be signed by the thesis supervisor and the head of the chemistry laboratory to the students via email. An example of a research permit can be seen in Fig. 7.



Fig. 7. An Example of Research Permit

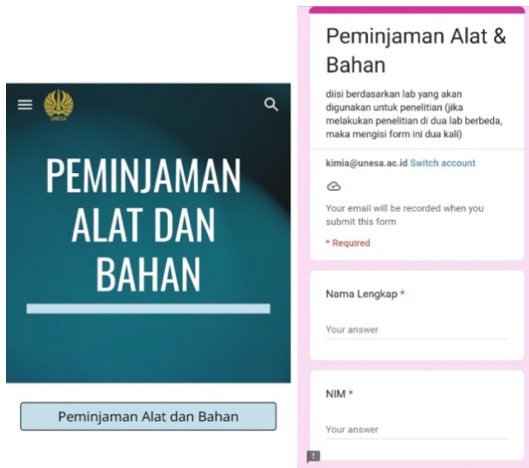


Fig. 8. Page and Google Form Tools and Equipment

The laboratory entry requirements menu is made as a complement to the laboratory permit (Fig. 8). The menu and google form can be seen in Fig. 9.

Laboratory discharge letter menu is specifically for students so that it can make it easier for students to obtain that letter as a graduation requirement. Students can fill out the laboratory discharge application form, in this google form students also fill in any equipment or instrument that have been used so that the laboratory admin can send invoices. After that, students can submit letter of statement for graduation requirement. The menu and google form can be seen in Fig. 10 and Fig. 11.

Fig. 9. Page and Google Form of Laboratory Entry Requirements

Fig. 10. Letter of Statement Laboratory Discharge Page

This website is also linked to other laboratory websites in the chemistry department. If we go to (for example) inorganic and instrument laboratories (Fig. 12). On the laboratory website there are menus such as equipment logbooks (Fig. 13) and material safety data sheets (MSDS).

This equipment logbook website contains google form links that can be filled out by students if the student uses electrical equipment in the inorganic chemistry laboratory and instrument laboratory, this logbook is used as supporting data to obtain laboratory discharge letter.

The Material Safety Data Sheet (MSDS) is a very important source of information regarding the hazardous properties of the chemicals used, such as flammable, toxic, corrosive, explosive, reactive, sensitive and hazardous materials. Others [9]. Therefore, the MSDS is very important in the laboratory, with the MSDS listed on the website and grouped according to the practicum, it will make it easier for students to access the MSDS. An example of the MSDS menu can be seen in Fig. 14.

The image shows a Google Form interface for a laboratory discharge statement. The form is titled "Surat Keterangan Bebas Laboratorium Jurusan Kimia" and is associated with the email "kimia@unesa.ac.id". It features two columns of input fields. The left column includes a header "Pengajuan Bebas Lab", a "Switch account" link, a warning about email recording, and three required text input fields: "Nama Lengkap", "Email", and "NIM". The right column contains a "Switch account" link, a warning about Google account information, an "Email" input field, and a note stating "Diisi dengan huruf kapital di awal kata saja (jangan huruf kapital semua)".

Fig. 11. Letter of Statement Laboratory Discharge Google Form

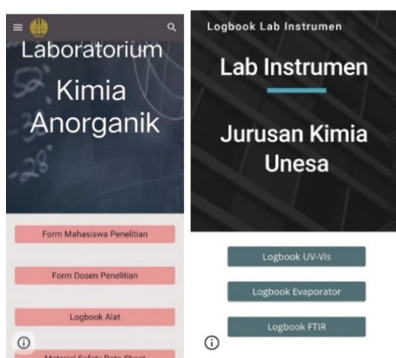


Fig. 12. Inorganic and Instrument Laboratory Website

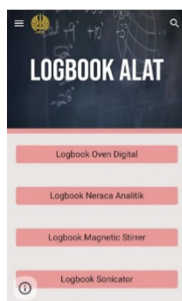


Fig. 13. Equipment Laboratory Logbook

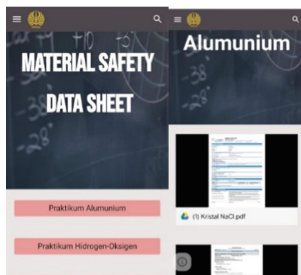


Fig. 14. Material Safety Data Sheet Page

Table 1. Questionnaire

No.	Question
Usability	
1	Ease of operating the site
2	Ease of filling out google forms
3	Clarity of questions in google form
4	Interaction with the site is clear and understandable
5	Ease of navigation
6	Attractive appearance
7	Display according to site type
8	There is additional knowledge from site information
9	Precise in preparing information layout
10	Easy to find site address
Information Quality	
11	Provide reliable information
12	Provide up to date information
13	Provide information that is easy to read and understand
14	Provide sufficient detailed information
15	Provide relevant information
16	Provide accurate information
17	Presenting information in an appropriate format
Service Interaction Quality	
18	Sense of security in conveying personal data
19	Ease of attracting interest and attention
20	Easy to communicate
Overall Impression	
21	Overall site appearance is good

Table 2. Questionnaire results

Validation by	Question	Result	Information
Laboratory user (student)	Website usability	84.5%	Very Satisfied
Laboratory user (student)	Information Quality	86.0%	Very Satisfied
Laboratory user (student)	Service Interaction Quality	85.3%	Very Satisfied
Laboratory user (student)	Overall Impression	86.0%	Very Satisfied

A customer satisfaction questionnaire was made to find out whether the website that has been created has reached the feasibility according to the user's wishes. The users referred to here are students who use the inorganic chemistry laboratory and instrument laboratory as many as 40 people. Customer satisfaction questionnaire used based on WebQual 4.0 [10]. WebQual 4.0 is a method to measure the quality of a website. WebQual has several variables, namely information quality, interaction quality and usability variables [11]. This method is used in this study because WebQual 4.0 basically measures the quality of a website based on user or visitor perceptions to find out what factors can be improved on the website so that it can provide the best service to users [12].

There are several qualifications in the questionnaire, namely usability, information quality, service interaction quality, and overall impression. The questionnaire contains several categories, namely very satisfied, satisfied, moderate, dissatisfied and very dissatisfied. The results of the customer satisfaction questionnaire can be seen from Table 1 and 2.

The user also gives some services that need to be improved such as the existence of videos of laboratory facilities and infrastructure to attract users' interest, the existence of a price list for purchasing materials and the use of laboratory equipment, the need for a QR code to make it easier for users to access the website or menus on the website.

4 Conclusion

In this research we can conclude that digitization can facilitate laboratory services in inorganic chemistry laboratories and instrument laboratories. Digitization using this website was made with several types of analysis and student requests as laboratory users. The laboratory user satisfaction questionnaire also proves that students are very satisfied with the digitization of laboratory services by using this website.

Acknowledgments. We would like to thank every student as a laboratory user who helped this research, we also thank Research and Academic Community Services Department for the generous support for this research. VDN as writer, RTS supporting data.

Authors' Contributions. All authors contributed equally to this research and paper.

References

1. [J. Scott Brennen & D. Kreiss, *Digitization (in: The International Encyclopedia of Communication Theory and Philosophy)*, USA: John Wiley & Sons, 2016.
2. E. Sukmana, “*Digitalisasi Pustaka*” [online], Available at https://www.researchgate.net/publication/236965703_DIGITALISASI_PUSTAKA [Accessed 11 April 2022]
3. D. Wahyuningrum, *Pengenalan, Penanganan dan Pemeliharaan Bahan dan Peralatan Laboratorium Kimia*, dalam: Workshop Pengelolaan Laboratorium MIPA PTAIN Se-Indonesia; Jakarta, 19-21 April 2004, Jakarta: Jurusan MIPA Fakultas Sains dan Teknologi Universitas Islam Negeri Syarif Hidayatullah, 2004.
4. Kementerian Pendayagunaan Aparatur Negara dan Reformasi Birokrasi, *Permenpan dan RB No.03 Tahun 2010 Tentang Jabatan Fungsional Pranata Laboratorium Pendidikan dan Angka Kreditnya*, 2010.
5. H. Umar, *Riset Pemasaran dan Perilaku Konsumen: Catatan Kedua*, Jakarta: Gramedia Pustaka Utama, 2002.
6. Reno Sari dan Tetty Resmiaty. *Bahan Ajar Teknologi Laboratorium Medis : Aplikasi Sistem Informasi Dan Manajemen Laboratorium*. Jakarta: Pusat Pendidikan Sumber Daya Manusia dan Kesehatan. 2017
7. I Made Arsana, Achmad Muktafi Akbar, Setya Chendra Wibawa, Handini Novita Sari. Utilizing Social Media and Applications to Stay Productive for Photographers in Pandemic Times. *Prosiding International Joint Conference on Science and Engineering 2021 (IJCSE 2021)*. 2021
8. Hidayat. Candra. “Metode Pengembangan Perangkat Pembelajaran Model 4D”. www.ranahresearch.com/metodepengembangamodel4d/#:~:text=Model%204D%20merupakan%20satu,Semmel%20pada%20tahun%201974.
9. Imrohatussodiq. MATERIAL SAFETY DATA SHEET (MSDS) atau LEMBAR DATA KESELAMATAN BAHAN (LDKB). DLHK Provinsi Banten
10. A. Sudrajat. *Metode Webqual 4.0 Untuk Mengukur Kualitas Website Quick Online Booking PT. Pos Indonesia*. Vol 5 No 1. Information System For Educators And Professionals. 2020
11. Barnes, S.J. & Vidgen. R. *Measuring Website Quality Improvements: A Case Study of The Forum on Strategic Management Knowledge Exchange*. Vol 103 No. 5. *Industrial Management & Data System*. 2003
12. Tarigan, J. *User Satisfaction Using WebQual Instrument: A Research on Stock Exchange of Thailand (SET)*. *Jurnal Akuntansi dan Keuangan*. 2008

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter’s Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter’s Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

