TELKOMNIKA Telecommunication Computing Electronics and Control
Vol. 24, No. 3, June 2026, pp. 852~865
ISSN: 1693-6930, DOI: 10.12928/TELKOMNIKA.v24i3.27663

Design and development of WIKIN: an interactive nuclear community website for Indonesia using Laravel framework

Halim Hamadi[1,4], Hammam Ahmad Hanif[1], Muhtadan[2], Anhar Riza Antariksawan[3]
Aleksey G. Goryunov[4]
[1]Department of Instrumentation Electronic, Polytechnic Institute of Nuclear Technology, National Research and Innovation Agency, Yogyakarta, Indonesia
[2]Research Center for Intelligent Mechatronics, National Research and Innovation Agency, Bandung, Indonesia
[3]Department of Electro Mechanic, Polytechnic Institute of Nuclear Technology, Yogyakarta, Indonesia
[4]School of Nuclear Science and Engineering, Tomsk Polytechnic University, Tomsk, Russia

Article Info

Article history:

Received Nov 10, 2025
Revised Jan 31, 2026
Accepted Mar 29, 2026

Keywords:

Laravel framework
Nuclear communication engagement
Nuclear science
Nuclear technology communication
System usability scale
Web-based system design

ABSTRACT

Despite its significant contributions to health, agriculture, and energy, the public perception of nuclear technology in Indonesia remains cautious and fragmented. Existing communication channels are largely one-way and regulatory, offering limited opportunities for public interaction and collaborative learning. This study investigates how an interactive web-based platform can enhance public engagement and knowledge sharing in nuclear science and technology. To address this challenge, a Nuclear Community Interactive Website (WIKIN) for Indonesia was designed and developed using the Laravel framework, following a structured waterfall methodology. The system integrates role-based access control, modular architecture, and responsive design to support community participation through the sharing of news, discussions, and documentation of service activities. The evaluation was conducted through black-box functional testing of 27 features (all passed) and a system usability scale (SUS) survey involving 51 users, which produced an average score of 74.8 ("Good"), indicating satisfactory usability and acceptance. These results demonstrate that WIKIN provides an effective model for fostering two-way communication, improving transparency, and strengthening public literacy regarding nuclear issues. This study contributes to digital public engagement research by demonstrating how user-centered design principles can be effectively applied to enhance trust, transparency, and community participation in nuclear science communication.

Corresponding Author:

Halim Hamadi
Department of Instrumentation Electronic, Polytechnic Institute of Nuclear Technology
National Research and Innovation Agency
Babarsari Ngentak St., Caturtunggal, Depok, Sleman, Yogyakarta, 55281
Email: hali003@brin.go.id

1. INTRODUCTION

The dissemination of nuclear science and technology information plays a critical role in fostering public understanding, trust, and engagement in nuclear programs, particularly in countries considering nuclear power development. In Indonesia, the National Research and Innovation Agency (BRIN) has recently intensified its efforts to strengthen the nuclear research ecosystem and promote transparent communication with the public [1]. These efforts align with the International Atomic Energy Agency (IAEA) guidance on nuclear knowledge management and public communication, which emphasizes the importance of structured, reliable, and easily accessible information platforms [2]. The IAEA also highlights that effective public

communication during normal operations and in emergency situations is essential to maintain trust and avoid misinformation [3].

Public understanding of nuclear science and technology in Indonesia remains low due to a lack of interactivity in communicating nuclear information. Existing platforms, such as the official website of *Badan Pengawas Tenaga Nuklir* (BAPETEN) [4], Indonesia's Nuclear Regulatory Agency, and other institutional publications, generally function as static repositories and focus more on regulation or technical matters rather than serving as interactive community portals.

Most existing information platforms are one-way communication channels, that is, from the government to the public. Few platforms provide a forum for the public or user-friendly knowledge platforms and two-way participatory communication between the public, researchers, and the government. For example, one of Indonesia's universities in the field of nuclear technology, Poltek Nuklir, the Indonesian Polytechnic Institute of Nuclear Technology, often conducts community service. Poltek Nuklir often carries out activities to solve problems in a region using nuclear technology. However, sometimes these activities are only known to the community in that region. These nuclear solutions can be used to solve problems in other fields. Therefore, interactive tools that include socialization, community, and communication between the public and researchers, institutions, and the government are required.

Recent studies have highlighted a significant paradox in Indonesia's nuclear energy relationship. While national surveys show surprisingly high public support, often exceeding 70%, this masks deep-seated local opposition and a prominent "not-in-my-back-yard" (NIMBY) phenomenon, particularly at proposed site locations. This challenge is compounded by ineffective communication strategies [5], [6]. Research into BRIN's digital outreach reveals a primary reliance on a one-way "deficit model," where information is broadcast to a passive audience, or a "controlled dialogue" that stops short of genuine public participation. This approach is in direct contrast to the contemporary paradigm of public engagement with science (PES), which argues that for controversial topics, building trust requires two-way dialogue and mutual learning, not just information dissemination alone. This gap between public needs and institutional practices underscores the necessity of a new type of digital platform [7].

The development of such a platform lies at the intersection of human–computer interaction (HCI) and science communication [8]. HCI research has explicitly called for more systems-focused analyses and the creation of purpose-built tools to support scientists' online outreach. Foundational studies on online communities emphasize that success depends on designing sociotechnical systems that balance usability with "sociability" features that foster social interaction, trust, and a shared identity [9]. From a technical standpoint, modern PHP frameworks, such as Laravel, are increasingly selected for building such platforms because of their robust security features, scalability, and modular architecture based on the model-view-controller (MVC) pattern, all of which are essential for developing secure and maintainable community-oriented systems [10]. While these individual fields of research are well-established, there is a clear gap in applying their principles collectively to create a dedicated engagement platform for a controversial scientific topic within the specific Indonesian context.

Building on this background, the present study addresses a crucial gap in nuclear knowledge management and public engagement. While previous studies have explored public perception and stakeholder trust, few have translated these insights into practical digital solutions that enable continuous, interactive communication between the public, researchers, and policymakers. We propose Nuclear Community Interactive Website (WIKIN), an interactive nuclear community website tailored for Indonesia. This platform introduces an innovation through a community-oriented website designed using the Laravel framework, offering role-based access, modular architecture, and responsive design.

We propose the WIKIN platform, which introduces an innovation through a community-oriented website designed with the Laravel framework, offering role-based access, modular architecture, and a responsive design. Unlike earlier information systems, WIKIN is not a general information website, but a strategic intervention tailored to a specific documented socio-political landscape. WIKIN facilitates two-way knowledge exchange by allowing users to share nuclear-related news, participate in discussions, form online communities, and adopt a modern paradigm of Public Engagement with Science. Its contribution is not merely the creation of a website but the application of HCI principles to construct a "third space" for engagement, one that is more structured than open social media but more participatory than static government portals. Furthermore, its usability and functionality were systematically evaluated through black-box testing and the System Usability Scale, providing empirical evidence of its effectiveness.

WIKIN research aims to create a single, user-friendly, and trustworthy hub where the public can access reliable news and the latest research findings. The second objective is two-way communication, knowledge sharing, and community participation in nuclear science and technology. This study addresses the limitations of existing static information systems and provides a scalable model for enhancing nuclear literacy, transparency, and public engagement in Indonesia.

2. METHOD

The waterfall model was deliberately selected for the initial development phase of WIKIN [11] This traditional linear approach was suitable because the project's primary goal was to build a clearly defined and fixed set of core features to validate the platform's concept and architecture. However, we acknowledge the inherent limitations of this model, particularly its rigidity and lack of flexibility, which make it less suitable for a live, user-centric community platform where requirements are expected to evolve based on user feedback and engagement. Therefore, while the waterfall method was appropriate for this foundational stage, all future developments and iterative refinements of the WIKIN platform will adopt an agile methodology. This shift to an iterative approach, characterized by sprints and continuous feedback loops, will enable the development team to be more responsive to community needs and collaboratively enhance the platform's features and user experience following its public launch.

The design and development of the WIKIN website uses the PHP programming language with the Laravel framework [12]–[14]. In addition, to support a more interactive website, JavaScript was added for object programming and BootstrapCSS to refine the appearance [15], [16]. For the three-month live testing period, the system was populated with initial content, including placeholder text and AI-generated media, to create a functional environment for user evaluation (https://wikin.live).

2.1. Unified modeling language (UML)

UML is a standardized visual modeling language used in software engineering to design, visualize, construct, and document software systems [17]. UML provides a set of graphical notation techniques to create abstract models of software systems, helping developers, analysts, and stakeholders understand the system's structure, behavior, and architecture. The UML used in the design of WIKIN are as follows.

2.1.1. Use case diagram

A use case represents system functionality through interactions between actors (humans or systems) and the system [18], [19]. Figure 1 shows a use case diagram of WIKIN that illustrates the complex interactions between various actors and features in the system. The actors involved include guests (as visitors), users (as members of the public, students, and lecturers), and admins, each with different access and functions in WIKIN.

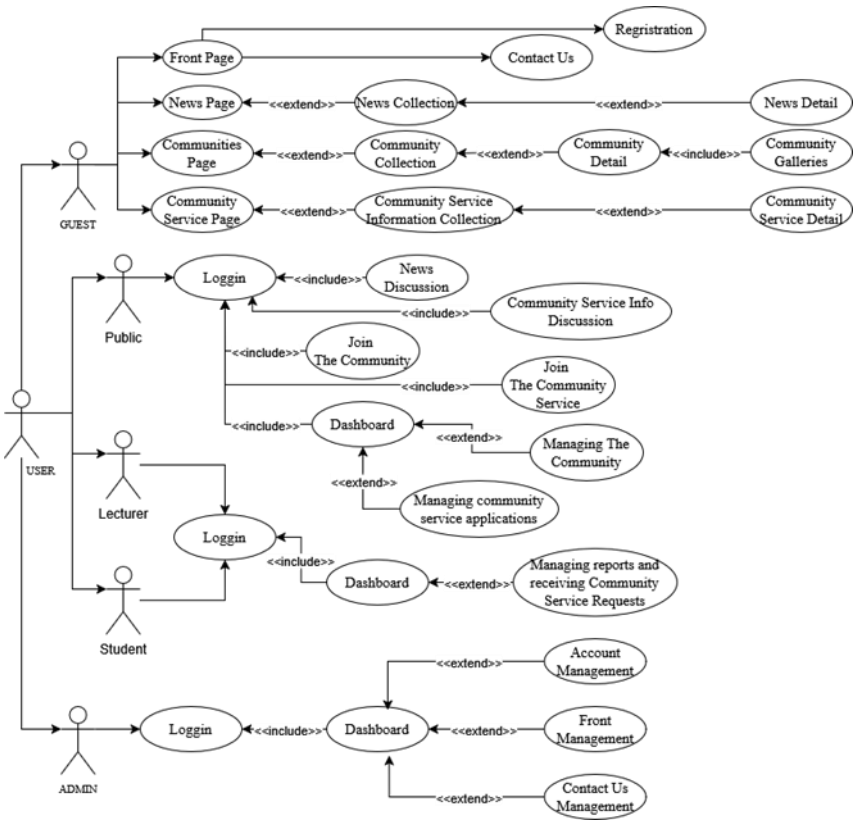


Figure 1. Use case WIKIN diagram

Guest actors can view a collection of news, communities, and information, as well as further details about the news, communities, and information. In addition, there is a "Contact Us" feature. Guests can change their status to a user by completing the registration process. User actors, including the public who have obtained an account, students, and lecturers, have further access after logging in. A dashboard is available to enable users to manage form and join communities and submit content. Users can also participate in news and content information discussions. Admin actors inherit all the capabilities of other actors and have additional management features. Admins can manage users, verify content, and have full access to edit or delete data if problems are detected.

2.1.2. Activity models

This activity model depicts the activities of each actor (Guest, User, Admin) within WIKIN [20]. The activity model is illustrated in Table 1.

Table 1. Activity models for each actor (Guest, User, Admin) in the WIKIN

Activity model	Guest	User	Admin
Loggin	√	√	√
Registration	√	√	×
Forgot your password	×	√	×
News and information	√	√	√
Community	×	√	√
Report and open recruitment for community service	×	√	√
Create news and information	×	√	√
Update and delete news	×	√	√
Create communities	×	√	√
Update and delete communities	×	√	√
Join community	×	√	√
Submit community service proposals	×	√	√
Create a report or open recruitment for community service	×	√	√
Update and delete community service proposals	×	√	√
Update and delete community service	×	×	√
Join to community service	×	√	√
Update profile	×	√	√
User management	×	×	√

2.1.3. Sequence diagram

Sequence diagrams illustrate the interactions between objects in a system in chronological order to complete a specific process or function [21]. Sequence diagrams illustrate the interactions between objects in a system in chronological order to complete a specific process or function. There are several sequence diagrams on the WIKIN, one which example is the login sequence diagram shown in Figure 2.

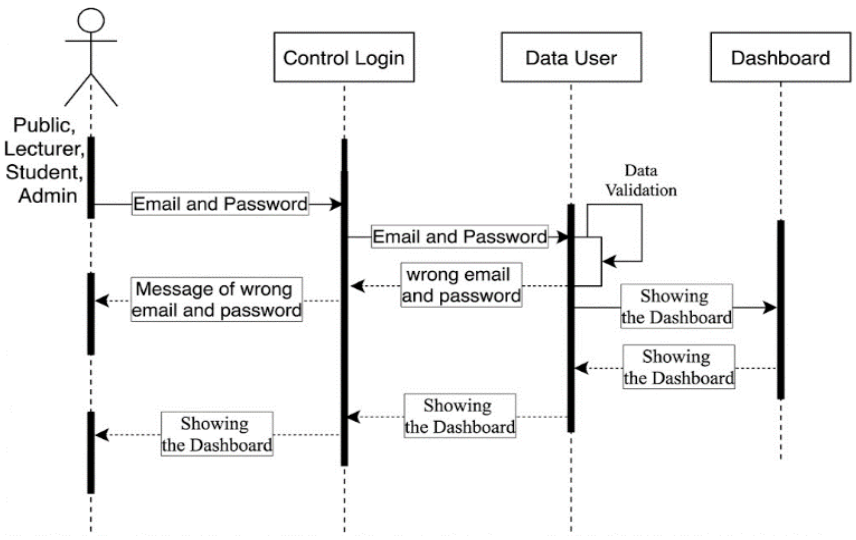


Figure 2. Example sequence login diagram

There are several other sequence diagrams in WIKIN. Each actor has its own control based on the access granted, as listed in Table 1. Therefore, not all actors have the same task. For example, a guest does not have the task of being able to create community service activities before this guest changes their role to a user by registering first. The admin plays an important role in the WIKIN. The admin is like the brain of the WIKIN. The administrator is also an actor who can change the status of a Guest to a User.

2.2. Entity relationship diagram (ERD)

An ERD is a conceptual modeling technique used in database design to represent data entities, their attributes, and the relationships between them. Originally introduced by Chen in 1976, ERDs have become a standard tool for designing relational databases because they provide a clear, high-level visualization of data structures before physical implementation [9], [22].

ERDs are widely used in software engineering because they help stakeholders and developers agree on the data requirements before implementation. Redundancy and inconsistency in database design should be reduced. It provides a foundation for generating a normalized database schema [23], [24].

The ERD WIKIN shown in Figure 3 shows several main entities and the relationships between them. The Users entity stores user information with ID as the primary key and attributes such as name, username, email, and others. The news entity contains news posted by users, with user_id as a foreign key referring to the user entity. The News entity contains news articles posted by users, with the user_id field serving as a foreign key that references the "Users" entity. Comments on news articles are stored in the "Comments" entity, which is linked to both the "News" and "Users" entities using foreign keys. The "Likes" entity records user likes on news articles or comments, establishing relationships with the "Users" entity and the respective "News" or "Comments" entries. Additionally, the form_pemas entity stores community service submissions made by users and is connected to the user entity via a foreign key.

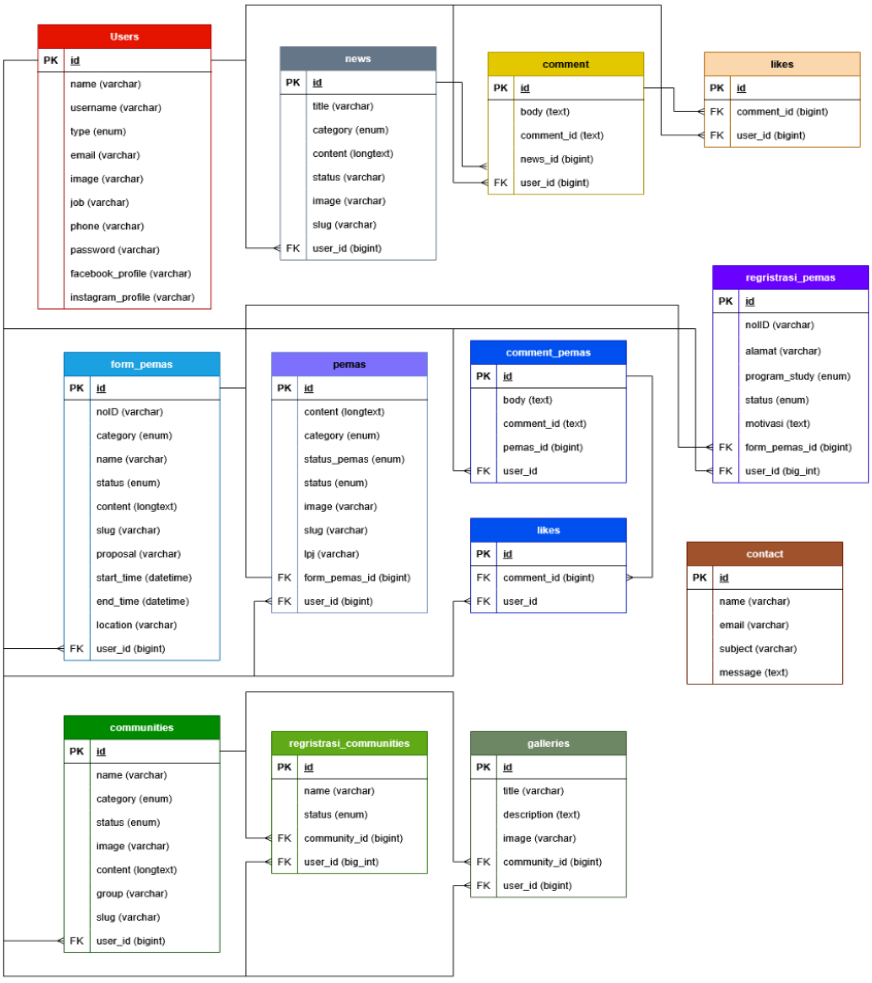


Figure 3. WIKIN entity relationship diagram

Comments related to these submissions are saved in the comment_pemas entity, which links back to both form_pemas and users. The community entity stores community information, is linked to users, and community registration is managed by registrasi_communities. The gallery entity stores community photos and is linked to communities and users. Finally, the contact entity stores user messages for the administrators. This diagram shows the organized relationships between entities, enabling efficient data interaction and management in the WIKIN.

2.3. Data flow diagram (DFD)

A DFD is a visual modeling tool used in systems analysis and software engineering to illustrate how data flows through a system. In web development, DFDs help developers, designers, and stakeholders understand how data are input, processed, stored, and output within a web application [25].

DFDs are often used during the requirements analysis and system design phases of web projects. They allow teams to model how information is handled before writing any code, thereby ensuring a clear understanding of how different components interact [26]. The actors involved in this data processing are adjusted to the use case diagram that has been created, namely, guests, users, and administrators. The DFD level 0 for WIKIN is shown in Figure 4.

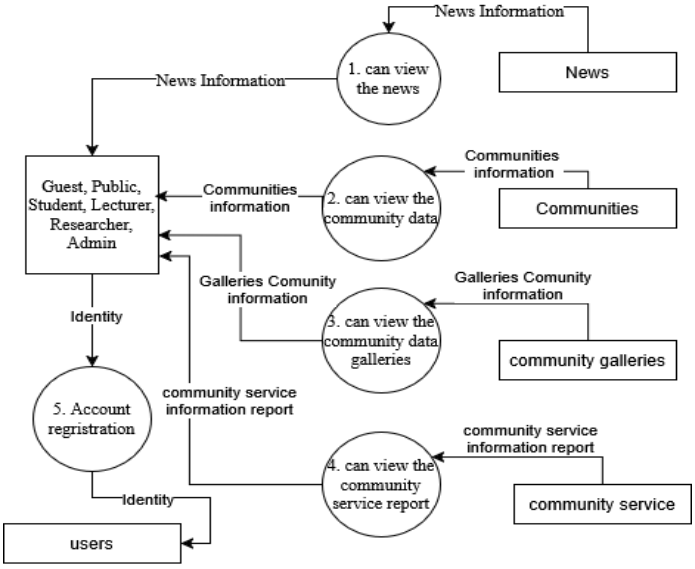


Figure 4. DFD Level 0 for regular actor in WIKIN

Figure 4 illustrates the data activities that can be performed by all the roles. All users can be involved in the process of viewing news data (news information), community data (community information), community gallery data (community gallery information), report data (report information), and registering accounts. The account registration process (identity verification) indicates the presence of security measures and personalization in data access, enabling users to obtain relevant and specific information according to their roles and needs within the system.

2.4. Website testing methods

During the WIKIN website testing phase, a series of tests was conducted to ensure optimal functionality, performance, security, and usability. Functionality testing utilized black-box testing methods to ensure that all features and functions, such as registration forms and comment features, operated as expected, without examining the code structure. User evaluation was conducted using the system usability scale (SUS) to measure user satisfaction levels through questionnaires related to their experience [27], [28]. This test aimed to ensure the quality of the Laravel-based WIKIN website.

The next testing method for WIKIN was the SUS test. The SUS testing model used was Jeff Sauro's SUS model [29]. The SUS consists of 10 statements that users are asked to rate according to their level of agreement. Half of the statements were formulated positively and half negatively. Each statement was rated on a five-point scale. There is also a technique for combining the ten ratings into an overall score on a scale of 0 to 100. The SUS score can be considered a percentage, where a score of 100 reflects perfection [30], [31].

The SUS is a 10 item questionnaire with 5 response options [29].

a. I think that I would like to use this system frequently.
b. I found the system unnecessarily complex.
c. I thought the system was easy to use.
d. I think that I would need the support of a technical person to be able to use this system.
e. I found the various functions in this system were well integrated.
f. I thought there was too much inconsistency in this system.
g. I would imagine that most people would learn to use this system very quickly.
h. I found the system very cumbersome to use.
i. I felt very confident using the system.
j. I needed to learn a lot of things before I could get going with this system.

Figure 5 shows the total SUS scores of the existing respondents. The SUS values were ranked by percentile ranks and letter grades from A to F, where A is the best grade and F is the worst grade [31].

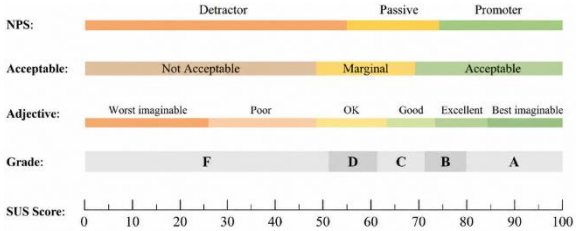


Figure 5. Ranking of SUS scores based on Jeff Sauro

3. RESULTS AND DISCUSSION

The WIKIN was successfully designed and deployed using the Laravel framework with a modular architecture and a responsive interface. The system aims to facilitate collaboration and information exchange among public users, researchers, and institutions involved in nuclear technology in Indonesia. WIKIN integrates multiple core modules, including news dissemination, discussion forums, community service submissions, community creation and management, activity documentation, and open recruitment of students and lecturers. These integrated features collectively promote two-way communication and provide a centralized platform for documenting and sharing nuclear-related activities.

The main user-facing components are illustrated in Figures 6 to 11. The homepage (see Figures 6(a) and (b)) serves as the central entry point, providing an overview of the platform's purpose and showcasing recent community activities to encourage exploration.

To directly counter the one-way flow of information common in institutional science communication, WIKIN incorporates features designed to foster dialogue, and users can generate content. The nuclear information feature (see Figure 7) acts as a repository for news and research but critically integrates a comment and reply to system, allowing users to engage in discussions and provide direct feedback on the content.

The platform's most significant departure from traditional models is its emphasis on community formation and action. Users can create and manage their own interest-based groups, or "communities" (see Figure 8), complete with dedicated pages and activity galleries. This feature provides the infrastructure for a "third space" where organic, user-led discussions can emerge, distinct from both unstructured social media and static institutional websites.

Furthermore, WIKIN facilitates the transition from discussion to action through its community service features (see Figure 9). This allows registered users to not only consume information but also to propose, report on, and recruit volunteers for community service projects that apply nuclear technology to solve local problems. This function is a practical implementation of the PES model, empowering users to become active participants in the application of science. All user-specific activities, including content creation and community involvement, are managed through a personalized user dashboard (see Figure 10), which provides a centralized overview of a user's contributions and engagements. The administrative backend (see Figure 11) provides robust tools for managing users and verifying content to ensure the quality and safety of the platform.

The next step was WIKIN testing. WIKIN testing is performed using two methods that are commonly used to test websites or web applications. The first test was a black-box test. Black box testing provides input and only looks at the output without looking at the process inside.

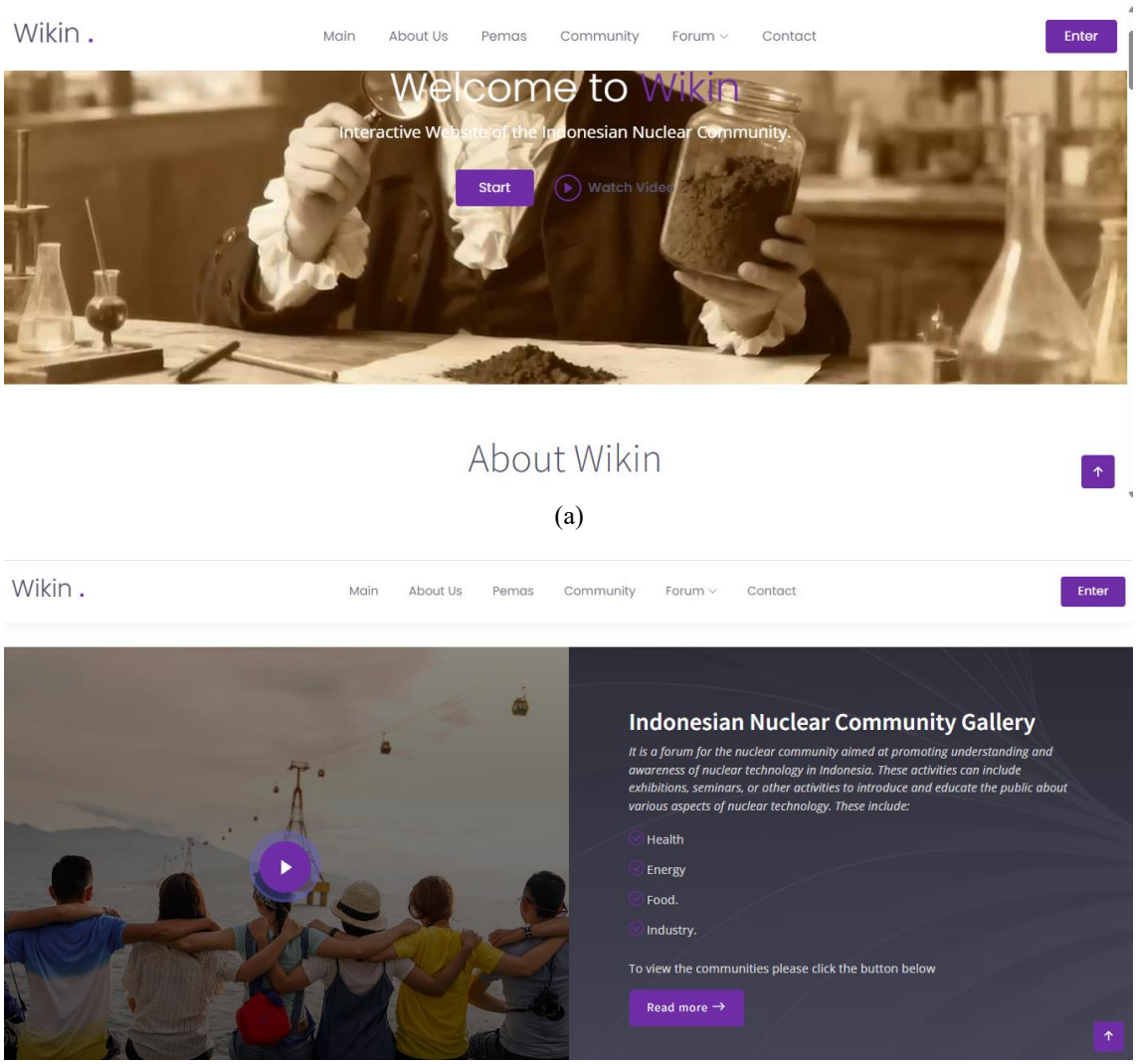


Figure 6. Home page of WIKIN: (a) introduction video and (b) community gallery side

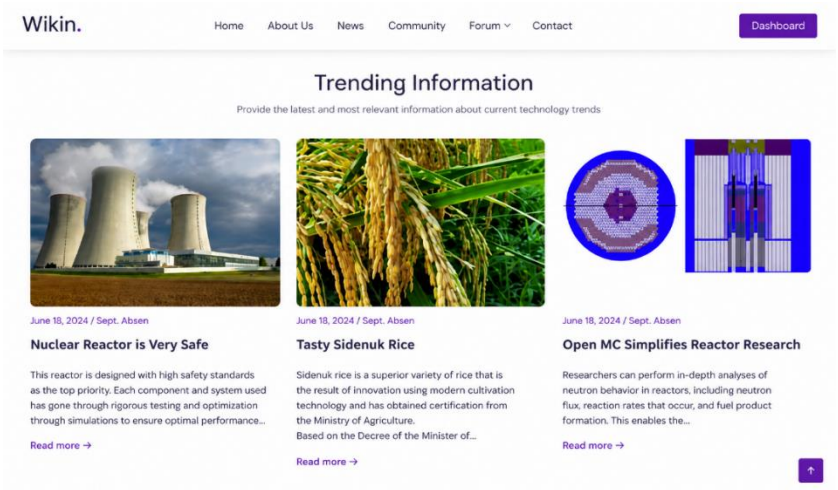


Figure 7. Nuclear information feature on WIKIN, showing discussion elements designed to encourage user interaction

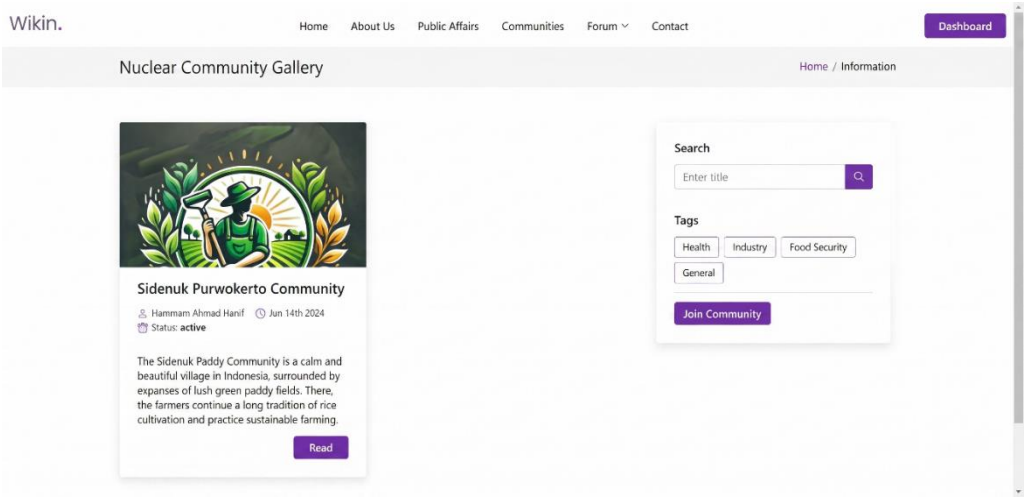


Figure 8. The “Communities” feature on WIKIN

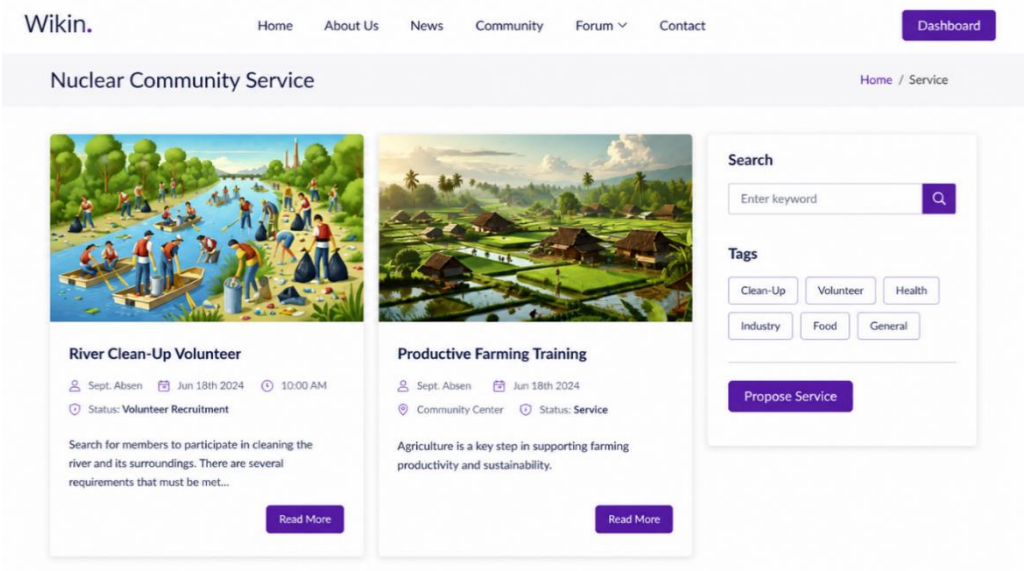


Figure 9. Community service information feature page

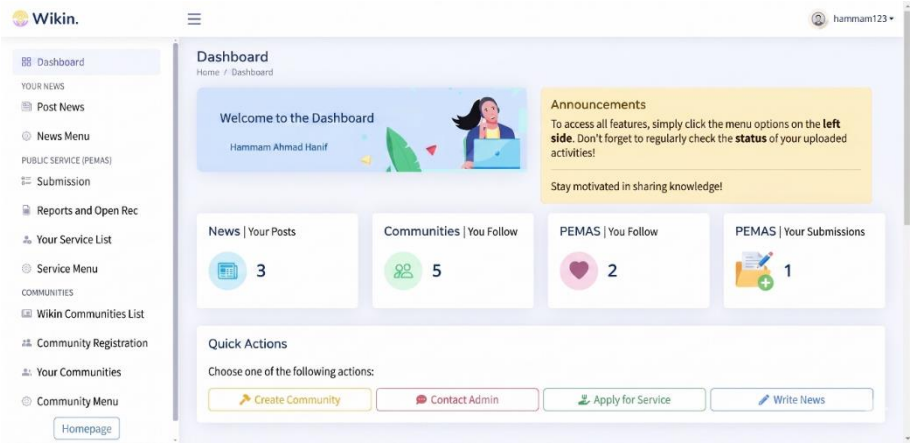


Figure 10. Community service information feature page

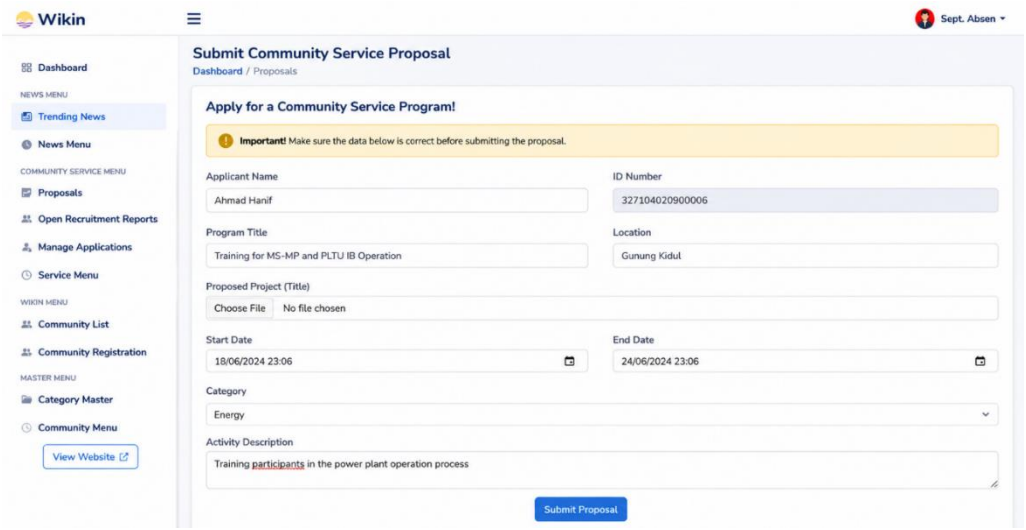


Figure 11. Community service dashboard

To verify that all the implemented features were performed as specified, a comprehensive black-box testing protocol was executed. The protocol included 27 distinct test cases covering all primary user pathways and administrative functions. The tests were grouped into five core functional categories to ensure full coverage of the features of the application. The results summarized in Table 2 show a 100% success rate across all test cases. This demonstrates that all modules, from user authentication and content management to community interaction and administrative oversight, functioned as expected. The overall test results confirm that the WIKIN application is technically robust, stable, and ready for user evaluation.

Table 2. WIKIN BlackBox functionality test results

Num	Feature category	Number of test	Result
1	User account and authentication	5	100% pass
2	News and information module	5	100% pass
3	Community service module	8	100% pass
4	Community and gallery module	6	100% pass
5	General site and admin functions	3	100% pass
	Totals	27	100% pass

The results of user evaluation using the SUS method on WIKIN show that this website has a good level of usability with an average SUS score of 74.80 (shown in Figure 12) with a rating of C, or 'Good.' This score indicates that most respondents had a positive perception of the usability and user experience of WIKIN. However, the evaluation results also show that several areas can be improved to enhance the user experience. Statistical analysis results are shown in Table 3.

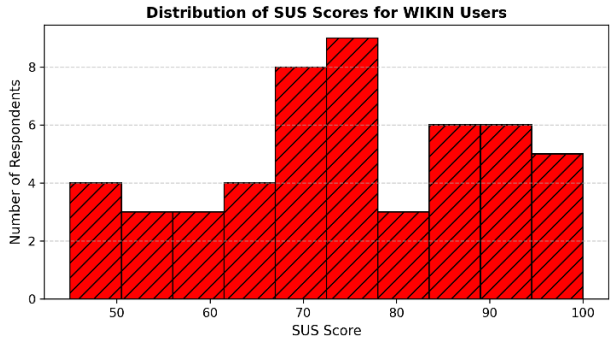


Figure 12. Distribution of SUS scores for WIKIN users (n = 51). The majority of participants rated the system between 70 and 90, corresponding to "Good" usability according to Bangor *et al*., 2009 [31]

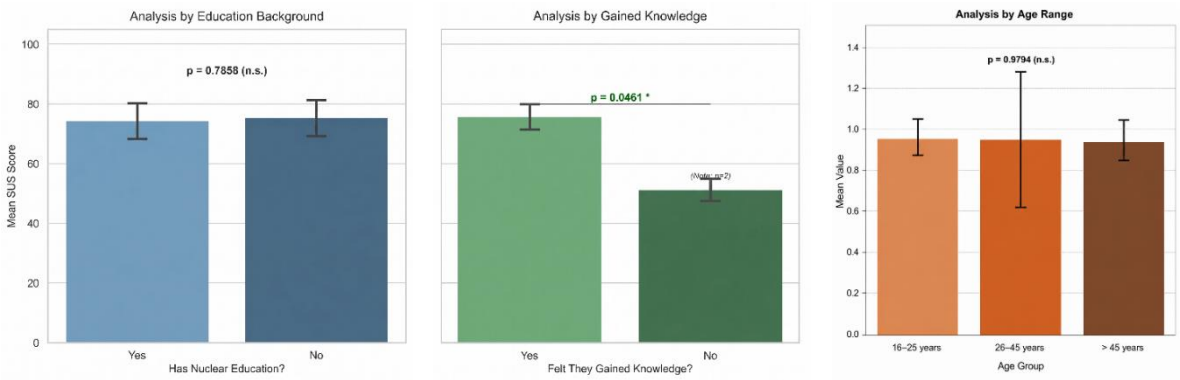
Table 3. WIKIN SUS functionality test results

Parameter	Value	Interpretation
Mean SUS score	74.8	Good usability
Median	75	Consistent central tendency
Standard deviation	15.1	Moderate variability among users
Minimum	45	Lowest recorded score
Maximum	100	Highest recorded score
Range	55	-
Respondents	51	-

Beyond the overall 'Good' usability rating ($Mean\ SUS = 74.80$), further statistical analysis was conducted to validate the effectiveness of WIKIN across key demographic segments, as summarized in Table 4 and Figure 13. The primary objective of this study was to create a platform that could bridge the knowledge gap between nuclear experts and the general public [32], [33]. An independent-samples t-test confirmed that this objective was met: no statistically significant difference ($t(49) = -0.273$, $p = 0.786$) was found in the usability scores between respondents with a nuclear education background ($M = 74.23$, $SD = 15.15$) and those without ($M = 75.40$, $SD = 15.34$). This lack of significance is a highly desirable outcome, demonstrating that platform design is equally accessible to both novices and experts.

Table 4. Summary of the statistical analysis of the SUS scores (N=51) based on three key respondent parameters

Parameter	Group	N (Count)	Mean SUS	Std. Deviation	Test method	Test statistic	p-value
Nuclear education	Yes	26	74.23	15.15	T-Test	t = -0.2733	0.7858
	No	25	75.4	15.34			
Gained knowledge	Yes	49	75.77	14.32	T-Test	t = 2.7934	0.0461*
	No	2	51.25	5.30			
Age range	16-25 years	32	75.16	15.58	ANOVA	F = 0.0270	0.9734
	26-45 years	15	74	14.22			
	>45 years	4	75	20.21			



(a) (b) (c)

Figure 13. Comparison of mean SUS scores for WIKIN users across three variables: (a) nuclear education background (Yes/No); (b) perceived knowledge gain (Yes/No); and (c) age range (16–25, 26–45, > 45)

This finding of universal accessibility is further reinforced by an analysis of age-related usability. One-way analysis of variance (ANOVA) revealed no statistically significant difference in SUS scores among the three tested age groups ('16-25', '26-45', and '>45'), $F(2.48) = 0.027$, $p = 0.973$. As illustrated in Figures 13(a) to (c), the mean scores and overlapping error bars for both the 'Nuclear Education' and 'Age Range' analyses are nearly identical, providing robust statistical evidence that the WIKIN prototype's usability is consistent, regardless of the user's prior expertise or generational cohort. This suggests that the design avoids common usability barriers often associated with specialized technical information systems.

Conversely, the second t-test revealed a statistically significant difference ($t(1.9) = 2.79$, $p = 0.046$) in usability based on whether users felt they gained new knowledge. Respondents who affirmed that they had learned something ($M = 75.77$, $SD = 14.32$) rated the platform's usability significantly higher

than those who did not ($M = 51.25$, $SD = 5.30$). This result, showed by the clear separation between group means in Table 4, provides critical insight: the platform's user experience (UX) is intrinsically linked to its perceived educational effectiveness (UX). While this finding should be interpreted with caution due to the small sample size of the 'No' group ($n = 25$), it strongly suggests that a positive, usable interface is a key prerequisite for achieving the platform's core mission of public education and knowledge dissemination.

This study is limited by the short operational period of the WIKIN, which was live for only three months during testing. Nevertheless, the evaluation results provide a promising indication of the platform's usability and its potential to support long-term public engagement in nuclear science communication.

4. CONCLUSION

This study successfully designed and developed WIKIN, a web application based on the Laravel Framework, as a novel solution for nuclear science communication in Indonesia. The WIKIN core features, including nuclear news, community service submissions, and interactive community spaces, were validated through functional black box testing, which achieved a 100% success rate. Furthermore, a user evaluation using the SUS method yielded an average score of 74.80. This "Good" rating indicates that it is an above-average, usable platform that meets user expectations and serves as a strong proof-of-concept.

Future development will focus on deploying WIKIN on a secure, scalable infrastructure, integrating verified nuclear content, and enhancing interactivity through features such as webinars, mobile access, and gamification. Strengthening moderation mechanisms and conducting longitudinal studies with diverse stakeholders will be essential to ensure trust, sustainability, and broader adoption. Ultimately, WIKIN has the potential to evolve into a national and even regional model for nuclear literacy, transparency, and public engagement, aligned with IAEA knowledge management frameworks.

ACKNOWLEDGMENTS

Thank you to Dr. Eng. Zaenal Arief, Director of the Polytechnic Institute of Nuclear Technology, for granting permission to conduct research at the Computer Laboratory. In addition, thank you also to Arfanny Yusuf Habibie and Erwin Fahrurozi. This research was conducted without external research funding or formal research contract.

FUNDING INFORMATION

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Halim Hamadi	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Hammam Ahmad		✓	✓		✓	✓	✓	✓	✓		✓		✓	✓
Hanif Muhtadan	✓		✓	✓		✓				✓	✓		✓	
Anhar Riza Antariksawan	✓			✓						✓		✓		
Alexey G. Goryunov	✓			✓						✓		✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [HH and HAH], upon reasonable request.

REFERENCES

[1] Badan Riset dan Inovasi Nasional, "Realizing Future Energy, BRIN Prepares a Research and Innovation Ecosystem for Nuclear Energy," *brin.go.id*. Accessed: Apr. 28, 2025. [Online]. Available: https://www.brin.go.id/en/news/121771/realizing-future-energy-brin-prepares-a-research-and-innovation-ecosystem-for-nuclear-energy

[2] International Atomic Energy Agency (IAEA), "Nuclear knowlege management," *IAEA*. Accessed: Apr. 28, 2025. [Online]. Available: https://www.iaea.org/topics/nuclear-knowledge-management

[3] International Atomic Energy Agency (IAEA), "Emergency communication to the public," *IAEA*. Accessed: Apr. 28, 2025. [Online]. Available: https://www.iaea.org/topics/emergency-preparedness-response/response/emergency-communication

[4] Badan Pengawas Tenaga Nuklir Indonesia (BAPETEN), "BAPETEN Profile," *BAPETEN*, 2025. Accessed: Apr. 30, 2025. https://bapeten.go.id/berita/profil-bapeten-142521.

[5] D. S. Wisnubroto, Ruslan, D. Irawan, and T. Erni, "Public opinion survey on nuclear energy in Indonesia: Understanding public perception on nuclear power plant program," in *AIP Conference Proceedings*, 2019, vol. 2180, no. June 2016, p. 020042, doi: 10.1063/1.5135551.

[6] Y. Sugiawan and S. Managi, "Public acceptance of nuclear power plants in Indonesia: Portraying the role of a multilevel governance system," *Energy Strategy Reviews*, vol. 26, no. November 2016, p. 100427, Nov. 2019, doi: 10.1016/j.esr.2019.100427.

[7] Yutainten, E. Kuswarno, U. Wahyudin, and I. Mirawati, "Reframing government science communication in the digital era: a multi-model study of BRIN (Indonesia)," *Publications*, vol. 13, no. 3, p. 45, Sep. 2025, doi: 10.3390/publications13030045.

[8] S. Williams, R. Jones, K. Reinecke, and G. Hsieh, "An HCI research agenda for online science communication," *Proceedings of the ACM on Human-Computer Interaction*, vol. 6, no. CSCW2, pp. 1–22, Nov. 2022, doi: 10.1145/3555591.

[9] D. Maloney-Krichmar and J. Preece, "A multilevel analysis of sociability, usability, and community dynamics in an online health community," *ACM Transactions on Computer-Human Interaction*, vol. 12, no. 2, pp. 201–232, 2005, doi: 10.1145/1067860.1067864.

[10] Aisyah Hamizah Mahussin, Amri Ab Rahman, Omar Kairan, Jasrul Nizam Ghazali, Mohd Azry Abdul Malik, and Ahmad Bukhari Mohd Yasin, "MySRS – The development of web-based using PHP Laravel framework," *Journal of Mathematics and Computing Science*, vol. 8, no. 2, pp. 143–158, 2022, doi: 10.24191/jmcs.v8i2.6994.

[11] Dennis Alan, Wixom Barbara Haley, and Tegarden David, *Systems analysis & design an object-oriented approach with UML Dennis Wixom Tegarden*. John Wiley & Sons, Inc., 2015.

[12] Laravel, "Laravel documentation - 8.x," *Laravel*, 2023. https://laravel.com/docs/8.x/upgrade.

[13] T. Matula, *Laravel application development cookbook*. New York: Packt Publishing, 2013.

[14] Matt Stauffer, *Laravel: up & running*. California, US: O'Reilly Media, Inc., 2019.

[15] C. L. Phang, *Mastering front-end web development*. US: Kindle Direct Publishing, 2020.

[16] M. Hartl, *Learn enough JavaScript to be dangerous: a tutorial introduction to programming with JavaScript*. Addison Wesley Professional, 2022.

[17] G. Booch, R. A. Maksimchuk, M. W. Engle, B. J. Young, J. Connallen, and K. A. Houston, "Object-oriented analysis and design with applications, third edition," *ACM SIGSOFT Software Engineering Notes*, vol. 33, no. 5, pp. 29–29, Aug. 2008, doi: 10.1145/1402521.1413138.

[18] R. Rischpater, *Wireless web development*. Berkeley, CA: Apress, 2002.

[19] A. Rodas, J. I. R. Y, and G. R. Solarte, "Creating an architecture using unified modeling language (UML)," no. 20, pp. 15–23, 2016.

[20] B. Unhelkar, *Software Engineering with UML*. New York: Taylor & Francis, 2018.

[21] G. Blokdyk, *UML a complete guide*. 5STARCooks, 2021.

[22] P. P.-S. Chen, "The entity-relationship model—toward a unified view of data," *ACM Transactions on Database Systems*, vol. 1, no. 1, pp. 9–36, Mar. 1976, doi: 10.1145/320434.320440.

[23] T. Teorey, S. Lightstone, and T. Nadeau, *Database modeling and design: logical design (4th ed.)*. San Francisco: Morgan Kaufmann, 2006.

[24] R. Elmasri and S. B. Navathe, *Fundamentals of database systems (8th ed.)*, 6th ed. New York: Pearson, 2016.

[25] T. DeMarco, "Structure analysis and system specification," in *Pioneers and Their Contributions to Software Engineering*, Berlin, Heidelberg: Springer Berlin Heidelberg, 1979, pp. 255–288.

[26] G. B. Shelly and H. J. Rosenblatt, *Systems analysis and design ninth edition*, 9th ed. Boston: Course Technology, 2012.

[27] G. J. Myers, C. Sandler, and T. Badgett, *The art of software testing*. New jersey, US: John Wiley & Sons, 2012.

[28] P. Ammann and J. Offutt, *Introduction to software testing*. New York: Cambridge University Press, 2016.

[29] J. Sauro, "Measuring usability with the system usability scale (SUS)," *Measuring Usability*, pp. 1–5, 2011.

[30] J. Brooke, "SUS: a 'quick and dirty' usability scale," in *Usability Evaluation In Industry*, CRC Press, 1996, pp. 207–212.

[31] A. Bangor, P. Kortum, and J. Miller, "Determining what individual SUS scores mean," *Journal of Usability Studies*, vol. 4, no. 3, pp. 114–123, 2009, doi: 10.5555/2835587.2835589.

[32] E. Sugawara and H. Nikaido, "Properties of AdeABC and AdeIJK efflux systems of Acinetobacter baumannii compared with those of the AcrAB-TolC system of Escherichia coli," *Antimicrobial Agents and Chemotherapy*, vol. 58, no. 12, pp. 7250–7257, 2014, doi: 10.1128/AAC.03728-14.

[33] K. Vehkalahti and B. S. Everitt, *Multivariate analysis for the behavioral sciences*, Second Edi. New York: CRC Press, 2019.

BIOGRAPHIES OF AUTHORS

Halim Hamadi received the Bachelor's and the Master's degree in Physics from the Universitas Gadjah Mada, Yogyakarta, Indonesia, in 2013 and 2016, respectively. He is currently pursuing a Ph.D. program at the School of Nuclear Engineering at Tomsk Polytechnic University, Russia. He is currently a lecturer in Research Center for Data and Information Sains, National Research and Innovation Agency, Indonesia. His current research interests focusing on numerical simulation, visualization, web application focusing on nuclear knowledge management, human-computer interaction, and internet of things (IoT). He can be contacted at email: hali003@brin.go.id.

Hammam Ahmad Hanif received the Bachelor's degree in Electronic Instrumentation from Polytechnic Institute of Nuclear Technology, Yogyakarta, Indonesia, in 2024. He is currently become an engineer in an oil company in Indonesia. He can be contacted at email: hammam.ahmad@polteknuklir.ac.id.

Muhtadan received the Ph.D.'s degree from Universitas Gadjah Mada in School of Electrical Engineering, Yogyakarta, Indonesia, in 2012. He is currently an associate professor in Research Center for Intelligent Mechatronics, National Research and Innovation Agency, Indonesia. His current research interests focusing on direction is interface and data acquisition, internet of things (IoT). He can be contacted at email: muht002@brin.go.id.

Anhar Riza Antariksawan received the DEA degree from Doctor of Energetique Physique, E.N.S de Physique de Grenoble, Institute National Polytechnique de Grenoble (INPG), France, in 1993. He is currently a Professor in Department of Electro Mechatronics, Polytechnic Institute of Nuclear Technology, National Research and Innovation Agency, Indonesia. He received the IAEA Best Practice Award in 2018. From 2019 to 2021, he served as Chairman of the National Nuclear Energy Agency (BATAN). His current research interests focusing on thermohydraulic in reactor research or nuclear power plant and reactor research safety modelling. He can be contacted at email: anha001@brin.go.id.

Aleksey G. Goryunov received the Ph.D. degree from School of Nuclear Engineering at Tomsk Polytechnic University, Russia, in 2006. He received Doctor of Science in 2012. He is currently a Professor in Nuclear Power Plants, Fuel Cycle, Radiation Safety, School of Nuclear Science and Engineering, Tomsk Polytechnic University, Tomsk Russia. His current research interests focusing on remote-control systems, microprocessor systems, automation of nuclear reactor, automation of nuclear fuel cycle, mathematical simulation and model. He can be contacted at email: alex1479@tpu.ru.