Cek Turnutin Artikel IJIM - Rudi Setiawan

by Turnitin Turnitin

Submission date: 24-Sep-2023 06:43PM (UTC-0700)
Submission ID: 2171362871
File name: Revisions_Final_Rudi_IJIM_cek_Turnitin.docx (914.89K)
Word count: 3817
Character count: 21108

Artificial Intelligence Based Chatbot to Support Public Health Services in Indonesia

https://doi.org/10.3991/ijxx.vx.ix.xxxx

Rudi Setiawan[1](✉), Rossi Iskandar[1], Nadilla Madjid[1], Ridwan Kusumawardani[1]
Trilogi University, Jakarta, Indonesia
rudi@trilogi.ac.id

Abstract— The aim of this study is to build artificial intelligence chatbot application to support public health services. Chatbot acts as an information service that can replace the role of humans. Analysis of functional needs was obtained from information submitted by one of the heads of public health centers in Indonesia. This study uses the scrum method with pregame stages to produce a plan consisting of functional and non-functional requirements analysis and conceptual design of the chatbot which will be developed using unified modeling language diagrams. The process of finding answers using matching graph master, graph master matching is a backtrack matching that uses a depth-first search strategy. There are 6 topics of chatbot services including service schedule, health information, registration, disease, drugs and early care services for chatbot users. Tests conducted on 6 topics showed an average correct answer ratio of 93.1% of a total of 251 questions and result usability measurement on the chatbot application that has been built, obtained a system usability scale value of 80.1 this indicates that chatbots that have been developed are acceptable for use.

Keywords—Chatbots, Artificial intelligence, AIML, Graph master, Chatbot to support public health services.

1 Introduction

The industry 4.0 revolution opens up opportunities for the industry to implement artificial intelligence, process big data, and carry out software development [1]. This is not the exception in the field of health care [2], where it is very important to pay attention to open access to information for the general public [3].

Indonesia has potential risks in the field of health along with the density of the population [4]. Based on the data available in Figure 1, the percentage of people who have had health complaints over the last month averaged 23% this indicates the rate of health complaint in Indonesia is quite high.

Challenges in health care come from a variety of factors, including the shortage of health care personnel and the spread of various diseases, making it difficult for many countries to deal with health problems. [5], the inability of health workers in the field and insufficient health data documentation systems are also major obstacles in the

provision of services [6]. Professionalism is something that health care should have, and the application of technology is part of professionalism in service [7].

Fig. 1. percentage of people who have had health complaints over the last month

Healthcare is currently at the heart of the mobile revolution [8], and software in the healthcare field is growing rapidly with the increasing use of mobile devices such as smartphones in society [9], [10], [11], making human life activities today greatly assisted by the existence of technology and activities effectively [12], [13], so that technology is an inseparable part of human life [14]. With the increasing use of the Internet and the development of technology in the health world, such as telemedicine, telehealth, and telenursing, telemedicine has become one of the alternatives to providing health and nursing services.

Telemedicine or telehealth-based healthcare systems involving humans as operators still have limitations, including service hours and limitations of officials' understanding in answering any question up to problems of communication ability. Chatbot exists as an automatic communication machine to answer user questions [15], chatbot simulates human conversational language into computer programs [16], through a natural language approach [17], so that the presence of chatbots can help organizations for various needs [4], [18], and create information services that are cost-effective, and don't take long to answer questions [3]. The ease and flexibility offered by chatbots makes it profitable for its users [19].

The application of chatbots as a medium or tool to provide information has been extensively researched in 2020 by [20] conducting research on online health medical suggestions designed with a modularly designed system so that this system can adapt to medical scenarios. Another study [21] in his research titled "Chatbot for Healthcare Systems Using Artificial Intelligence" used cosine similarity calculations to classify questions and used TF-IDF to find out how relevant a question is to the answers available in the dataset. The study [22] used text messages and voice messages as input that were then processed using machine learning to predict the type of disease experienced by the patient and monitor the health condition in Covid-19 cases.

Open access to health information is a challenge ahead. This research aims to develop chatbots that support the public in the process of searching for health infor-

mation, so that access to health services is easily accessible and can increase public satisfaction with health information services.

2 Methods

In this study, the method used is Agile, Agile is one of the software development methodologies [23]. There are various frameworks that exist in Agile, one of which is Scrum. Scrum was chosen because of the advantages it can run with design sprint iterations in a short period of time. Scrum is made with the principle of being fast, lightweight and can move freely [24]. The process of analyzing user requirements in Scrum is carried out at the beginning as input from the end user to start the Scrum process. Scrum is the most suitable method for developing chatbots because of its constant meetings that better involve the team in the project [25]. In Scrum there are 3 stages of the process to be carried out, namely pregame, game and postgame.

1. At the pregame stage there are 2 sub-stages, namely planning and architectural design. Planning is carried out with the head of the public health center to determine what features will be developed in the application the architectural design sub-stage is the stage of designing software architecture based on the features to be developed.
2. On Game Stage the activities carried out are analysis and design. The analysis is based on the planning carried out in the early stage of the pregame stage, the analysis can result in the conceptual design of the system to be developed.
3. Postgame is a stage of the demo and delivery product, before the product in the delivery needs to be done product testing to make sure the product has been developed based on the needs of the user.

The Scrum method is chosen because the daily meetings conducted at each sprint period can identify potential problems that occur during the system development process that may be experienced by all team members.

3 Results

3.1 Pregame Stage

At the pregame stage, an agreement was reached with the head of the community health center, which was described in terms of the proposed system flow, user needs, and functionality requirements.

A. Planning

1) Functional Needs

1. The application is able to manage the list of questions about public health services including viewing the list of questions, adding questions and deleting questions

2. The application is able to provide answers to every question asked by the user
3. The application is able to save every question asked by the public into the database
4. The application can display statistics of frequently asked questions

2) Non-Functional Needs

1. Availability of applications that can be updated at any time and must be able to operate 7 days per week, 24 hours per day without any problems
2. Availability of applications that can be updated at any time and must be able to operate 7 days per week, 24 hours per day without any problems
3. Applications that are developed later must have a high level of security where every user who enters cannot change data belonging to other accounts

B. Architectural Design

Design of software systems is a long series of processes that can be carried out in several ways [26]. Unified Modelling Language diagrams are considered as the main component in the software requirements engineering process and become a standard reference in many companies [27]. Use case diagrams of the system to be developed are drawn and explained at the points below. Use case diagrams describe the functional requirements of the system being developed and the relationship between the system and the external environment [26]. There are 2 actors involved in the system, the community as the actor who most frequently interacts with the chatbot to ask various matters related to health services and the chatbot will automatically answer each question based on the pattern in the database that was previously inputted by the administrator. The use case diagram of a public health service chatbot is illustrated in Figure 2.

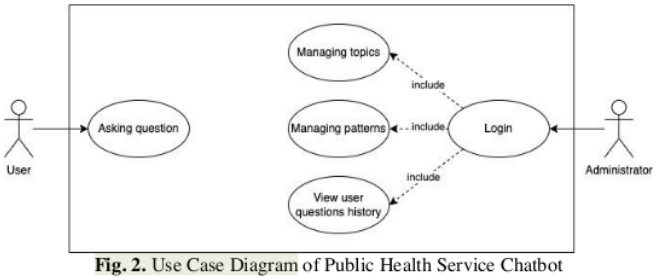

Fig. 2. Use Case Diagram of Public Health Service Chatbot

3.2 Game Stage

A. Analysis

The necessary datasets for chatbots are collected through the data that exists on the service procedures in the public health center, in addition, the data is also obtained

through the process of interviews to health nurses. This data consists of the types of health services, service times, health information, and the most frequently asked questions by the public as well as the answers given to those questions.

The dataset is stored in a database that will be called by the application in the form of a JSON file, an example JSON files for healthcare topics.

```
<category>
<pattern> * Dentist </pattern>
<template> Dentist services open on Mondays at 9 am
</category>

<category>
<pattern> * Dentist * </pattern>
<template> Dentist services open on Mondays at 9 am
</category>

<category>
<pattern> Dentist * </pattern>
<template> Dentist services open on Mondays at 9 am
</category>
```

Pattern is a question given by the chatbot user. Sign * on pattern is any word that is at the beginning or end of the pattern.

Table 1. Sample Question

* (Prefix Word)	Pattern	* (Last Word)
Tell me about	Dentist	
Is there a	Dentist	today?
	Dentist	there?

The answers to each question are grouped according to the topic of the question with each number of patterns shown in Table 2.

Table 2. Topics and Patterns

Topic	Patterns	Description
Salutation	8	Initial conversation greeting from the system for chatbot users
Service Schedule	23	Questions about health services
Health Information	34	Questions regarding health information
Registration	26	Questions regarding registrations
Disease	28	Questions about disease
Drug	29	Questions about drugs

B. Conceptual Design

1) Pattern Matching Method

Graph master is a method for storing stimulus-response categories from AIML (Artificial Intelligence Markup Language). To achieve efficiency in pattern matching and memory usage, AIML (Artificial Intelligence Markup Language) uses the Graph master method [28], where all category tags (<category>) in AIML will be stored in the form of a tree starting from the root node "*" to a certain path from a pattern.

Graph master is in the form of a tree, when the client from the bot (agent) enters text as a stimulus, Graph master will look for categories to match them into the <pattern> function according to the context of the sentence, then produce output <template> in response.

Graph master matching is a backtrack matching that uses a depth-first search strategy. Depth-first search is one of the blind search (blind search). This search is carried out from the initial node in depth to the most recent or until it is found. In other words, the branch or child node that is visited first.

The stages of the Graph master Pattern Matching Algorithm are detailed as shown in figure 3 [29].

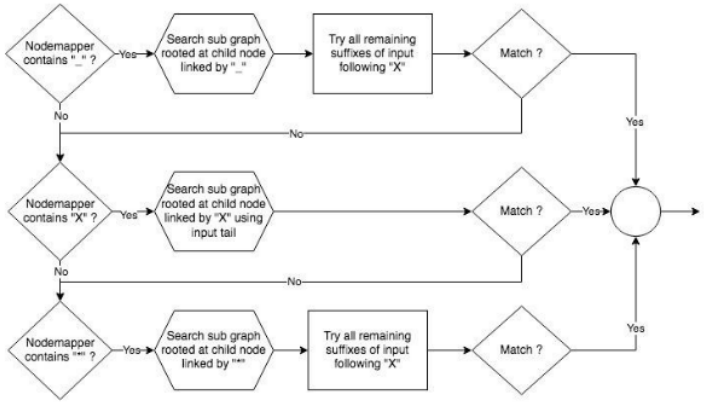

Fig. 3. Graph master Pattern Matching (source: www.alicebot.org)

C. Chatbot Architecture

The chatbot system consists of three entities: chatbot interface, chatbot backend and database. Each of these entities cannot be separated. Chatbot interface serves as an application interface used by the user, text messages sent by the chatbot user will be processed by the backend using a pattern of matching by taking data from the database. chatbot architecture is depicted in Figure 4.

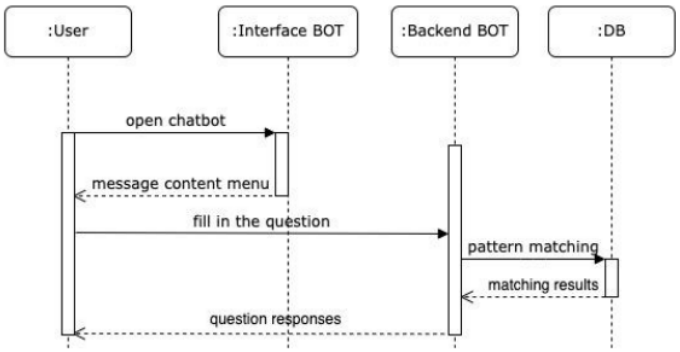

Fig. 4. Chatbot Architecture

3.3 Post-Game

A. Application Demo

The chatbot application test was conducted by 58 respondents, each respondent interacted with the chatbot but not all respondents performed experiments on all existing topics. Tests conducted on 6 topics showed an average correct answer ratio of 93.1% of a total of 251 questions and a summary of test results for each topic is shown in Table 3.

Table 3. Summary of the test results on each topic

	Topics					
	Salutation	Service Schedule	Health Information	Registration	Disease	Drug
Total Testing Topics	58	46	42	35	37	33
Answer is Correct	58	42	39	34	32	30
Percentage of correct answers	100,0%	91,3%	92,9%	97,1%	86,5%	90,9%

Chatbots are designed to answer questions using the Indonesian language, examples of chatbot test results are shown in Figure 5.

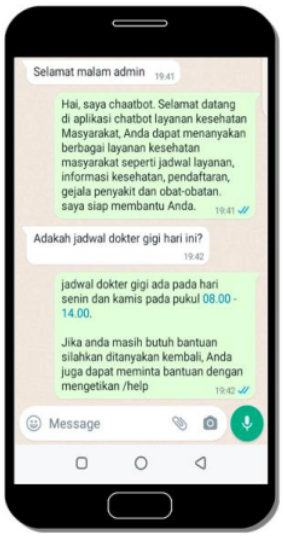

Fig. 5. Example Question and Answer from Chatbot

B. Usability Measurement Results

Usability measurement is done using System Usability Scale (SUS). These methods can help determine whether the system can already be used properly [30], Based on a thorough review of the collected data, SUS is summarized as follows [31].

1. SUS is dependable. Users regularly answer to the scale items, and SUS has been demonstrated to be more sensitive to variations than other questionnaires at smaller sample numbers.
2. SUS is accurate. In other words, it measures what it says it is measuring.
3. SUS isn't a diagnostic tool. To put it another way, it doesn't explain what makes a system useful or not.
4. SUS scores return a value between 0 and 100, although they are not percentages. You need to look at your product's percentile ranking to determine how it stacks up against the competition.
5. SUS evaluates both usability and learnability. Although there is a little association between SUS scores and task performance, it is not surprising that people's subjective evaluations may

Figure 6 show grades for SUS performance.

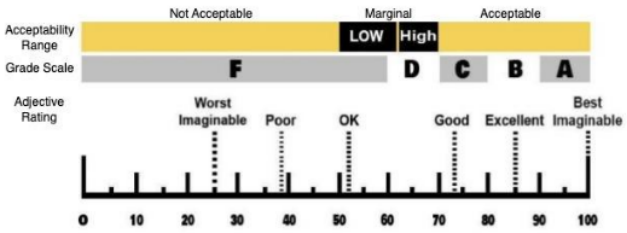

Fig. 6. Grades for SUS Performance

The usability measurement was carried out involving 58 respondents with the characteristics of respondents shown in Table 4.

Table 4. Characteristics of respondents

Gender	Age	Total	Percentage
Male	15 - 25	4	53,4 %
	26 – 35	7	
	36 – 45	10	
	46 – 55	8	
	> 55	2	
Female	15 – 25	5	46,6 %
	26 – 35	12	
	36 – 45	6	
	46 – 55	3	
	> 55	1	

Based on the questionnaire results of 58 respondents, the measurement results of SUS are shown as in Table 5.

Table 5. SUS Score

No	Question	Average Score
1	I think that I would like to use this chatbot frequently.	4,5
2	I found the chatbot unnecessarily complex.	1,9
3	I thought the chatbot was easy to use.	4,8
4	I think that I would need the support of a technical person to be able to use this chatbot.	2,0
5	I found the various functions in this chatbot were well integrated.	4,6
6	I thought there was too much inconsistency in this chatbot.	1,1
7	I would imagine that most people would learn to use this chatbot very quickly.	4,7
8	I found the chatbot very cumbersome to use.	1,1
9	I felt very confident using the chatbot.	4,9

10	I needed to learn a lot of things before I could get going with this chatbot.	2,5
	Total	32,1
	SUS Score (2,5 * Total)	80,1

From the results of the usability measurement on the chatbot app that has been built, obtained a SUS value of 80.1 this indicates that chatbots that have been developed are acceptable for use.

4 Conclusion

The study produced chatbots based on artificial intelligence to support public health information services, based on the difficulty of obtaining access to information for people who are far from health care locations, the development of a chatbot is the solution. There are several methods in finding answers to questions given by the user including using case base reasoning and brute force algorithms, in this study, it is proposed to use a backtrack graph master pattern matching algorithm, namely using a deep search strategy with depth-first search using Artificial Intelligence Markup Language.

Chatbots that have been developed using the graph master pattern matching algorithm are able to produce chatbots who can interact like interacting with humans with an average success of correct answers reaching 93.1% of the total of 251 questions.

5 References

[1] S. A. Azlan, N. Zakaria, K. Z. Umi, "Building Operation and Maintenance: A Framework for Simplified Building Information Modeling (BIM) Digital Mobile Application," *International Journal of Interactive Mobile Technologies*, vol. 15, no. 20, pp. 146-160, 2021. https://doi.org/10.3991/ijim.v15i20.23753

[2] A. F. M. F. Ismail, M F. M. Sam, K. A. Bakar, A. Ahamat, S. Adam, & M. L. Qureshi, "Artificial Intelligence in Healthcare Business Ecosystem: A Bibliometric Study," *International Journal of Online and Biomedical Engineering (iJOE)*, vol. 18, no. 9, pp. 100–114, 2022. https://doi.org/10.3991/ijoe.v18i09.32251

[3] M. Adam, M. Wessel, and A. Benlian, "AI-based chatbots in customer service and their effects on user compliance," *Electronic Markets*, vol. 31, no. 2, pp. 427–445, 2021, https://doi.org/10.1007/s12525-020-00414-7

[4] E. Asfoura, G. Kassem, B. Alhuthaifi, and F. Belhaj, "Developing Chatbot Conversational Systems & the Future Generation Enterprise Systems," *International Journal of Interactive Mobile Technologies*, vol. 17, no. 10, pp. 155-175, 2023. https://doi.org/10.3991/ijim.v17i10.37851

[5] S. Davey and A. Davey, "Mobile-health technology: Can it Strengthen and improve public health systems of other developing countries as per Indian strategies? A systematic review of the literature," *International Journal of Medicine and Public Health*, vol. 4, no. 1, pp. 40-45, 2014. https://doi.org/10.4103/2230-8598.127121

[6] N. Rendell, K. Lokuge, A. Rosewell, and E. Field, "Factors That Influence Data Use to Improve Health Service Delivery in Low- and Middle-Income Countries," *Global Health: Science and Practice*, vol. 8, no. 3, pp. 566–581, 2020. https://doi.org/10.9745/ghsp-d-19-00388

[7] L. Schaumberg, "Advanced Practice Telenursing Through a Pandemic," *Journal of Psychosocial Nursing and Mental Health Services*, vol. 58, no. 9, pp. 4-6, 2020. https://doi.org/10.3928/02793695-20200624-09

[8] B. Ramdurai, "A study on Mobile apps in the Healthcare Industry," *International Journal of Mobile Computing and Application,* vol. 8, no. 1, pp. 17-21, 2021. https://doi.org/10.14445/23939141/IJMCA-V8I1P104

[9] A. A. Pinem, A. Yeskafauzan, P. W. Handayani, et al, "Designing a health referral mobile application for high-mobility end users in Indonesia," *Heliyon,* vol. 6, no. 1, pp. 1-8, 2020. https://doi.org/10.1016/j.heliyon.2020.e03174

[10] S. McLean, A. Sheikh, K. Cresswell, et al, "The impact of telehealthcare on the quality and safety of care: A systematic overview," *PLoS ONE*, vol. 8, no. 8, pp. 1-11, 2013. https://doi.org/10.1371/journal.pone.0071238

[11] H. Sikandar, A. F. Abbas, N. Khan and M. I. Qureshi, "Digital Technologies in Healthcare: A Systematic Review and Bibliometric Analysis," *International Journal of Online and Biomedical Engineering (iJOE)*, vol. 18, no. 8, pp. 34–48, 2022. https://doi.org/10.3991/ijoe.v18i08.31961

[12] V. S. Nijampurkar, "The Emergence of Cyber Literature it's a Need for Today's Life," *International Journal of Advanced Research in Science, Communication and Technology,* vol. 3, no. 3, pp. 159–164, 2023. https://doi.org/10.48175/ijarsct-8134

[13] D. N. Bestari and A. Wibowo, "An IoT Based Real-Time Weather Monitoring System Using Telegram Bot and Thingsboard Platform," *International Journal of Interactive Mobile Technologies*, vol. 17, no. 6, pp. 4–19, 2023. https://doi.org/10.3991/ijim.v17i06.34129

[14] J. Spangler, T. Huth, and R. Xie, "Patient Perspectives: An Integral Part of Health Technology Assessment Methodology," *International Journal of Technology Assessment in Health Care,* vol. 38, no. 1, pp. e85, 2022. https://doi.org/10.1017/s0266462322003270

[15] Kharis, M., Schön, S., Hidayat, E., Ardiansyah, R., & Ebner, M. (2022). Mobile Gramabot: Development of a Chatbot App for Interactive German Grammar Learning. *International Journal of Emerging Technologies in Learning (iJET)*, *17*(14), pp. 52–63. https://doi.org/10.3991/ijet.v17i14.31323

[16] Wan Hamzah, W. M. A. F., Ismail, I., Yusof, M. K., Mohd Saany, S. I., & Yacob, A. (2021). Using Learning Analytics to Explore Responses from Student Conversations with Chatbot for Education. *International Journal of Engineering Pedagogy (iJEP)*, *11*(6), pp. 70–84. https://doi.org/10.3991/ijep.v11i6.23475

[17] Kaiss, W., Mansouri, K., & Poirier, F. (2023). Effectiveness of an Adaptive Learning Chatbot on Students' Learning Outcomes Based on Learning Styles. *International Journal of Emerging Technologies in Learning (iJET)*, *18*(13), pp. 250–261. https://doi.org/10.3991/ijet.v18i13.39329

[18] R. Alotaibi, A. Ali, H. Alharthi, and R. Almehamdi, "AI Chatbot for Tourist Recommendations: A Case Study in the City of Jeddah, Saudi Arabia," *International Journal of Interactive Mobile Technologies*, vol. 14, no. 19, pp. 18–30. 2020. https://doi.org/10.3991/ijim.v14i19.17201

[19] M. Kabiljagić, J. Wachtler, M. Ebner, and M. Ebner, "Math Trainer as a Chatbot Via System (Push) Messages for Android," *International Journal of Interactive Mobile Technologies,* vol. 16, no. 17, pp. 75–87. 2022. https://doi.org/10.3991/ijim.v16i17.33351

[20] A. Shangrapawar, A. Ravekar, S. Kale, N. Kumari, et al, "Artificial Intellegence based Healthcare Chatbot System," *International Research Journal of Engineering and Technology*, vol. 7, no. 2, pp. 2019-2021, 2020.

[21] L. Athota, V. K. Shukla, N. Pandey, A. Rana, "Chatbot for Healthcare System Using Artificial Intelligence," in 8th International Conference on Reliabilty, Infocom Technologies and Optimization (Trends and Future Directions), 2020, pp. 619-622.

[22] M. V. Vasileiou, I. G. Maglogiannis, "The Health Chatbot in Telemedicine: Intelligent Dialog System for Remote Support," *Journal of Healthcare Engineering,* vol. 2022, pp. 1-12, 2022. https://doi.org/10.1155/2022/4876512

[23] P. A. G. Permana, "Scrum Method Implementation in a Software Development Project Management," *International Journal of Advanced Computer Science and Applications,* vol. 6, no. 9, pp. 198-204, 2015. https://doi.org/10.14569/IJACSA.2015.060927

[24] A. Pham, et al, *Scrum in action Agile software project management and development*. Boston, Course Technology PTR, 2011. [E-book] Available: https://libcat.simmons.edu

[25] R. L. Ayala, S. R. Cosi, and L. A. Arenas, "Design of a Mobile Application to Improve the Lifestyle of Patients with Diabetes," *International Journal of Interactive Mobile Technologies,* vol. 17, no. 05, pp. 100–116. 2023. https://doi.org/10.3991/ijim.v17i05.37441

[26] S. A. Abdulhak and D. K. Kang, "Effectiveness of Simultaneous Blending of User Experience and System Development Lifecycle Models in Application Developments," *International Journal of Software Engineering and Its Applications,* vol. 6, no. 2, pp. 167-172, 2012.

[27] N. M. Minhas, A. M. Qazi, S. Shahzadi, and S. Ghafoor, "An Integration of UML Sequence Diagram with Formal Specification Methods – A Formal Solution Based on Z," *Journal of Software Engineering and Application,* vol. 8, pp. 372-383, 2015. https://doi.org/10.4236/jsea.2015.88037

[28] M. Marietto, et al, "Artificial Intelligence Markup Language: A Brief Tutorial," *International Journal of Computer Science and Engineering Survey,* vol. 04, no. 3. 2013. https://doi.org/10.5121/ijcses.2013.4301.

[29] R. S. Wallace, "The Element of AIML Style" Alice AI Foundation Inc. 2003.

[30] A. Bangor, P. Kortum, and J. Miller, "Determining what individual SUS scores mean: Adding an adjective rating scale," *Journal of Usability Studies,* vol. 4, no. 3, pp. 114-123. 2009.

[31] J. Sauro and J. Lewis, "When designing usability questionnaires, does it hurt to be positive?," in Proceeding of the Conference in Human Factors in Computing Systems, 2011.

6 Authors

Rudi Setiawan is a lecturer from Information System Study Program, Faculty of Science, Engineering and Design, Trilogi University, Jakarta, Indonesia. (email: rudi@trilogi.ac.id).

Rossi Iskandar is a lecturer from the Elementary School Teacher Education Study Program, Faculty of Education, Trilogi University, Jakarta, Indonesia. He is studying at Jakarta State University to get a doctoral degree (email: rossiiskandar@trilogi.ac.id).

Nadilla Madjid is a student of the Information Systems Study Program at Trilogy University (email: nadilla.madjid@trilogi.ac.id).

Ridwan Kusumawardani is a student of the Information Systems Study Program at Trilogy University (email: ridwan.kusumawardani@trilogi.ac.id).

Cek Turnutin Artikel IJIM - Rudi Setiawan

ORIGINALITY REPORT

8%	7%	7%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Tennessee Knoxville Student Paper	4%
2	online-journals.org Internet Source	<1%
3	www.scirp.org Internet Source	<1%
4	www.warse.org Internet Source	<1%
5	Tri Pujadi, Bachtiar H. Simamora, Vikas Kumar, Yosafati Hulu, Tumar, Wihendro. "Modeling of E-Commerce Supply Chains Mobile Application", 2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS), 2020 Publication	<1%
6	repository.upi-yai.ac.id Internet Source	<1%
7	www.atlantis-press.com Internet Source	<1%

8	www.ncbi.nlm.nih.gov Internet Source	<1%
9	Ati Suci Dian Martha, Ezar Rizqullah Tsaqif Setyawan, Rosa Reska Riskiana. "Measuring Usability on User-Centered Mobile Web Application: Case Study on Financial Mathematics Calculator", Khazanah Informatika : Jurnal Ilmu Komputer dan Informatika, 2023 Publication	<1%
10	Fajar Pradana, Punaji Setyosari, Saida Ulfa, Tsukasa Hirashima. "Development of Gamification-Based E-Learning on Web Design Topic", International Journal of Interactive Mobile Technologies (iJIM), 2023 Publication	<1%
11	mobt3ath.com Internet Source	<1%
12	www.researchgate.net Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		