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Chatbot-Based Application Development and Implementation as an Autonomous Language Learning Medium

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A B S T R A C T

Autonomous learning has an important role in online learning because teachers cannot directly supervise the student learning process, which makes students themselves responsible for their learning. As an attempt to provide teachers with an alternative autonomous learning medium, this study aimed to use a chatbot-based Japanese grammar learning application namely Gengobot as an autonomous Japanese learning medium. This study applied Analysis, Design, Development, Implementation, and Evaluation (ADDIE) instructional design model. The data of this research was collected using a pre-experimental method and distributed a Likert scale questionnaire to 50 Japanese language learners with Japanese language levels equivalent to or less than JLPT level N3. The results showed that Gengobot as a chatbot-based Japanese grammar learning medium is an interesting and innovative medium to support Japanese autonomous learning because learners can decide how they learn using this application to improve their Japanese grammar skills. In addition, Gengobot is a chatbot-based learning medium that is more interactive than other Mobile-based media, which makes learners more interested in using Gengobot as a Japanese grammar learning medium. However, Gengobot still needs further development such as adding advanced grammar content (N2 and N1), adding Japanese pronunciation features (audio), etc.

A R T I C L E I N F O

1. INTRODUCTION

Autonomous learning has been one of the most discussed topics in language learning. especially during a pandemic like nowadays, teachers/educators are required to provide learning with existing limitations. Autonomous Learning has now become an important part of online learning because teachers cannot directly supervise student learning (Cheng, 2020; Chen, 2021; Xiao & Ran, 2020; Xie, 2020). Autonomous Learning is self-managed and self-monitored learning, and under certain conditions self-regulated (Yan, 2012). The main reason for the importance of this learning model in online learning is because in autonomous learning the learner is fully responsible for all his decisions in the learning process (Yan, 2012). In language learning, especially in second language acquisition, Autonomous Learning was introduced by Holec in 1979 (Ohki *et al.*, 2004). Currently, there are many studies on autonomous language learning, one of which examined the combination of technology with autonomous language learning in English with the conclusion that combining technology with autonomous learning in English brings forth a positive impact on students. In addition, studies in China regarding the application of the Autonomous Learning model in English pronunciation also show a positive impact on learners. Besides being often applied in English learning, autonomous language learning can also be applied in learning other languages. One of them is in Japanese learning. Komori and Zimmerman, (2001) studied the effectiveness of the Kanji (Japanese Character) learning application for self-study with results showing that the application helped improve their learning outcomes, although there were still students who found it difficult to use the application.

In learning Japanese, grammar *(bunpou)* is one of many aspects that is difficult to learn especially for beginner Japanese learners. One of the effective ways to improve Japanese grammar skills is using the Drill and Practice method (Oki *et al.,* 2001). This is because the Drill and practice method goes hand in hand with the law of exercise and the law of effect developed by Edward L. Thorndike in 1927. The law of exercise encourages the repetition of an activity to master a skill or technique (Allen, 2007). The law of effect states that the stimulus and response will strengthen if the results are satisfactory and will be abandoned if the results are unsatisfactory. The drill and practice method of repetition and exercise in learners is directed to implement a series of exercises designed to improve existing and new skills. The use of this method assumes that the learner has received some instruction and learning about the concept, principle, or procedure to be trained. To be more effective, this method must include feedback to reinforce correct responses and to correct errors that the learner may have made in the process. Drill and practice methods are generally used in math tasks, and foreign language learning, especially to enrich vocabulary. Furthermore, computer media (CALL) is very effective for use in drill and practice methods, especially language learning (Decoo, 1994; Hubbard & Siskin, 2004). Computer-Assisted Language Learning (CALL) is a development of Computer Assisted Instruction (CAI) which is learning with the help of computer technology (Chapelle & Jamieson, 1986). As technology develops, CALL also develops into MALL or Mobile Assisted Language Learning which provides flexibility and portability (Chinnery, 2006; Jarvis & Achilleos, 2013). Ten learning methods can be implemented in MALL, including Presentation, Demonstration, Discussion, Drill and Practice, Tutorial, Cooperative Learning, Games, Simulation, Discovery, and Problem Solving. All these methods are related to Autonomous Learning, especially the Drill and Practice method (Lai, 2019). Many media can be used in the MALL model, one of which is a short messaging application. In short, short

messaging technology facilitates users to have short conversations in the form of notes or written text in a particular application, such as WhatsApp, LINE Messenger, and others that are very popular today. In its development, short messaging technology combined with artificial intelligence (Artificial Intelligence) becomes a new technology called a chatbot. A chatbot is a computer program that simulates conversations with or with multiple users through auditory or textual methods using natural language with the help of artificial intelligence technology (Azwary *et al.*, 2016; Wang & Petrina, 2013; Levy, 2009). The chatbot works by interpreting the message given by the user, processing the message intent, determining, and executing what the chatbot needs to do based on the user's command, and conveying the result of program implementation to the user (Shawar & Atwell, 2007). However, one of the difficulties in developing chatbots is how to implement a good chatbot system. A good chatbot system requires a lot of effort when programming, because it is usually multilevel, iterative, reactive, and requires many components. Chatbots also still have problems that are difficult to solve such as ambiguity and conclusion drawing (Jia, 2009).

The use of chatbot technology as a language learning medium can be quite popular because with chatbots, learners can simulate conversations in the language being studied. Jia, (2009) explained that one of the most effective ways to learn a language is through conversation with native speakers. But it is difficult to practice in class because of limited time and human resources. One solution that can be applied is to use a computer conversation system as a conversation partner. Some examples of chatbots in language learning are ELIZA, CHATBOT LUCY, and ALICEBOT for learning English which is proven to improve language skills through conversational exercises (Jia, 2009; Levy, 2009; Wang & Petrina, 2013). One of the messaging applications that have

features to develop chatbot technology is LINE. LINE itself has around 167 million monthly active users worldwide and is dominated by teenagers who are generally students. This is what underlies the development of Japanese grammar learning media based on the Gengobot chatbot on the LINE messaging application. It is expected that Gengobot can be an alternative as a learning medium to improve Japanese grammar skills, especially for intermediate-level language learners.

This research is a follow-up study on the development of the Gengobot as a chatbot-based Japanese grammar learning medium (Haristiani *et al.*, 2019; Haristiani & Rifai, 2020; Rifai *et al.*, 2020). The main problem to be investigated is the process of developing Gengobot as a medium for learning Japanese grammar based on the international standard Japanese Language Proficiency Test (JLPT) at the N3 level. The learning medium in this study was developed with the perspective of the ADDIE learning tool development model. Other than learning medium development, this study will also examine the implementation whether Gengobot is suitable for autonomous Japanese learning.

2. METHODS AND MATERIALS

In every learning medium development process, there should be an instructional design model referred to as the development procedure guide (Segaran *et al.*, 2014). ADDIE model is one of the most used instructional design models. ADDIE is an acronym for the five phases in instructional design, which are Analysis, Design, Development, Implementation, and Evaluation (Adoobie, 2015; Hess & Greer, 2016; Mitsui, 2014). In addition, ADDIE is a framework that is useful for examining, creating, and implementing development and learning programs which makes ADDIE has an important enlightening effect on the

development of contemporary education (Mayfield, 2011). The stages of the ADDIE model can be seen in **Figure 1**. The implementation of ADDIE in the development of the Gengobot is described as follows:

(i) Analysis Stage. In this stage, the needs of students which will later be applied to the application will be analyzed. Such as learning objectives, materials, training methods, and others.

(ii) Design Stage. At this stage, the developer will prepare everything needed for application development based on the data in the previous analysis stage including application flowcharts, application design, database preparation, and software that will be used in development. The software used in this development includes Adobe Illustrator to design the application interface, My SQL as the database application used, Sublime text editor to write an application programming language, and hosting as a place to store application data.

(iii) Development Stage. The application will be developed based on the flowchart that has been made previously. Then, it will be tested by experts in their respective fields to find out the shortcomings that can be corrected in the application. The assessments assessed by the expert are the User Interface (UI), User Experience (UX), and the material in the application.

(iv) Implementation Stage. In this stage, the application will be tested on 50 Japanese language learners with the aim of knowing the responses from students regarding the use of applications developed in learning.

(v) Evaluation Stage. The evaluation stage is carried out to determine the advantages and disadvantages of the application developed based on the data collected from 50 Japanese language learners through a questionnaire at the implementation stage. The type of questionnaire used is a Likert scale questionnaire which will be analyzed using the SPSS 24 application with reference values based on **Table 1.**
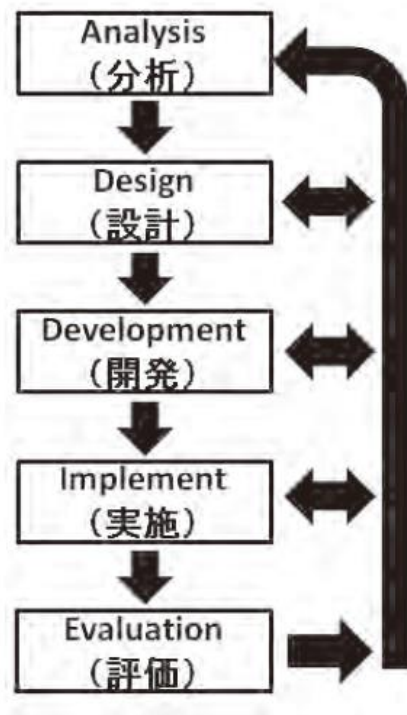

Figure 1. ADDIE model stages (adopted from Tanaka, 2014).

Table 1. Questionnaire score (adopted from Firmansyah *et al.*, 2018).

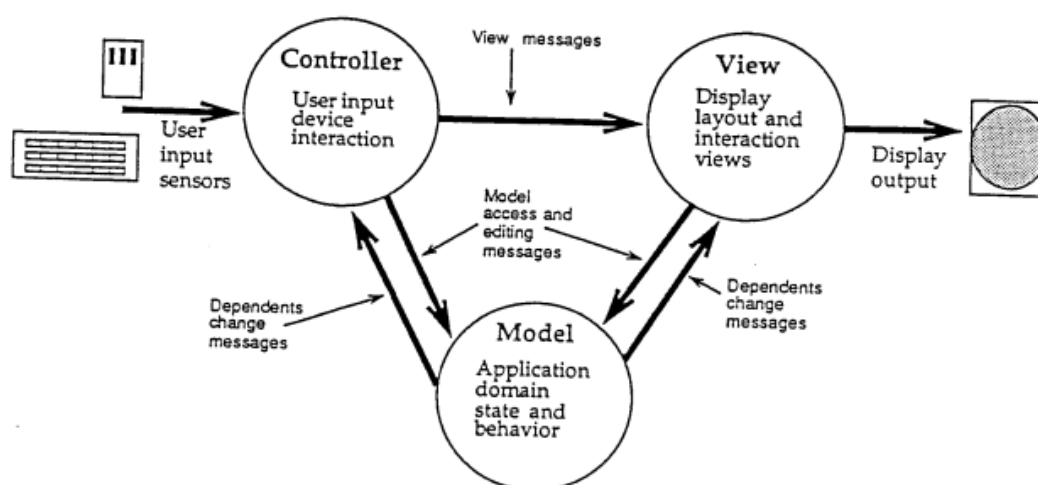| Mean Score	Category
0%-20%	Very bad
21%-40%	Bad
41%-60%	Enough
61%-80%	Good
81%-100%	Very Good

3. RESULTS AND DISCUSSION

3.1. Application Development

The MVC concept has a 3-way factor, namely programs related to the application domain such as database settings (models), programs that regulate the appearance of an application (views), and programs that regulate user interaction with views and models (Bucanek, 2009; Deacon, 2009; Krasner & Pope, 1988). The advantage of this MVC concept is that programming can be more modular because the development process can be divided into several parts as described previously. In addition, development can be more flexible because in the MVC concept we can change the view without changing anything in the controller or model, and programmers can use it in several programming languages (Bucanek, 2009; Thakur & Pandey, 2019). The MVC concept diagram can be seen in **Figure 2**.

The process of writing the Gengobot program uses the Sublime Text editor application. The program is written concerning the application interface flowchart (**Figure 3**), while the writing process can be seen in **Figure 4**. The database system used in this study is MySQL. The MySQL database structure in the form of a table that is flexible and easy to use is the reason why the developer used this system. There are three main databases created for the development of this chatbot, among others: (1) User database, for storing user data, such as name, language being used, practice scores, and others; (2) Grammar database (N3); (2) Database of questions and answers (N3). The grammar database and questions were created based on the grammar equivalent to the material of the intermediate level (N3) of the Japanese Language Proficiency Test (JLPT). The grammar database contains Japanese grammar, Indonesian equivalents, examples with meanings, and information about the grammar. An example of the database used in the Gengobot may be seen in **Figure 5.**

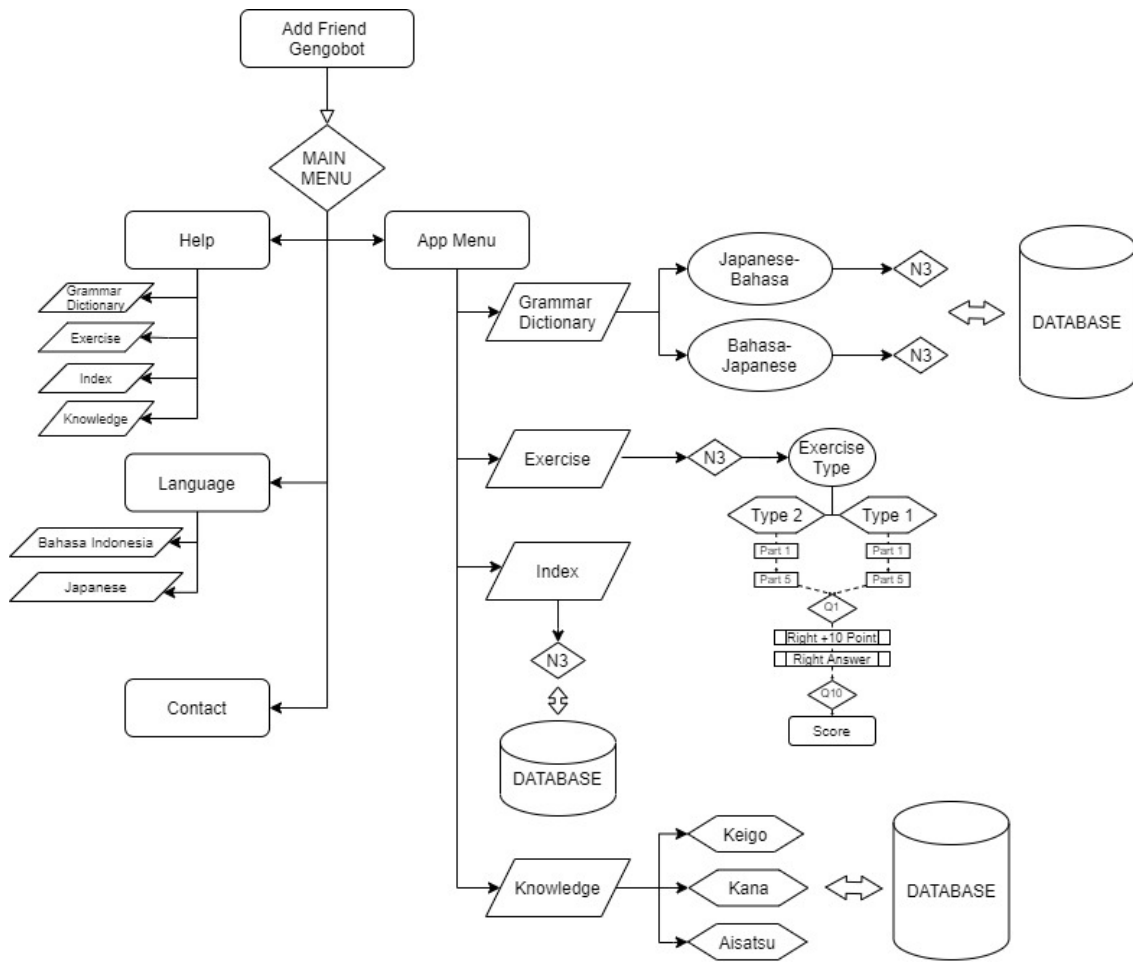**Figure 2.** MVC concept (adopted from Krasner & Pope, 1988).

Figure 3. Gengobot interface flowchart.

Figure 4. The writing process of the Gengobot program.

Figure 5. Example of gengobot database.

The Gengobot User Interface (UI) is designed using the Adobe Illustrator CC application with predetermined colors and concepts. The Gengobot UI may be seen in **Figure 6.** After all the program development process is complete, the program is connected to the LINE instant messaging application which is a Gengobot container. The LINE application which has the Messaging API feature gives us access to put an application program, in this case, an Artificial Intelligence (AI) into the instant messaging platform. From there, Gengobot took the concept of a chatbot where users may use the features of the Gengobot such as exchanging messages with someone. The concept of connecting the Gengobot program that has been developed with the LINE application may be seen in **Figure 7.**
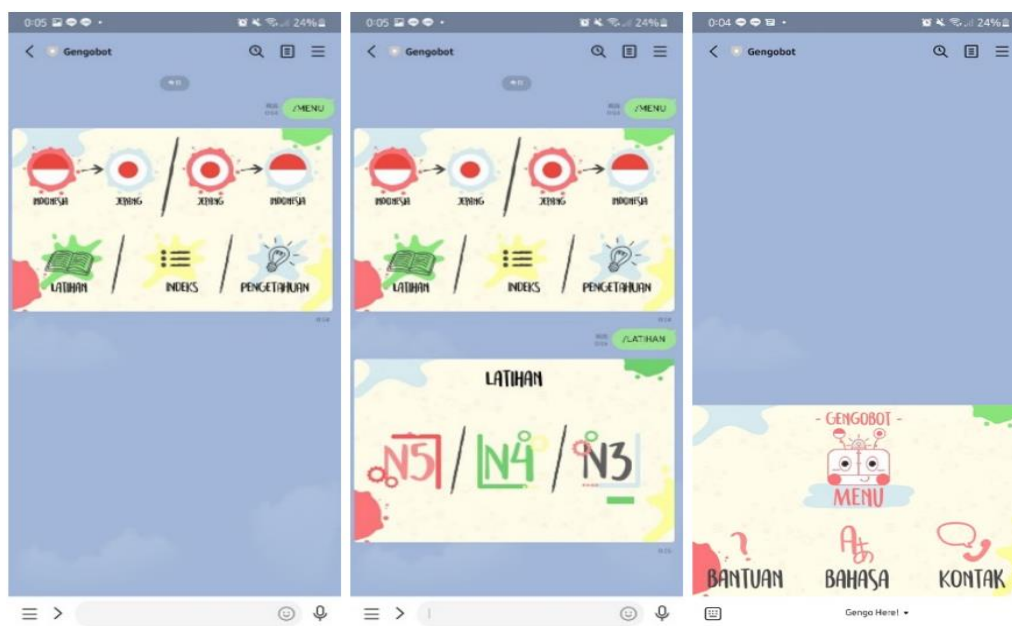
Figure 6. Gengobot user interface in the LINE application.
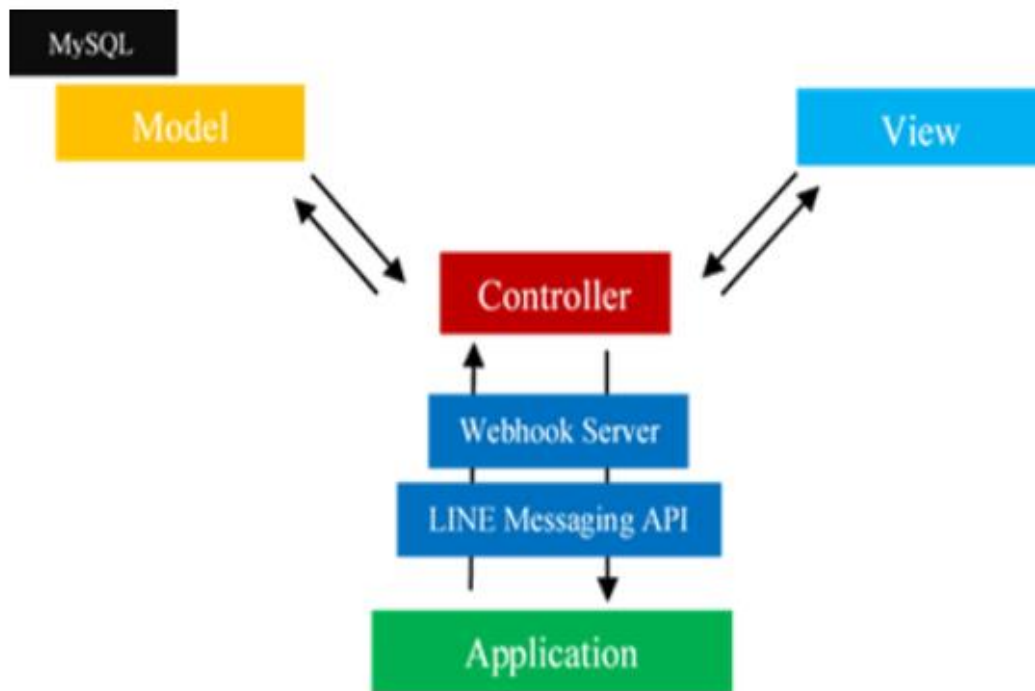
Figure 7. The concept of integration between the Gengobot app and LINE
(adopted from Haristiani & Rifai, 2020).

3.2. Application Features

The Gengobot is a chatbot-based Japanese grammar dictionary application with the main feature of Japanese grammar searching. The searchable grammars were originally only basic level grammars (N5 and N4). In this development, intermediate level Japanese grammar or equivalent to JLPT level N3 were included. This grammar search feature allows students to search for Japanese grammar from their Japanese keywords and their Indonesian equivalent. The search results that will appear are Japanese grammar, Indonesian equivalents, grammatical structures, example sentences and their meanings, and descriptions of the use of these grammars. In addition to the search feature, Gengobot has a companion feature to support Japanese learning, especially grammar. These features include a grammar index feature, an exercise feature, and a knowledge feature (Haristiani & Rifai, 2019).

The Index feature is provided to make it easier for users to search for grammar in Gengobot. This feature provides an index or list of grammar available in Gengobot. The list is separated by language and grammar level. That way users may discover what grammar is contained in Gengobot. The practice feature allows students to practice using Japanese grammar by answering the questions in the exercise. The questions provided are about 100 questions per ability level which are divided into two types of questions, namely the fill-in-blank questions and words arrangement. Those types of questions are based on the grammar questions tested in the Japanese Language Proficiency Test. The Knowledge feature contains general knowledge of the Japanese language which includes *kana*, *aisatsu*, and *keigo*. Gengobot features may be seen in **Figure 8**.

Figure 8. Example of features in Gengobot.

3.3. The Implementation of Gengobot Application

The previous version of Gengobot may be said to be a success. Students who used the application as a medium for learning Japanese grammar at level N4 have a significant increase in ability compared to students who did not use the application (Rifai *et al.*, 2020). However, based on the research results, there are still some shortcomings from the previous version, such as the need for improvements to the UX to make it more intuitive and responsive, and many requests to update the database to the next level of grammar. In this version, Japanese grammar level N3 is included as an update so that the use of Gengobot maybe even wider.

The latest version of Gengobot was piloted to 50 respondents who are 4th-semester students in the Department of Japanese Language Education, Indonesia University of Education. After the trial was conducted, students were asked to fill out a questionnaire regarding Gengobot which consists of 3 assessment aspects, namely Application (X), Contents (Y), and Usability (Z). Questionnaire data were then analyzed with SPSS 24 version application, and the result can be seen in **Table 2**.

In the aspect of the application, 86% of respondents consider the Gengobot is easy to use and practical (see **Table 3**). The design and features of Gengobot were also considered to be 'very good' by the respondents (m=4.32, p=86% and m=4.38, p=87%).

In addition, 86% of respondents considered that Gengobot is suitable as a medium for learning Japanese, especially grammar. From the results of the questionnaire, it can be interpreted that Gengobot is an application that is suitable and preferred to use by the respondents as a medium for learning Japanese grammar because it has interesting and innovative features. Although the answers from respondents were very positive, there are still many features in the application that need to be developed such as adding pronunciation *(hatsuon)* features, video features, and improving the User Experience (UX) which are stated as slightly confusing in the current version.

Table 2. Questionnaire data (Analyzed with SPSS 24 Application).

Q	Valid	Missing	Mean
X.1	50	0	4.32
X.2	50	0	4.38
X.3	50	0	4.46
X.4	50	0	4.20
X.5	50	0	4.30
X.6	50	0	4.10
Y.1	50	0	4.14
Y.2	50	0	3.84
Y.3	50	0	4.02
Y.4	50	0	4.16
Y.5	50	0	4.06
Y.6	50	0	4.42
Z.1	50	0	4.20
Z.2	50	0	4.04
Z.3	50	0	4.30
Z.4	50	0	4.04

Table 3. Evaluation results on application aspect.

No.	Statements	Mean Score	%
1.	Gengobot is easy to use and practical.	4.32	86
2.	The design of the Gengobot app is attractive and innovative.	4.38	87
3.	The features in the Gengobot are very useful	4.46	89
4.	Help features are clear and easy to understand.	4.20	84
5.	The Gengobot is suitable as a medium for learning Japanese grammar.	4.30	86
6.	I like the Gengobot application.	4.10	82

On the other hand, as presented in **Table 4**, we can see the results of the questionnaire on the content aspect. The grammar contained in the Gengobot is in accordance with the JLPT N3 level which is proven by 82% of respondents who agree with this statement, and the grammar is stated to be comprehensive (m = 3.84, p = 76%). In addition, about 80% of respondents thought that the explanations of the grammar and practice questions were easy to understand. 88% of respondents also think that the practice questions contained in the Gengobot help them learn Japanese grammar easily. Based on these results, the content aspect can be said to be good with an average of 80% value of respondents' evaluation. Even so, there are some criticisms and suggestions from respondents regarding the content in Gengobot, such as the necessity to add a list of Japanese vocabulary and their meanings, the JLPT simulation feature, and one of the most common suggestions is to add grammatical content at the advanced JLPT level, namely N2 and N1 levels.

Table 5 shows respondent's evaluation of Gengobot on the aspect of its usefulness in learning. As can be seen in **Table 5**, Gengobot can increase students' motivation to learn

Japanese, especially N3 (m=4.20, p=84%). Furthermore, grammar exercise using Gengobot is considered more fun because it is practical and more interesting than using the conventional medium as paper (m=4.30, p=86%). This is the reason why learners can understand N3 Japanese grammar better using Gengobot (m=4.04, p=80%), and it improves their Japanese grammar ability (m=4.04 p=80%).

From the survey results above, it can be perceived that the learners' evaluation of the Gengobot application is very positive overall. Gengobot is considered suitable to improve learners' Japanese grammar skills. In addition, Gengobot as a chatbot-based learning medium also has a good effect because it is innovative and interesting as a new medium, and is integrated with the LINE short message application which is often used by learners so it is more user friendly (Sivabalan & Ali, 2019).

These results also showed that Gengobot is effective as a medium for learning Japanese (Xiaoxu & Yoshino, 2011; Stockwell & Hubbard, 2013; Haristiani *et al*., 2019; Haristiani & Rifai, 2020). The use of the MALL concept and the features in Gengobot which are new and interesting make users more motivated in learning Japanese (Chuang, 2014; Ediansyah *et al*., 2019), and also

because the application is practical and easy to use (Hasan *et al*., 2020; Keezhatta & Omar, 2019; Kondo *et al*., 2012). The material in the application is also suitable for the targeted level of learners and easy to understand (Haristiani *et al*., 2019; Haristiani & Rifai, 2020). Furthermore, the practice features in Gengobot are also considered suitable to improve Japanese language skills, which is in line with other computer-based applications results (Oki *et al*., 2001; Allen, 2007) and other chatbot-based applications research results (Fryer *et al*., 2017; Fryer *et al*., 2019; Jia, 2009).

From the above analysis, the Japanese language learning chatbot-based application 'Gengobot' can be said to be very suitable for use as an autonomous language learning medium because learners can manage their learning style using this application (Lai, 2019; Hasan *et al*., 2020). In addition, these results confirmed the findings from previous research (Haristiani & Rifai, 2020) which concluded that Gengobot can help improve students' Personal Learning Environment (PLE), because autonomy, ownership, diversity, openness, and connectedness are important aspects of students' personal learning environment (Rahimi *et al*., 2015a; Rahimi et al., 2015b).

Table 4. Evaluation results on contents aspect.

No.	Statements	Mean Score (m)	% (p)
1.	The grammar contained in the application is according to the level.	4.14	82
2.	The grammar contents of the application are comprehensive.	3.84	76
3.	The explanation of the grammar search feature is easy to understand	4.02	80
4.	Explanation of questions and contents in the Gengobot is easy to understand.	4.16	83
5.	The practice questions contained in the Gengobot are in accordance with the material.	4.06	81
6.	The Practice Questions contained in the Gengobot helped me learn Japanese grammar.	4.42	88

Table 5. Evaluation results on gengobot as language learning medium.

No.	Statements	Mean Score (m)	% (p)
1.	Gengobot can increase motivation to learn JLPT N3 level Japanese grammar.	4.20	84
2.	It became easier for me to understand the use of JLPT N3 level Japanese grammar.	4.04	80
3.	Practice grammar using the Gengobot is more fun than using conventional media such as paper.	4.30	86
4.	My Japanese grammar skills improved after using Gengobot.	4.04	80

4. CONCLUSION

A chatbot-based application, Gengobot is a medium for learning Japanese grammar to improve Japanese language skills as one of the autonomous language learning media. Gengobot has features that support autonomous language learning, such as practice, a Japanese grammar search tool, and knowledge of Japanese. In addition to these features, because this application is based on a chatbot, Gen-gobot can be used anywhere and anytime. The results of the survey prove that the gengobot application is suitable for use as a medium for learning Japanese grammar with interesting and innovative features and has an effect on the respondents' Japanese language skills, especially Japa-nese grammar skills. Although respondents' responses were very positive, there are still many application features that still need to be developed, such as adding pronuncia-tion features (hatsuon), learning videos, and improving User Experience (UX), which is still a little confusing, as well as updating the materials to the next JLPT level.

5. ACKNOWLEDGMENT

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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