

## **GENGObOT: A CHATBOT-BASED GRAMMAR APPLICATION ON MOBILE INSTANT MESSAGING AS LANGUAGE LEARNING MEDIUM**

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### **Abstract**

The omnipresence of social media is crucial in the educational environment and has an important role in shaping the ways students learn, and thus, worth to be investigated. Social media has many types, with social networking as its most popular type including Mobile Instant Messaging (MIM) service. This study aimed to develop an application for language learning, namely *Gengobot* integrated with MIM service LINE. *Gengobot* is a chatbot-based grammar dictionary application that consists of Japanese Language Proficiency Test Level 5 and Level 4 (N5 and N4) grammars as a database, with the explanation and meanings in Japanese, Indonesian and English. The application development processes include problem identification and analysis, application designing, testing and improvement, and application implementation and publishing. As a result, *Gengobot* application has been successfully developed, and the test results showed that all its features successfully functioned as expected. The main features in *Gengobot* include Japanese grammars, meanings and explanations in three languages (Japanese, Indonesian, and English), index list, exercise, and basic knowledge about Japanese. The application is user-friendly and functions as a language learning medium that allows users to adjust their own learning speed, which is suitable to support independent learning, as well as to support teaching.

Keywords: Artificial intelligence (AI), Chatbot, Grammar, Language learning, Mobile instant messaging (MIM), Personalised learning.

## 1. Introduction

The growth of social media and other Web 2.0 technologies is unprecedented [1]. In recent years, new Web-based social media have been portrayed as placing the learner at the centre of networks of knowledge and expertise that potentially lead to new forms of learning and education [2]. Social media is crucial in an educational environment where technology is transforming the ways students communicate, collaborate, and learn. The notion that social media could be an effective tool for educational purposes has received recent attention and increased research interest, thus, its potential role as a facilitator and enhancer of learning is worth investigating [3].

Social media has many types including social networking sites (i.e., Facebook, Twitter, LINE), media sharing networks (i.e., Instagram, YouTube), discussion forums (i.e., Reddit, Quora), blogging and publishing networks (WordPress, Tumblr), and others. Among these types of social media, social networking sites (SNS) particularly Mobile Instant Messaging (MIM) are the most popular category due to its multi-modal (e.g., text, pictures, video) communication capability [4-6]. Several literature reviews have been written on the topic of MIM and ubiquitous learning [7-9]. In the field of education, MIM is reported to be effective in utilizing second language learning [10-12] to provide discussion forums on specific materials or topics [13-15] and to be information delivery media used by teacher or students [16, 17].

Apart from MIM, a chatbot could also be useful for learning media. Shevat [18] mentioned that Chatbot (also called as talkbot, chatterbot, Bot, IM bot, interactive agent, or artificial conversational entity) is a computer program or artificial intelligence, which carries out conversations through audio or text and interact with users in a particular domain or topic by giving intelligent responses in natural language [19, 20]. It works by interpreting the message given by a user, processes the intent of the message, determines and executes what it needs to do based on user's instructions, and delivers final results of the program execution to the user. Generally, users interact by giving questions or comments, and the chatbot will provide responses that might include comments, answers or new topics [21]. More sophisticated chatbot like *Lingubot* can produce responses such as a further conversation with the user, reading or writing to external systems (for instance to open a web page or update a database) or a combination of these [22].

In language learning, the chatbot could provide a means of language practice for students. Jia [23, 24], Fryer and Carpenter [25] and Hill et al. [26] reported that learners are interested in using chatbot because they can be used anytime and virtually anywhere, and that learners are more confident in learning languages using chatbot than when dealing directly with humans. Chatbot has also been reported effective to provide distance education [27] and providing multilingual corpus transcript [28].

Although there are many studies reported that social media, especially MIM and chatbot, contributed potentially in education, the study that developed an application combining the two has not yet been found by writers. Therefore, based on various advantages of MIM and chatbot to enhance the possibility of their advantages in language learning, this study aims to develop a chatbot-based application, namely *Gengobot* that will be integrated with MIM service. The name of *Gengobot* comes from a Japanese vocabulary, *Gengo*, which means 'language'

and Bot is a short of 'robot', which depicts its' function as a chat robot (chatbot)-based dictionary application as a language learning medium. One of the most popular MIM applications used worldwide is LINE. Especially in Indonesia, LINE instant messaging is used by 90 Million active users, which made Indonesia ranked the fourth among the world's top LINE users. Moreover, the age range of LINE users in Indonesia is around 18 to 25 years old, which can be estimated that LINE users are mainly students [29]. Therefore, utilizing LINE as a learning medium including language learning is crucial and potential. That is why LINE was selected as a platform for developing *Gengobot* in this study.

This study was intended to develop *Gengobot* as a chatbot-based grammar dictionary application that is integrated with LINE. The application also provides meaning and explanations on grammar available in three languages including Japanese, Indonesian, and English. *Gengobot* is also equipped with index and exercise features. The development of *Gengobot* is conducted through the following stages: problems identification and analysis, application designing, testing and improvements, and application evaluation and implementation. *Gengobot* is expected to be a user-friendly application and function as a language-learning medium that allows users to adjust their own learning speed, which suitable to support independent learning, as well as to support teaching.

## **2. Methods**

### **2.1. Materials**

#### **2.1.1. Materials for application development**

Materials for developing the application included both software and hardware. The software for the application development was a database system, web hosting and domain including SSL, LINE social media as chatbot platform, and Adobe Illustrator CC for application designing purposes. The hardware was in the form of PC units or laptops and smartphone with special specifications. Chatbot system was designed to store information about grammar, meaning and explanation in three languages (Japanese, Indonesian and English), data index, and built-in exercises.

#### **2.1.2. Sources for chatbot database**

The database of grammar content in this application was based on Japanese grammar topics that appear in level 5 (N5) and level 4 (N4) of *Nihongo Nouryoku Shiken* (Japanese Language Proficiency Test) as the most recognized Japanese proficiency test worldwide. The database consists of 33 Japanese grammar focuses on N4 and 14 grammar focuses on N5, including Tenses, Objectives, Adversative conjunctions, Conditions, Comparisons, etc. While the grammar pattern entries included approximately 250 pattern entries for N4 and 30 pattern entries for N5. The sources of the data used in this application also included a number of Japanese grammar textbooks, such as *Donna Toki Dou Tsukau Nihongo Hyougen Bunkei Jiten* (2007), *Nihongo Nouryoku Shiken Koushiki Mondai* (2012), *Nihongo Nouryoku Shiken Kanzen Moushi* (2013), *TRY! Nihongo Nouryoku Shiken Bunpoukara Nobasu Nihongo* (2014), *Jiniasu Eiwa Jiten* (2014), *Indonesian - English Dictionary* (2015), etc. The database in this application consists of Japanese grammar, meaning in Indonesian and English, examples and their meaning, and explanation.

## 2.2. Method

The development process of *Gengobot* included several stages as follows: 1. Problems identification and analysis; 2. *Gengobot* application designing; 3. Testing and improvements; 4. Application, implementation and evaluation. *Gengobot* development is shown by the flow chart is as seen in Fig. 1.

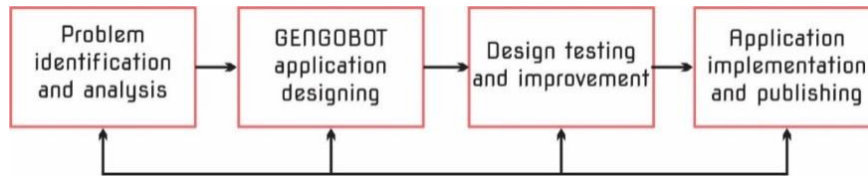


Fig. 1. Flow chart of *Gengobot* development.

### 2.2.1. Problem identification and analysis

In this stage of the research, the researcher identified and analysed the problems to be investigated, starting from the background of the problem to the planned solution for the problem. The analysis was limited to hardware and software requirements and the development of application designs that would be developed, including the end-user interface design (Graphical User Interface/GUI) and the desired application design. This was followed by the collection of relevant data from data sources as described in Section 2.1.2 for the construction of the chatbot database. The database construction processes consisted of gathering grammar data from reliable sources as mentioned in Section 2.1.2, translating the meaning in Indonesian and English, adding explanation for grammars, and conducting validation judgement for the contents.

### 2.2.2. Application designing

Application designing processes including determining the hardware specification and application design that will be developed. The hardware used in application development is one unit of laptop PC with Intel Core i5 3.40 GHz with 4/8GB RAM and 500GB HDD, a MiFi Modem GSM for Internet connection, and USB flash drive for data transfer. For designing purposes, software such as Adobe Illustrator CC and CorelDraw X7 were used. Also, web hosting with 5GB capacity for application storage, MySQL database management system, and domain (.com) with SSL certificate for application web-hook were used in application designing and development processes.

### 2.2.3. Design testing and improvement

Application tests were conducted repeatedly while repairs and evaluations were carried out up to the point where application and its features functioned as expected. The tests involved twenty students to use the trial version of application and feedback was gathered to evaluate the application's performance, as well as the input to improve the design and performance of the application.

Evaluations and improvements were continued to be made during the trial process in order to obtain application products that were ready to be implemented.

## 2.2.4. Application implementation and publishing

The developed application was implemented and reported in the results and discussion section of this paper. However, the application publishing is still limited to specific users/students, since it still needs to be developed and perfected through further application and design testing and evaluations.

## 3. Results and Discussion

### 3.1. Gengobot application development

Developing *Gengobot* application was conducted in three steps, including: 1) Building a chatbot platform on LINE as domain, 2) Constructing chatbot and 3) Integrating chatbot with LINE.

#### 3.1.1. Building chatbot platform on LINE

*Gengobot* application development consisted of several steps, starting from creating a platform for chatbot on LINE. The processes of creating a platform included creating an official account and a provider on LINE developers to create the LINE chatbot application (see Figs. 2(a) and (b)). After creating the official account and provider, the next step was activating the messaging API for chatbot application that will be created later (see Figs. 2(c) and (d)).

After the official account was created, it is necessary to set the identity code, the secret channel and the access channel token to integrate the created official account with a chatbot that will be created later (see Figs. 3 (a-d)). Non-activating autoreply and greeting message while setting an official account is essential since the bot already has similar features.

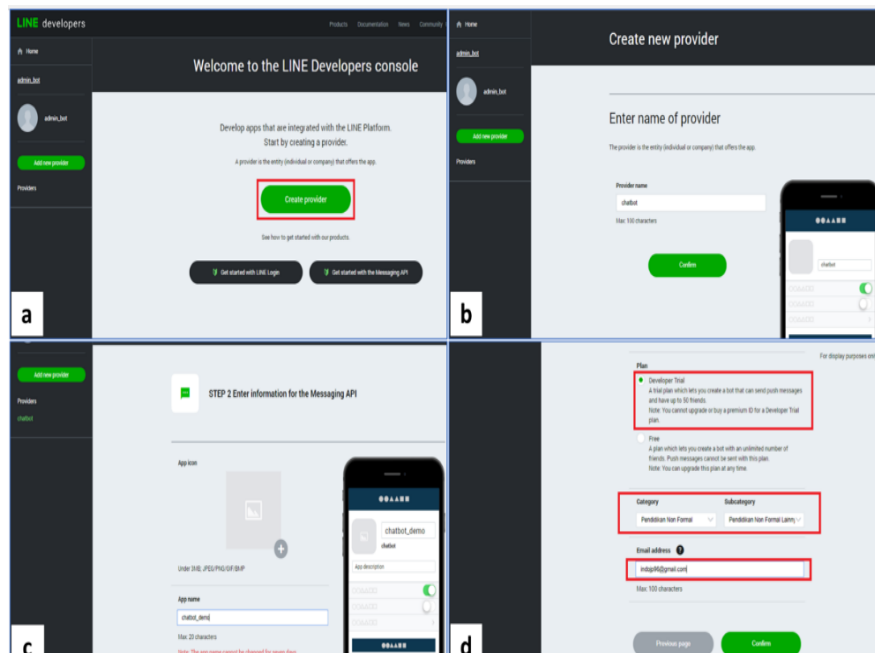
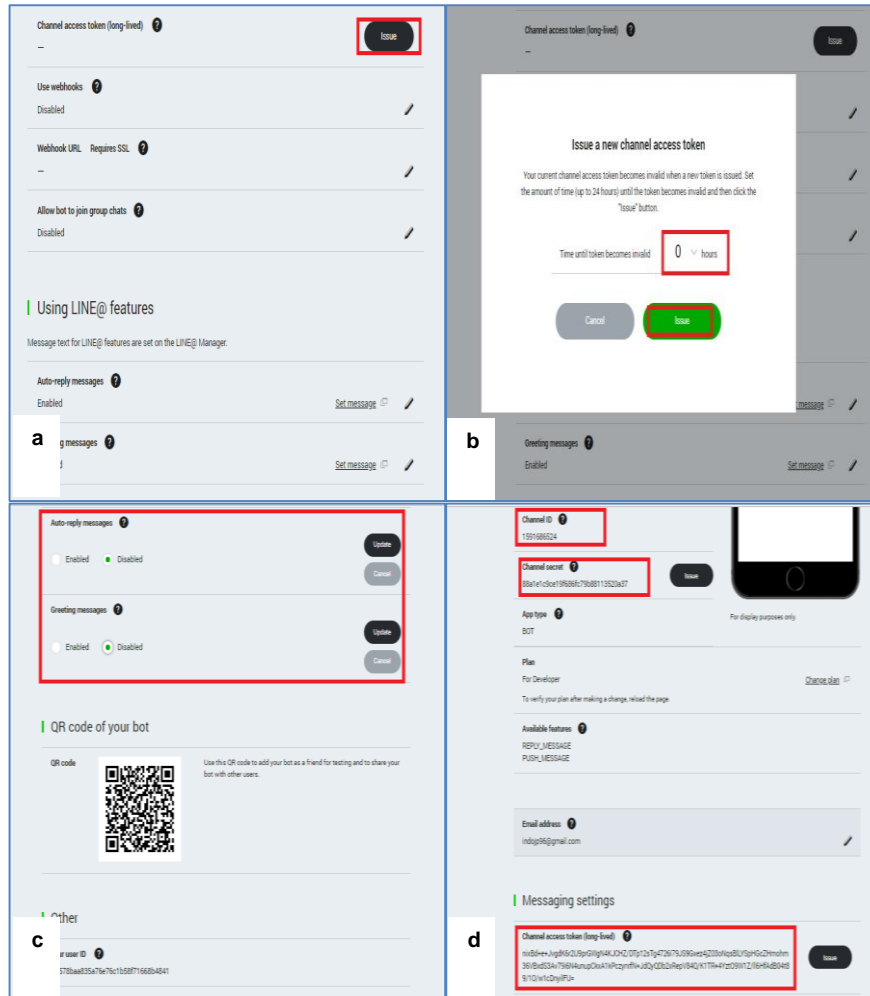


Fig. 2. Images of creating provider and messaging API.



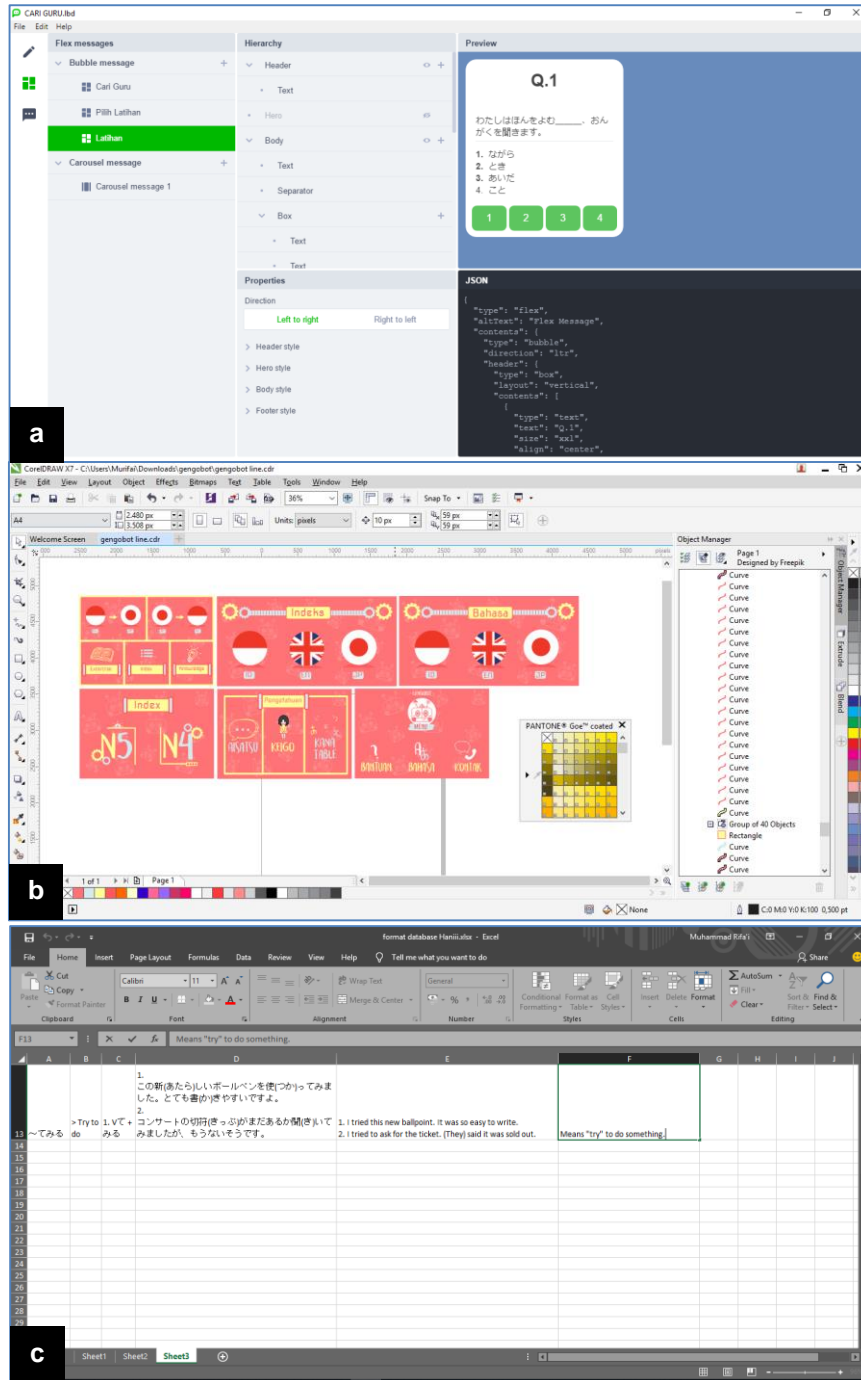
**Fig. 3. Images of: (a) Activating channel access token; (b) Setting the channel access for unlimited time; (c) Non-activating autoreply and greeting message; and (d) Channel ID, channel secret and channel access token.**

### 3.1.2. Chatbot construction

The chatbot was constructed through several steps (See Figs. 4 and 5). The first step was to create a design for chatbot using LINE BOT DESIGNER application for an overview (Fig. 4(a)).

The next step was designing the interface using Corel raw X7 (Fig. 4(b)), inputting the data (Fig. 4(c)), importing data to chatbot server (Fig. 5(a)), and connecting database with the chatbot (Fig. 5(b)). Then, the coding process was started using the PHP programming language directly on the bot server (Fig. 5(c)).

The coding process was the most complicated part because of each response from chatbot needed to be written in detail using logic PHP programming language.



**Fig. 4.** Images of *Gengobot* construction processes: (a) Coding for exercise features; (b) Chatbot interface designing; and (c) Grammar database input.

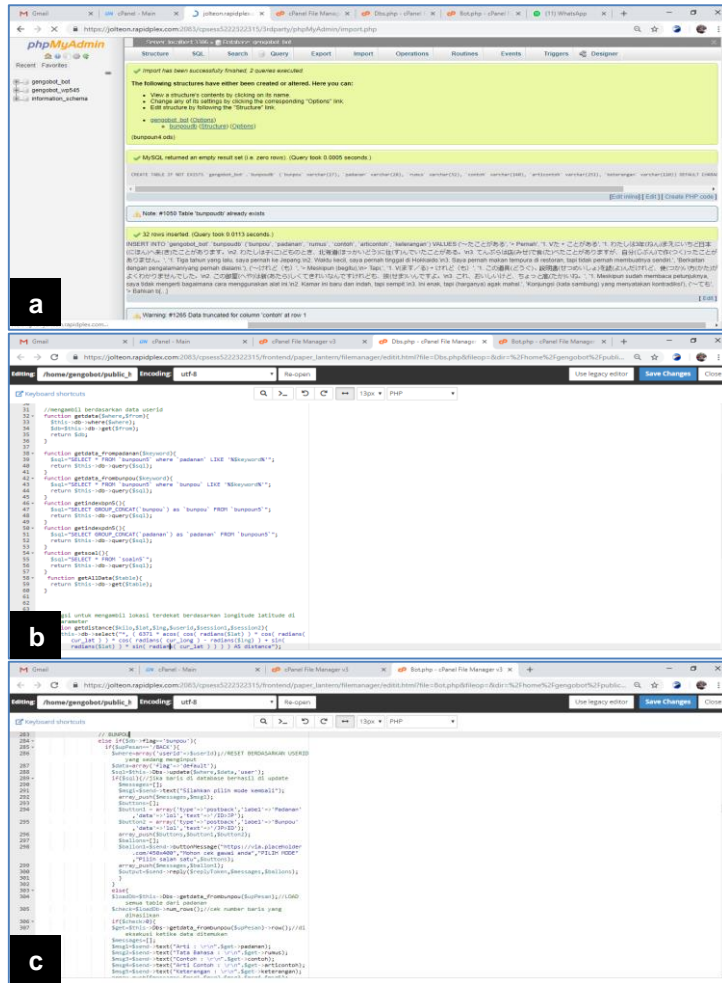


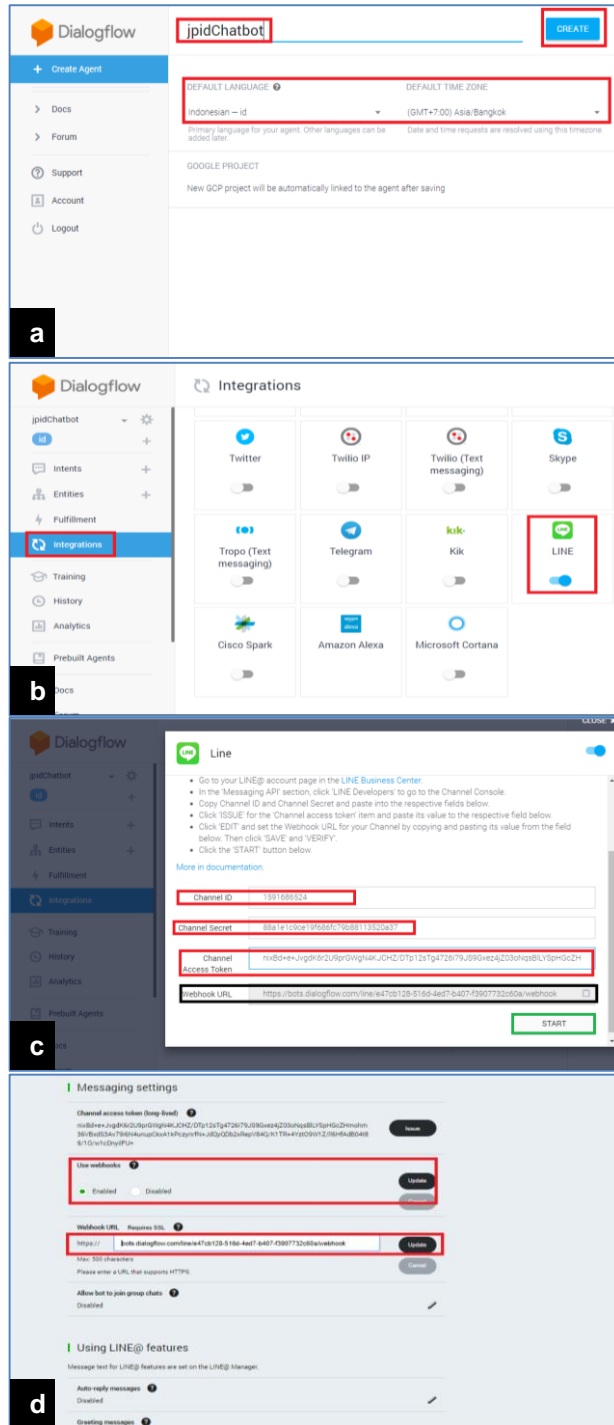
Fig. 5. Images of Gengobot construction processes: (a) MySQL database interface and importing database process; (b) Chatbot model for manipulating and connect database to controller and (c) Chatbot controller programming process.

### 3.1.3. Integrating chatbot with LINE

After the chatbot was created, the next step was integrating the chatbot with social media chosen as a platform using Dialog flow. To integrate the chatbot with created LINE official account, it is necessary to input the Channel ID, Secret Channel, and access token channel in dialogue flow by copying the existing URL webhook.

Then the webhook link was activated to connect LINE and chatbot application (see Figs. 6(a-d)). Once LINE and chatbot were integrated, intents or commands needed to be input into dialogue flow, thereby, when a user sends a message to this application, it will answer him/her automatically. The intents consist of two important parts, namely training phrases or keywords, and text responses. Training phrases or a keyword is a command when a user types them into the application. The application will respond with text responses as the answer to each keyword is received by the application/chatbot.





**Fig. 6. (a) Bot application display; (b) Integrating chatbot with LINE; (c) Inputting channel ID, Channel secret, Channel access token official account; and URL webhook and (d) Activating webhook to connect LINE and chatbot.**

### 3.2. Gengobot implementation

Gengobot is a chatbot-based grammar dictionary application that is integrated with social media LINE. This application is expected to be an interactive and user-friendly language learning application, which can be used anytime and anywhere. The algorithm processes involved in designing the application is shown in Fig. 7.

After the prototype of application was completed, several tests were performed to check whether each feature was running as expected, also as a reference to improve features and to develop its functions. The results of Gengobot application tests were presented in Table 1, consisting of nine types of application tests. The application and all features were successfully functioned as expected, and ready to be implemented and published.

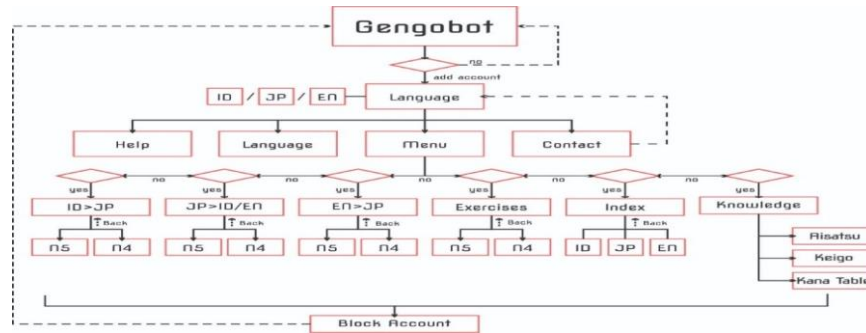


Fig. 7. Gengobot navigation/user flow chart diagram.

Table 1. Test results of Gengobot.

| No                | Test                                      | Expected results  | Test results | Ratification |
|-------------------|---|---|--------------|--------------|
| 1                 | Add account                               | After user add Gengobot account, a greeting message and language setting appear                                 | Confirmed    | ✓            |
| 2                 | Language menu                             | Linked to language options, which are Indonesian, English and Japanese  | Confirmed    | ✓            |
| 3                 | Help menu                                 | Linked to step by step instructions about how to use the application  | Confirmed    | ✓            |
| 4                 | Menu                                      | Connected to 'Menu', 'Exercises', 'Index', and 'Knowledge' menus  | Confirmed    | ✓            |
| 5                 | Translation menu (IN⇔JP, EN⇔JP, JP→IN/EN) | Chat interface with space for the user to type a grammar and find its translation in chosen language appears    | Confirmed    | ✓            |
| 6                 | Index                                     | Linked to all list of grammars consisted in database  | Confirmed    | ✓            |
| 7                 | Exercises                                 | Exercise contents appear  | Confirmed    | ✓            |
| 8                 | Knowledge                                 | Linked to Aisatsu (greetings), Keigo (Japanese honorific style) and list of Katakana and Hiragana letters menus | Confirmed    | ✓            |
| 9                 | LINE group chat join                      | Connected to a group chat with multiple users   | Confirmed    | ✓            |
| <b>Conclusion</b> |   |   | Confirmed    | Legitimate   |

### 3.3. Gengobot navigation pages and contents

The main navigation page includes several menus as follows (see Figs. 8 and 9): 'Menu' (as the main menu), '*Bantuan*' (or 'Help'), '*Bahasa*' (or 'Language'), and '*Kontak*' (or 'Contact') as shown in Fig. 8(a). Under 'Menu', there are several sub-menus including 'Exercise', 'Index', and 'Knowledge' as shown in Fig. 8(c). Under the 'Help' menu, the user can find step-by-step instructions describing how to use *Gengobot*. In the 'Contact' menu, the user can find the developer's website, Instagram account, and email address.

In the 'Language' menu, users are able to access contents in three languages, and they can choose one preferred language. Language options include 'Indonesian', 'English', and 'Japanese', as shown in Fig. 8(b). When the user chooses 'English' as language preference, 'English to Japanese' (EN→JP) and 'Japanese to English' (JP→EN) translation options will appear in the sub-menu page as shown in Fig. 8(c). On the other hand, when users choose 'Indonesian' as language preference, 'Indonesian to Japanese' (IN→JP) and 'Japanese to Indonesian' (JP→EN) translation options will appear, while when users choose 'Japanese' as a preference, Indonesian and English translations will appear automatically. Furthermore, in 'Language' sub-menu, there are three menus namely 'Exercise', 'Index', and 'Knowledge'.

Under 'Exercise' sub-menu (see Figs. 9(a) and (b)), users will be directed to answer questions about grammars studied in the application. The appearance for users is shown in Fig. 9 (c). Each question is provided with four options of answers and one exercise session consists of ten questions. At the end of the session, after users complete one session of exercise, the result will be shown as a score ranging from 0 to 100 (see Fig. 9 (d)). Under 'Index' sub-menu, users can find the list of all grammars that consists in *Gengobot* database (see Fig. 9(b)). Under the 'Knowledge' sub-menu, users will be provided with general knowledge about Japanese language consisting *Aisatsu* (greetings), list of *Keigo* (Japanese honorific style), and list of Japanese *Katakana* and *Hiragana* characters.

The grammar data available in *Gengobot* is based on Japanese Language Proficiency Test Level 4 and Level 5 (N4 and N5) grammar materials, along with Indonesian and English meanings, usage patterns, examples, and examples' meaning in Indonesian and English. Several grammar items with their meanings, patterns, and their English translations included in *Gengobot* are shown in Table 2, while their appearances in *Gengobot* are shown in Fig. 9(a).



Fig. 8. *Gengobot* main navigation pages.

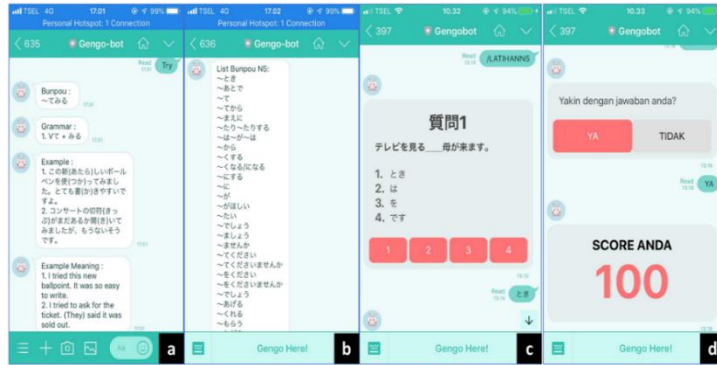


Fig. 9. Gengobot main navigation pages: (a) Grammar correction; (b) Grammar index; (c) Exercise and (d) Exercise results.

Table 2. Examples of grammar and contents in Gengobot.

| Grammar | Meaning      | Pattern   | Example (Japanese)  | Meaning (English)   |
|---------|--------------|---|---|---|
| ～ば      | If...        | <ol style="list-style-type: none"> <li>V (可能形) + ば</li> <li>Adj-i+ければ</li> <li>Adj-na/N + ならば</li> </ol>  | <ol style="list-style-type: none"> <li>よく読(よ)めば、わかります。</li> <li>明日、天気がよければテニスをしますが、よくなければ家でDVDでも見ます。</li> <li>もしその人がいい人ならば、いっしょに仕事をしたい。</li> </ol>                        | <ol style="list-style-type: none"> <li>If you read it well, you will understand it.</li> <li>Tomorrow, if the weather is good, I will go to play tennis. However, if the weather is bad, I will just watch DVD at home.</li> <li>If that person is a nice person, I want to work with him.</li> </ol> |
| ～まえに    | Before...    | <ol style="list-style-type: none"> <li>N+の+まえに</li> <li>V (辞書形) +まえに</li> </ol>                           | <ol style="list-style-type: none"> <li>食事のまえに、手を洗(あら)いましょう。</li> <li>寝(ね)るまえに歯(は)をみがきなさい。</li> </ol>  | <ol style="list-style-type: none"> <li>Before we eat, let us wash our hands first.</li> <li>Before sleeping, go and brush your teeth first.</li> </ol>  |
| ～が      | But          | <ol style="list-style-type: none"> <li>V (ます形/辞書形) + が</li> <li>Adj-i+が</li> <li>Adj-na+だ/です+が</li> </ol> | <ol style="list-style-type: none"> <li>10月に<b>なり</b>ましたが、毎日暑(あつ)い日が続(つづ)いています。</li> <li>あの人は優(やさ)しいが、ちょっと気が短(みじか)いです。</li> <li>この部屋は新しくきれいです<b>が</b>、狭(せま)いです。</li> </ol> | <ol style="list-style-type: none"> <li>It is October but every day is hot.</li> <li>That man is kind but short tempered.</li> <li>This room is new and clean but it is small.</li> </ol>  |
| ～ませんか   | Would you... | V (ます形) +ませんか   | いっしょに花火を見に行きませんか。   | Would we go to see the fireworks together?  |

### 3.4. Discussion

The importance of developing this application is highlighted in the discussion. The purpose of application development was to provide a user-friendly language-learning medium that can be used by language learners anytime anywhere using PC and smartphones. Although many papers have reported the use of mobile-based media and applications for learning-friendly as well as for assessment [30-33], this study was focused on a chatbot-based media in language learning, particularly grammar. The reason behind the selection of chatbot-based media is its novelty and its innovation as a chatbot is an application utilized by Artificial Intelligence (AI).

Also to the author's knowledge, the number of chatbot-based application development as a language learning medium, especially for grammar learning, is still very limited. The application of *Gengobot* is also developed due to its potential as it can be integrated with Instant Messaging (IM) service as one form of social media. As stated before, LINE instant messaging in Indonesia reached 90 Million with students and university students as the most active users [29]. These facts indicate that using LINE as a learning medium including language learning is very important and potential, and integrating *Gengobot* with LINE as a learning medium is expected to answer this challenge. Accordingly, *Gengobot*, which enable its users to learn in the context of social media considered to be a highly self-motivated, autonomous, and informal, as well as an integral part of the college experience [34, 35]. Other than to enhance autonomous learning, *Gengobot* that is integrated with LINE is also considered efficient for its user. When the users communicate with Indonesian/English/Japanese speakers and need grammar information, they can directly access *Gengobot* without leaving the chat or exiting LINE. This will be different if a user is using a separate application, she or he will need to leave the chat, open the dictionary application, and return to chat, which is less convenient.

Furthermore, *Gengobot* containing JLPT N5 and N4 grammar materials can be used to help both beginner level of Japanese language learners in formal institutions and self-taught learners because it can be accessed by everyone. Chatbot-based *Gengobot* also functioned as an individual language learning media that allows users to adjust their own learning speed [36], which is suitable for self-taught language learners. As an application developed using mobile technology, *Gengobot* also able to utilize distance learning [27, 36, 37], as well as ubiquitous learning [38]. Moreover, based on studies by Iftene and Vanderdonck [38], Dabbagh and Kitsantas [39] and Mediayani and Riza [40], the use of *Gengobot* is entirely controllable and adaptable by its users according to their needs in formal and informal learning needs (i.e., language level competency, language preference, etc.), which is suitable to enhance personalised learning. Using *Gengobot* is also expected to improve learners' self-confidence and comfortability in learning grammar, compared to learning directly with an instructor/teacher [23, 24, 26].

*Gengobot* consists of not only grammar and sentence patterns but also meanings, examples of usage, and the meaning of examples of their use in Indonesian and English. This broadens the benefits of *Gengobot*, which could be used not only by Indonesian speakers who are learning Japanese but also by English speakers who are studying Japanese or Indonesian, as well as Japanese speakers who are learning English or Indonesian. The comprehensive content of *Gengobot* also allows *Gengobot* to be used not only by learners but also by teachers as teaching material or teaching reference. As we reported in our previous studies by Haristiani and Aryadi

[30], Haristian and Firmansyah [31] and Philiyanti et al. [41]. Indeed, this *Gengobot* will improve current situations for the need in applying simple teaching and learning using smartphone. In our future work, we will do further tests and developments for improving the *Gengobot* program, developing application as well as feature, and increasing the readiness and easiness for users to use the application.

#### 4. Conclusion

*Gengobot* is a chatbot-based language learning application that utilizes Japanese grammar learning. It is equipped with meanings and explanations in English and Indonesian. Furthermore, *Gengobot* is also equipped with exercises, index of grammar content, and information about Japanese basic knowledge. *Gengobot* is integrated with Instant Messaging application LINE that enables users to use in a chat without exiting the chatroom or the application. *Gengobot* has been evaluated and improved based on the results. Finally, *Gengobot* can be used to enhance autonomous and personalised language learning for learners and as teaching supplement application for teachers.

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