Dinus Intelligent Assistance (DINA) Chatbot for University Admission Services

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Nowadays, universities offer most of their services using corporate website. In higher education services including admission services, a university needs to always provide excellent service to ensure student candidate satisfaction. To obtain student candidate satisfaction apart from the quality of education must also be accompanied by providing consultation services and information to them. This paper proposes the development of Chatbot which acts as a conversation agent that can play a role of as student candidate service. This Chatbot is called Dinus Intelligent Assistance (DINA). DINA uses knowledge based as a center for machine learning approach. The pattern extracted from the knowledge based can be used to provide responses to the user. The source of knowledge based is taken from Universitas Dian Nuswantoro (UDINUS) guest book. It contains of questions and answers about UDINUS admission services. Testing of this system is done by entering questions. From 166 intents, the author tested it using ten random sample questions. Among them, it got eight tested questions answered correctly. Therefore, by using this study we can develop further intelligent Chatbots to help student candidates find the information they need without waiting for the admission staffs's answer.

Keywords—Chatbot, ontology, Neural network, NLP

I. INTRODUCTION

Nowadays, most of universities use a corporate website to offer services to the student candidates. In the field of higher education services, a university needs to always provide excellent service to ensure student candidate satisfaction [1]. To obtain student candidate satisfaction apart from the quality of education, a university must also be accompanied by providing consultation services and information to student candidates. The use of web-based student candidate service system and social media is one of the facilities that are given to student candidates to meet the needs of information. Along with the increase in the world of web services, many of the latest innovations in development focus on developing websites that pay great attention to user convenience [2]. In website itself, there are various types of student candidate service available such as phone service and live chat support. All available supports aim to communicate between peoples, therefore it needs time to answer student candidate questions. In addition, the increasing of web visitors may lead to increase questionnaires and waiting times, resulting in poor client satisfaction [3].

The rapid development of computer-based information technology has made many changes in the joints of human life. One of the promising technological developments is Artificial Intelligence (AI) [4]. By using AI, the computer can perform certain tasks as performed by humans such as robot chat. Robot chat refers to as Chabot system that adopts knowledge of human nature interaction to the computer (HCI). So that computers have intuitive abilities to realize the conversation with their users using natural language [5][6]. Ranoliya el. al stated that Currently text-based Chabot is used extensively in commercial web systems [1]. Based on natural Language complexity, the implementation of Chatbot system is not an easy task because we need a set of mechanisms to extract knowledge from user FAQs [7].

In this paper describes and proposes the development of Chatbot which acts as a conversation agent that can help the role of as student candidate service. This Chatbot called DINA, Dinus Intelligent Assistance. Scope of language understood by DINA used Bahasa Indonesia because, in our university, Bahasa Indonesia is used as the official language of our daily conversation. DINA uses as a center for machine learning approach. The extracted patterns from knowledge-base then can be used to provide random responses to the user. The

source of knowledge based is taken from Universitas Dian Nuswantoro (UDINUS) guest book. It contains questions and answers about UDINUS, particularly related to admission questions. This knowledge based is used to store information that is frequently asked by the student candidate and search based on keywords, phrases, and examples that have been customized into database. For unanswerable question will be a new data for Chabot and will automatically be stored in the database of knowledge based. In this paper, Chatbot is needed for admission service domain in the field of education to provide student candidate satisfaction. Finally, DINA Chatbot is expected to help the admission staffs work and shorten time for student candidate to get information about UDINUS.

The rest of the paper is organized as follows: Section II presents the technical arrangement on the DINA Chatbot relies on, also provide textual entailment in Dialogflow framework. Section III introduce development the OWL ontologies to integrate the Dialogflow model. Section IV details our technical solution to extend the Dialogflow model with domain knowledge from OWL ontologies. Section V illustrates how the textual entailment is used to support conversations on DINA Chatbot.

II. RELATED WORK

The history of question answering system research and artificial intelligence produces the modern innovations in the form of chat robots derived from early systems such as ALICE [4] and ELIZA [8]. This system is built as a dialogue system or a conversation agent [9]. This conversation can use imperative or control commands such as voice-activated phone calls, music selection, or television control.

This paper [9] describe an approach to develop Chatbot for college management system using AI. The Chatbot simulates conversations in the form of computer programs that can perform dialog with users in natural language. A Chatbot is just a program, and not a robot (it does not have a body and does not have a mouth so unable to talk like a human). It is a dialog between people as users with Chatbot which is carried out by typing what will be asked and then Chatbot will respond it. The person who creates and develops a Chatbot program is called a botmaster.

A University Chatbot related to Frequently Ask Question (FAQ) was developed by [10], which is used as a question answering application about FAQ at Manipal University. The FAQ chat is information exchanges application developed using the Artificial Intelligence Markup Language (AIML) pattern that retrieves set of matching information from the FAQ databases. The Chatbot FAQs of Manipal University will assist students to get information needed like availability of services, updates regarding activities happening inside the campus, ranking of the university, university environment, and many more about academic information.

Debasatwa et.al, [11] stated in their paper that there are many types of cloud-based Chatbot platform which are api.ai now called Dialogflow, Luis.ai, Pandorabots.com, and wit.ai. In the paper, the authors compare 4 different Chatbot platforms based on Natural language processing capability and complex feature development abilities. Based on the result of Dialogflow evaluation, they selected to develop Chatbot because Dialogflow has the ability to handle sub-intent purposes of user's text as input. The intelligent Chatbot can be accessed using web browser and Android apps. The node.js runtime environment has been used for server side processing and client-side requests. The user interface has been developed used The BotUI Javascript framework.

This study [12] proposes an Ontology-based Chatbot on the E-commerce domain. The data used in the form of E-commerce Website and PROTEGE platform are used to build ontology templates that retrieve data from sources (using Jape rules). After the process of the data retrieval into the template, the user can ask questions to the bot and present the answer in text form corresponding to user input that will be set using Natural Language Processing (NLP) in Dialogflow Platform. Dialogflow uses intent and other properties built through *python*. API calls the ontology template and the query to be answered by Chatbot from data taken in the Ontology template. Based on the results, the proposed system successfully maps the relationship between multiple intents and retrieves the data according to the user's request. Base on the related work above, the author proposes to construct DINA Chatbot using Dialogflow platform and ontology knowledge.

A. Knowledge based (KB)

There is some work on the extraction of knowledge from the online web community to support Q&A and summarization Development of KB depends on the use of existing tools and information resources (eg FAQs, APIs, system logs, etc.) [13][14]. These research approach is to develop characteristic of their corpora and matched for their specific tasks, but they constrain each corpora and their tasks. Hence, it is difficult to apply their method directly to our Chatbot approach of knowledge extraction. Furthermore, DINA uses the knowledge sources, i.e., guest book from admission office of university. Data extract from guest book become a FAQs corpus. Those knowledge based corpus contains knowledge for answering student candidate problem solving. This study uses knowledge based approach and Rule-Based Reasoning which contains:

1. Knowledge in bot is represented in the form of IF-THEN or in the form of Production Rules.

2. The determination of the initial rules (rule antecedents) is carried out using inference logic.

3. The appropriate rules are placed on the agenda and can be activated so that it will generate new facts on the right side. Furthermore, activation of one rule is part of another activation rule.
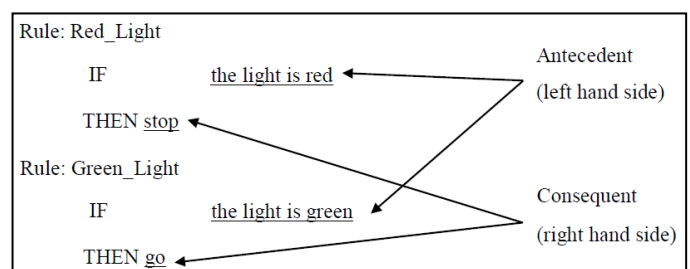

Figure 1. Knowledge based approach - Rule-Based Reasoning

B. *Dialogflow Framework*

Dialogflow is one of the Chatbots development platform based on natural language conversation [2]. When a user sends a message to Chatbot through some intermediate media such as telegram, line, and web, this message will be proccessed in the Dialogflow platform where the question will be changed in the object form. After that, it is forwarded to the external web server and undergoes some appropriate logic entailment process to complete the user request and responds to the user in text form.

The Dialogflow provides important elements to allow a conversation with the user such as:

- Dialogflow provides the dialog manager that will service us to obtain the intents of the query posted by the user using NLP.

- Create Entities to declare the various type of question (@date, @beasiswa, @nomor and etc), synonyms of the text, and properties of the various user input and output.

- Generating the JSON form node.js to recognize the user's question from Intent and entity platform

- JSON code is used to get data from ontology template PROTÉGE and sent to messaging bots which forms the interface for the project.

- Machine learning approach is used in the program that acts as an advisor or smart consultant by taking knowledge stored in a particular domain.
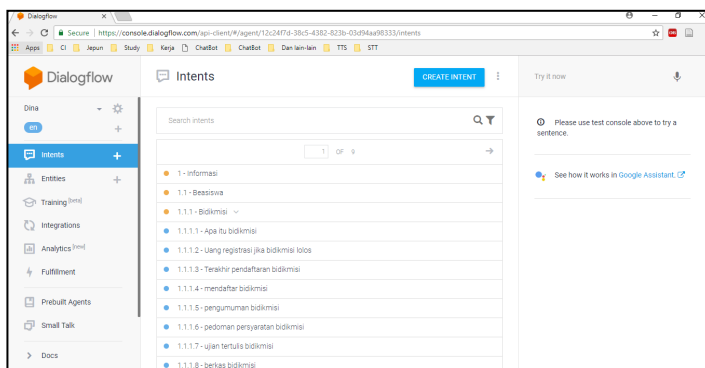

Figure 2. Developing Intents and entities for DINA Chatbot

Figure 2 shows the functionality in Dialogflow. It presents when a user enters data in an Dialogflow platform. It is first checked if it matches a predefined purpose then search and matching the input of the user with intents. Dialogflow has a feature called "Default Fallback intent" to handle user input that does not match pre-defined intent. User speech activation can be conditioned by the use of context, resulting in more human-like conversations.

C. *Ontology template*

Several NLP research has adopted the advantage of ontology such as Chatbot [14], sentiment analysis [15], and question answering[15]. Moreover, our previous study related to ontology also have been published in several international journal and conferences [16][17][18]. Commonly, there are two ways of ontology development that are using manual and automatic manner. Manual ontology development will take a lot of time and effort as compared to development automatically because we have to detail in all the corpus we will use.

There are several steps in how to build an ontology: First we have to select a domain for our ontology. In this step we choose admission knowledge based on the university registration information. Knowledge based that we used is from Frequently Asking Question (FAQ). We divide into several part along with category of FAQ. Each FAQ consists of several question and answer, so to make it easy we group one question with the answer into one intent. After that, step continued to build a glossary of terms. Means each intent have its special term to make it easier finding the intent and for categorizing. Third, build concept hierarchy. As explained before, each group of FAQ divided into its own intent so there are child of knowledge from each group. To make it as hierarchy of knowledge, index must be put for each intent created. Finally after all one knowledge of registration information are describe into hierarchy of knowledge divided into each group and has its own index, so Chatbot ontology for admission of the university was created showed in figure 3.
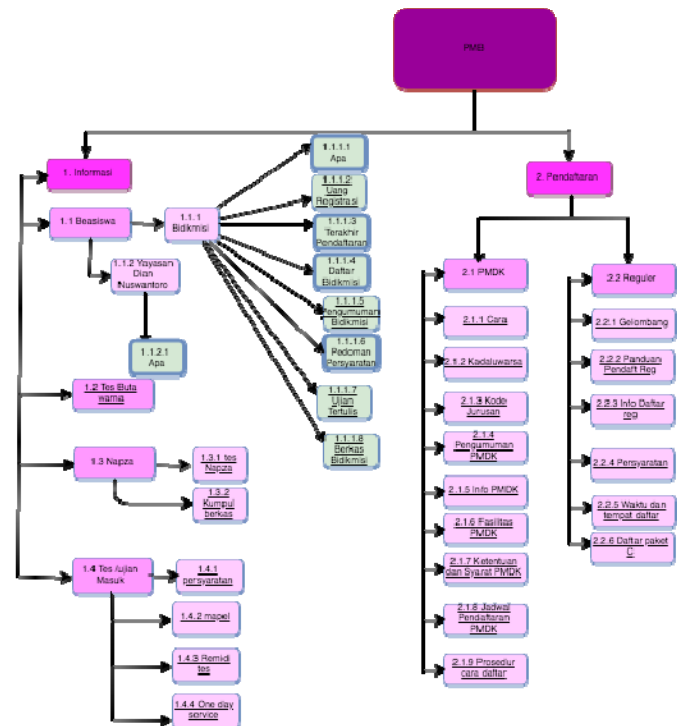

Figure 3. Admission Chatbot Ontology

III. Chatbot Architecture

The DINA Chatbot takes input through social media platform i.e., telegram and line, or website. It analyses that input using NLP provided by Dialogflow to find out what the user is trying to ask and responds accordingly. DINA uses a

modular architecture to respond to user input. Each module contains knowledge based, initialization mechanism, and logic to handle user requests. DINA also use a modular architecture to respond to the user input. Each module includes knowledge based, initialization mechanism and logic to handle user requests.
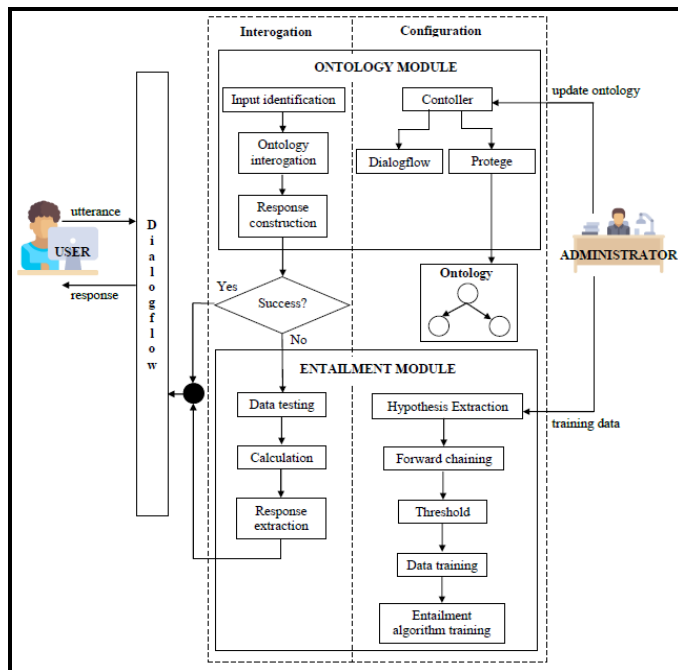

Figure 4. DINA Architecture

Figure 3 shows that DINA comes with two main modules: the learning module created using Forward chaining, which is used as the default fallback mechanism (providing answers to not pre-defined user questions), and the ontology module, which is used as an answering machine for user questions based on data stored in the OWL. DINA ontology and corpus consist of question answering argument. The modular architecture ensures that the system tries to answer questions using information in ontology first and only if no answer can be generated entailment module is used. The following sections describe the module of Chatbot in detail.

The Chatbot module will be divided into two parts. The first part is the integration part used to process user requests. This section will send a query that inputs the user to the conversation agent and continues processing phases using Dialogflow. Platform module in the Dialogflow will perform a search to customize the input text with an existing intent in the data corpus. The second part is the configuration section. Therefore, both modules can communicate and interact with the web server. The configuration part of one of the modules must include logic to handle the Dialogflow model used (in our system this is done by the ontology module).

A. Ontology module

This module is used to extract knowledge from the corpus into the ontology format. Hence, it will produce the suitable answer with *entities* and translate from otology template to

Dialogflow format. The following step of making ontology as a notation language:

1) Configure Dialogflow by creating classes, properties, name of individual, and defines ontology. So it expands the knowledge based of Dialogflow
2) During the process of translation, the placeholder parameters on the ontology replaced by entities in Dialogflow
3) Create a set of simple entities for each class, and the combined entities are required if a class has subclasses
4) Create a synonymous concept for each class and add in the class entity.
5) Creation of parameters related to the entity class to facilitate responding of user input. All templates associated with labels on ontology have the same number of parameters.

B. Learning module

Forward chaining has been applied to the DINA Chatbot as learning module. The process of forwarding chaining begins when user entering information or questions into the text form provided by the application. Figure 4 show the flowchart of learning module.
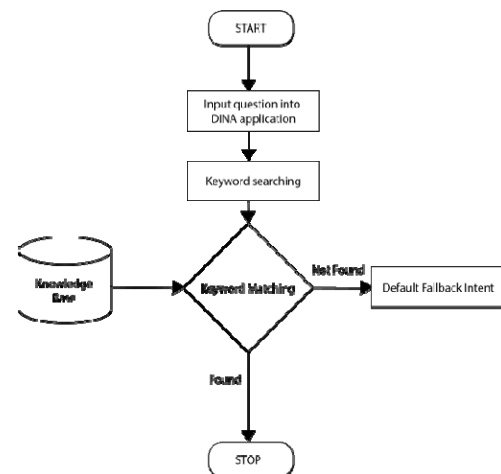

Figure 5. Flowchart Forward Chaining DINA Learning Module

Based on figure 4, the question is split into several words and searched for keywords that match the one in the application. After the keywords found, then the application answers the user's question with the correct answer. If the application can't find the keyword then the answer appears which is taken from Default Fallback intent .

Technically, the textual entailment is enabled either when Dialogflow does not identify the intent or when due to restrictions, no response templates can be used in the ontology request module. It will send default answer or specified default intent fallback, Extraction of the hypothesis based on hierarchical grouping able to estimate the similarity between user input and debate questions.

IV. RESULT

The Chatbot is implemented to meet the academic information needs of new student candidates. Chatbot was

built using Dialogflow platform for Universitas Dian Nuswantoro. It will help potential students to take information such as admission procedures, university ranking and study program accreditation, service availability, university environment and so forth. The implementation of forwarding chaining ontology based Chatbot application is located in the search process for answering questions from the user. The first process occurs when the user enters the question into the question box. After that, the input will be searched based on the selected category and the keywords in question as described in Figure 4. Here is a table of the implementation results in DINA Chatbot.

Table 1. Testing Result

No	List of question	Keyword/ Intent	Answer	Response	Correct Response
1	Di mana kah letak kampus Udinus? (Where is Udinus campus?)	Lokasi Alamat Udinus	Kampus I: Jalan Nakula I No. 5 - 11 Semarang dan Kampus II: Jalan Imam Bonjol No. 207 Semarang. (Campus I: Nakula I Street No. 5 - 11 Semarang and Campus II: Jalan Imam Bonjol No. 207 Semarang.)	Correct	-
2	Bagaimana cara mendaftar di Udinus? (How to register at Udinus?)	Pendaftaran	Pendaftaran Udinus ada 5 macam, antara lain: PMDK, Reguler, Online, Transfer, dan Pindahan. Silahkan ketik "Pendaftaran PMDK" atau "Syarat daftar reguler", atau "Prosedur daftar transfer", dan lain sebagainya. Kamu ingin lewat jalur apa untuk daftar udinus? (Registration Udinus there are 5 kinds, among others: PMDK, Regular, Online, Transfer, and Moving. Please type "PMDK Registration" or "Regular list requirement", or "Transfer list procedure", and so forth. What do you want to go through on the registration udinus?)	Correct	
3	Berapa biaya pendaftaran di Udinus? (How much is the registration fee at Udinus?)	Uang pendaftaran	Uang pendaftaran Udinus sebsar Rp.200.000 (Udinus registration fee is Rp.200,000)	Correct	-
4	Biaya perkuliahan di Udinus? (Tuition fee at Udinus?)	Biaya	Biaya pendidikan ada di web. Silakan dibaca di sini: http://id.dinus.ac.id/fees (The cost of education is on the web. Please read here: http://id.dinus.ac.id/fees)	Correct	-
5	Min, itu yg surat pernyataan bebas narkotika wajib? (admin, is the narcotic-free letter a mandatory?)	Tes Napza	Tes bebas narkoba merupakan salah satu syarat wajib registrasi di Udinus. Tes bisa dilakukan di klinik terdekat rumah Anda atau di Poliklinik Udinus (depan Gedung C) pada hari Senin-sabtu, 07.30-16.00 WIB. Registrasi saja terlebih dahulu. Setelah mendapatkan NIM, barulah ke poliklinik. Biaya tes sekitar Rp. 70.000. (The drug-free test is one of the requirements for registration in Udinus. Tests can be done at your nearest clinic or Udinus Polyclinic (in front of Building C) on Monday-Saturday, 07.30-16.00 WIB. Register first. After getting the NIM, then to the polyclinic. The test fee is about Rp. 70,000.)	Correct	-
6	min apa ada perbedaan dari pendaftar gel IIA dengan IIB? (min what is the difference between IIA gel registries and IIB?)	Tidak ikut matrikulasi	Matrikulasi adalah fasilitas untuk maba pendaftar gelombang awal, sehingga yang tidak ikut matrikulasi tidak akan mendapatkan kegiatan pengganti. Kegiatan selanjutnya yang wajib diikuti semua maba adalah dinus inside. Untuk melihat detail infomasi pelaksanaan dinus inside silahkan akses http://dinus.ac.id/ (Matriculation is a facility for new student from first batch, for who do not participate in matriculation will not get replacement activities. The next activity that must be followed by all new student is dinus inside. To see detail information on the implementation of the dinus inside please access http://dinus.ac.id/)	Not corrrect	perbedaan hanya pada tanggal pendaftaran. (The difference only on registration date.)
7	Kak di udinus ada kelas karyawan? (Sister in udinus there is employee class?)	Kelas karyawan	Kelas karyawan hanya ada di Fakultas Kesehatan, program studi Kesehatan Masyarakat S1 dan Rekam Medis D3. Kuliah di hari jum'at mulai pukul 14.00 WIB dan di hari sabtu mulai pukul 08.00 WIB. (Employee class only available in Faculty of Health, Public Health Study program S1 and D3 Medical Record. Lecture on Friday starting at 14.00 pm and on Saturday starting at 08.00 pm.)	Correct	-
8	Mau tanya, kalo saya dari IPA tp ngambil jurusan Ilkom apa boleh? (Want to ask, if I'm from IPA but wanna take majors Ilkom, is it possible?)	Pindah jurusan	Jika Anda belum melakukan tes, ganti jurusan bisa dilakukan di petugas pendaftaran. Jika sudah melakukan tes, ganti jurusan dilakukan di bagian registrasi. Jika sudah menjadi mahasiswa aktif di Udinus silakan konsultasi ke Kepala Progdi terlebih dahulu. (If you have not done the test, change majors can be done at the front officer. If you have done the test, change majors done in the registration. If you are already an active student in Udinus please consult the Head of Faculty first.)	Not correct	Boleh. (Yes, you can)
9	Min,saya mau nanya. Buat pendaftaran tahun depan dri kejar paket apa udinus mau menerima nya? (Min, I want to ask. I want register next year through the equivalence test certificate,	Kejar paket	Bisa, asalkan sudah ada ijazah. Silakan disimak info berikut untuk jadwal dan persyaratan: http://admisi.dinus.ac.id/pmbonline/menu/jalurpendaftaran. (Yes, as long as you have a certificate of graduation. Please check the following info for schedule and requirements: http://admisi.dinus.ac.id/pmbonline/menu/jalurregistrasi)	Correct	-

	is Udinus willing to accept it?)				
10	*Min, persyaratan lengkap bidikmisi apa saja? Trimakasih* (Min, what are the complete requirement s of bidikmisi? Thank you)	*pedoman persyaratan bidikmisi*	*Pedoman/ persyaratan lengkap dapat diunduh pada website ini bidikmisi.belmawa.ristekdi kti.go.id/petunjuk/pedoman* (Full guidelines / requirements can be downloaded on this website bidikmisi.belmawa.ristekdi kti.go.id/instructions/guide)	Correct	-

The testing process is done in accordance with the form of questions that are often asked by the user. This stage is done to determine the ability of the application in handling questions. The testing process was more focused on the sentence form which used 166 intents. It is done by running the application DINA then enter the sentence in the text field that has been available.
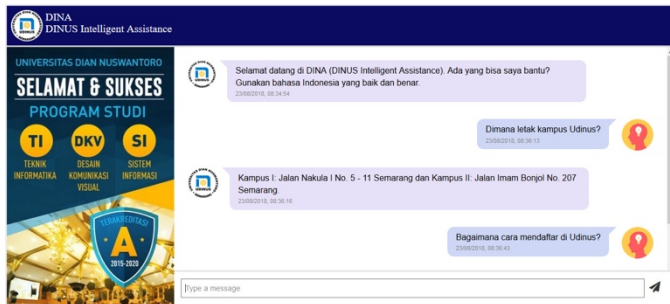

Figure 6. DINA Display in website

From 166 intents, The author tested ten random sample questions. The result showed that it got eight questions answered correctly and able to answer any question from perspective student as showed in Figure 5.

V. CONCLUSION

Through DINA Chatbot that researcher proposes, the conclusion drawn is that the new proposed system will help users to obtain information needed. With the proposed approach, major flaws existing in current Chatbots that cannot understand the relationship between entities and properties can be solved. The proposed system successfully maps and retrieves data. By using this study, we can further build an intelligent chat bots to help users find the appropriate information. It also help user to obtain answer without waiting for the admin staff's answer. With enough training from ontology bots, we can now successfully interact with ontology bots. For further development, we will equip our Chatbot with voice recognition and text-to-speech capability.

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