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Chatbots in education: A Question & Answer Chatbot

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Abstract

Chatbots have been in use and trending for quite a few years now. They have shown success in many areas such as commerce and medicine. This paper is focused on chatbots application in educational settings. There have been quite a few papers published that examine the phenomenon. This paper explores the subject by doing a systematic literature review of papers published from 2005 to 2021 on the application of chatbots in education. The results discovered two main categories of chatbots used in educational settings: service-oriented and teaching-oriented chatbots. The paper concludes that chatbots have been successfully implemented in educational settings to assist teachers in various tasks. The paper then goes on to examine the possible roles and features that chatbots can have in these settings as well as exploring their use in a wider community. The paper also examines the development process of the chatbot Nina a Question & Answer chatbot developed by using Rasa NLU and it further explains the technology used.

1. Introduction

1.1. Chatbots in the wider community

The chatbot technology is in use for a wide variety of things like retrieving information, answering questions, as a shopping assistant, language partner, education and so on (Shawar and Atwell, 2007).

As said above chatbots have many different uses, one of the most popular ones is to extract information from conversations to answer user queries on specific topics. This is a very popular use case of chatbots, they can help with various tasks like answering FAQs to helping customers make business decisions. One example of a chatbot that serves this purpose is the YPA, a chatbot that is used to provide information to users from British Telecom's Yellow pages. The principle is the user asks a question then the chatbot searches its database to retrieve appropriate information, i.e. if a user requests a plumber the chatbot will retrieve contact information, or if no results were found ask for additional information. (Shawar and Atwell, 2007a). This type of chatbot does not only exist in a business setting it can be applied in the educational sector also, for example, but a chatbot with the name ALEX also helps students in finding basic legal information (Deryugina, 2010).

Another use case for a chatbot is a language learning assistant. Chatbots have the potential to become excellent learning partners for people who want to learn a language. Chatbots are programmed and differently from humans they do not mind repetitive tasks besides that they would be available to students anytime, they can work with both text and speech input making them capable of helping in learning reading, writing, and listening. With that, they also come with disadvantages their responses are often expected, repeated, or they do not hold memory of what they previously wrote. The majority of chatbots are bad at detecting grammar mistakes. Still, chatbots could be

used to assist in learning a language for non-beginners they can be programmed with rich knowledge as a friend who listens to the user. (Shawar and Atwell, 2007b).

When considering chatbot applications in education, Shawar and Atwell (2007c) state that this technology should be used to assist teachers and tutors rather than as a means to replace them. One such example would be if the chatbot is communicating with the students those log files could be useful to the teacher to find out the weaknesses and strengths of students. So the teacher can use the chatbot to look for problems and students to solve them. (Shawar and Atwell, 2007d).

1.2. History of chatbots

In 1950 Turing asked himself a question himself “Can machines think?”. Afterwards he created the now-famous Imitation game (or Turing test), the game where the computer attempts to fool a human into thinking he is conversing with another human being (Turing, 1950). Turing asked himself two questions by defining two things his meaning of a machine and the concept of thinking, he then went on to revise the question to instead be: “Are there imaginable digital computers which would do well in the imitation game?”. The imitation game is then used as a tool to determine the machine's ability to think.

Up until now, no machine has come close to beating Turing’s imitation game and the best contestants are not close yet. In an attempt to further develop intelligent machines Hugh Loebner came up with a version of the Turing test in 1990 with the name Loebner Prize Competition. Becoming the first formal version of a Turing test that is organized annually. The contest consists of 4 judges that are interacting with two dialog partners in a chat. After 25 minutes the judges are asked to decide which partner is a machine. If a program fools two judges it wins the silver prize and gets $25,000 as a prize. If the judges find out which contestant is a machine they are asked to rate its “thinking” capacity on a scale of 0 to 100 the top 4 programs are awarded cash prizes. The Grand Prize and $100,000 are reserved for the program who can fool all the judges into

thinking it is a human and pass the Turing's test and become proof of a thinking machine. (Loebner.net, 2017; Loebner, H., 1994; Taddeo, and Turili, 2009).

Turing's ideas received a lot of praise from the Artificial Intelligence (AI) community. AI is a branch of computer technology that develops digital computers or computer-controlled robots with abilities similar to the human brain identified as intelligence (or thinking) (Copeland, B.J, 2018). As with all other things that are revolutionary Turing's ideas received a lot of criticism as well. One of Turing's biggest critics is Searle (1980) who argues that "only a machine could think, and only very special kinds of machines, namely brains and machines with internal causal power equivalent to those of brains." With these statements, Searle (1980a) made his definition of two types of AI, strong AI, and weak AI. Differentiating strong AI as an actual thinking machine, i.e. a system that has the causal brainpower that Searle remarks, and weak AI a machine that could not think rather than just imitating a human's intellectual behavior (Searle, 1980b; Deryugina, 2010a).

With the previously given definition of chatbots in mind and the concept of weak and strong AI from Searle (1980), a conclusion is drawn. The chatbot technology that is available today mostly resembles the weak AI definition from Searle (1980). Still, chatbots are considered using AI technologies and they are valuable with a lot of use cases. The two most popular chatbots in history are presented in the next paragraph ELIZA and ALICE.

1.2.1. ELIZA and ALICE

The first chatbot was ELIZA developed by Weizenbaum (1966). He published an article explaining the design process of ELIZA and explains how it uses natural language to hold conversations between humans and computers. ELIZA was developed as a program to imitate a Rogerian psychotherapist it works on a pattern recognition matching what this means is that it identifies keywords to give an associated response by mapping input and associating it to output. If there is no keyword matched it would

go about giving a response from earlier outputs or a content-free remark is given (Weizenbaum, 1966a). Being the first AI chatbot it received a lot of press from specialists from the AI field as well as non-professional people (Deryugina, 2010b). One of the main claims for ELIZA's success is its replication of a therapist and a patient, a conversation that involves asking questions and listening to answers. This could be the reason still it meant that it was crucial to be aware of the limitations of the technology and making use of it in a way that enhances its capabilities (Weizenbaum, 1966b).

Artificial Linguistic Internet Computer Entity (ALICE) is the first Artificial Intelligence Markup Language (AIML) chatbot developed by Wallace (2009). It was inspired by the Weizenbaum (1966c) chatbot ELIZA. It won the Loebner prize as "the most human computer" at the annual Turing Test contests in 2000 and 2001 (Loebner, 2002). ALICE was created as free software is open source with 500 volunteers contributing to its development. By developing ALICE the AIML markup language was invented it was the primary markup language used for developing chatbots. AIML is an extension of XML language designed for creating stimulus-response chatbots. Some view ALICE and AIML as an extension of the old ELIZA psychiatrist program. Compared to ELIZA, ALICE has more than 40,000 categories of knowledge where ELIZA has only 200 (Loebner, 2002a). The model of learning in ALICE that the program is based on is called supervisor learning because it needs a programmer to monitor its conversations and create new AIML content to make the responses better. In his paper Loebner (2002b) argues that Turing (1950a) when predicted that his game could be played in "50 years" after his paper envisioned a concept where programs would be developed to grow like a child, able to be taught language as we are. Taking these terms into account the role of the programmer in the case of ALICE would be something similar to that of a parent teaching his child language.

2. Methodology

This dissertation aimed to find the capabilities for chatbots in education and the research approach was a qualitative one. This research was carried out by a systematic review of the literature (Snyder, 2019). A systematic review is a method that thoroughly examines relevant findings on a particular research topic (Ruiz et. al., 2012).

The literature search strategy was conducted by obtaining relevant articles by using Google Scholar with the following search terms: “chatbot” or “conversational tutor” or “conversational agent” or “bot”. The initial search phase resulted in 80 articles after reviewing the articles by reading their abstract 17 articles were considered as relevant to the main research question (how can chatbots be used in educational settings). The selection of appropriate research papers was done by selecting papers that were published from 2005 to 2020 making sure that papers reviewed were not obsolete.

2.1. Research questions

Having in mind that students come with various backgrounds and needs throughout the research there were different types of chatbots with varying functions that are developed using different technologies. The primary objective of the research questions was to examine the use of the usage of chatbots in the educational setting. The main research questions are:

1. How chatbots are currently being used in the wider community?
2. How can chatbots be used in the educational setting?
3. How could chatbots be applied to enhance a student’s learning experience?

The first question gives more insight into the overall usage of chatbots in the wider community identifying common patterns of usage of chatbots. The second research question refers to the main purpose of the research how can chatbots be applied

specifically in educational settings trying to find out use cases for chatbots in education their roles and features. The third research question tries to explain how does a chatbot contributes to the learners' experience. Except for the first research question all of the research questions try to give deeper insight into the use of chatbots in educational settings giving a perspective on whether or not they can be successfully implemented. The questions aim to answer whether chatbots can be useful in educational scenarios.

3. Chatbot development: Using Rasa NLU

This chapter will briefly describe the development process of building a chatbot using Rasa natural language understanding (NLU). Rasa is an open-source library for building chatbots from scratch. (Rasa, 2021)

3.1. Installing Rasa and the basics

To install Rasa you need to have Python installed and then open the Anaconda prompt and activate a new virtual environment this can be done by running the following commands:

conda create -n rasa-app– to create the project

conda env list – to create the virtual environment

conda activate rasa-app – to activate the virtual environment

pip3 install rasa – and finally install Rasa

After successfully installing rasa the project is created by running rasa init --no-prompt.

The project starts with several files:

config.yml - it comes with the configuration of the NLU and Core models

credentials.yml - it defines details for connecting to other services

data/nlu.md - here you define your NLU training data

data/stories.md – your stories

domain.yml - your assistant’s domain

endpoints.yml - details for connecting to other channels

(Rasa, 2021a)

3.2. Rasa NLU and Rasa Core

Here I will introduce the technology behind creating Nina Question & Answer Rasa NLU chatbot. In this section, I will give a short overview of the technology behind the chatbot Rasa NLU. It is an open-source Natural Language Processing (NLP) library for extracting intents classifications and entity extractions in chatbots. It helps in building custom-made chatbots using NLP. (Sumir, 2019) In this chapter I will cover two parts of Rasa:

- **Rasa NLU:** By using NLU we will prepare our bot by giving him adequate training datasets, writing configuration files, choosing the pipeline and training model. We will predict the intent of messages in our model as well as showing how to parse entities using Rasa NLU.
- **Rasa Core:** In the second part of this chapter I will cover how to train the dialog management model to give responses back to the user. This part is of great importance when there are various intents, follow-up questions, or responses. It gives us the ability to instead of writing the intents we use Rasa Core to train our assistant to give adequate responses. (Sumir, 2019a)

To explain Rasa NLU simply it is there to understand user messages and Rasa Core is there for holding conversations and deciding what to do next. As mentioned above Rasa NLU is an active open source project that is maintained constantly with a great community build around it. This means that if we do not want to share our users' sensitive data open-source tools like Rasa NLU are the valid choice since the data will remain on our server. What is different when using Rasa NLU you do not depend on any third-party APIs, it gives you full command over your chatbot to train it any way you want. You can experiment with different machine learning (ML) algorithms rather than

depending on a fixed one. (Sumir, 2019b) Both Core and NLU modules provide various functionalities that can be customized as shown in Figure 1.

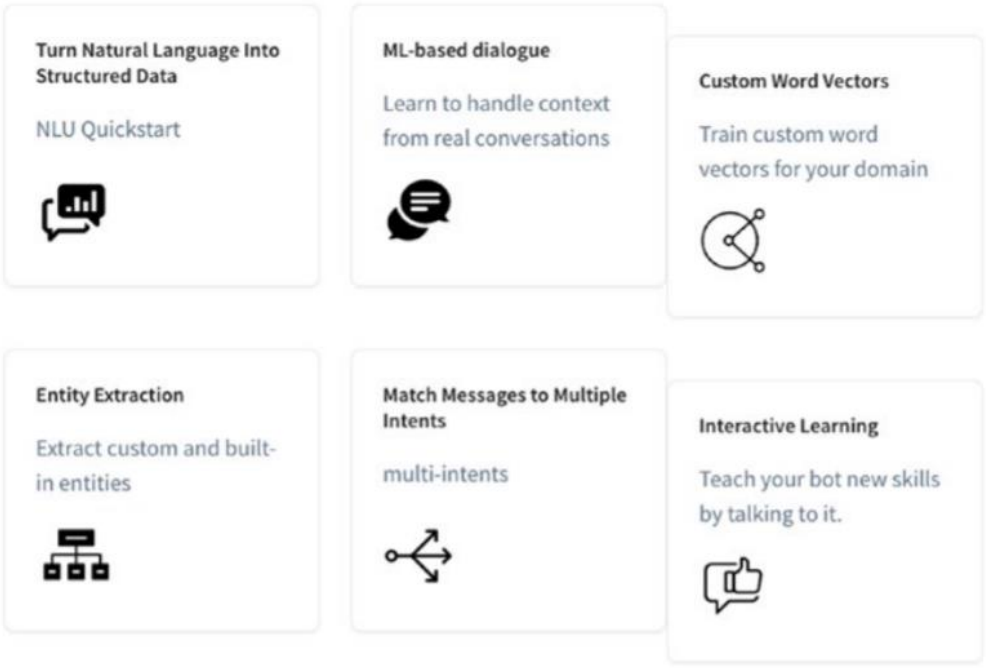

Figure 1. Functionalities of Core and NLU modules

(Rasa, 2021b)

- **Turn natural language into structured data:** This enables the Rasa modules to parse structured, semi-structured, and unstructured data from the knowledge base to prepare it for querying.
- **ML-based dialogue:** Rasa comes with its dialogue management module that is customizable through simple steps.
- **Custom word vectors:** Rasa enables customization to train word vectors for our domain. This helps the engine to better classify intents.
- **Entity extraction:** By using entity recognition models Rasa identifies entities in user messages.

- **Match messages to multiple intents:** It is possible to match user messages to multiple intents that come with different match scores along with the best intents that are returned in the response.
- **Interactive learning:** Rasa provides a handy platform to train your chatbot interactively through a series of messages.

(Sumir, 2019c)

Rasa framework flow of conversation makes use of two models as shown in Figure 2.

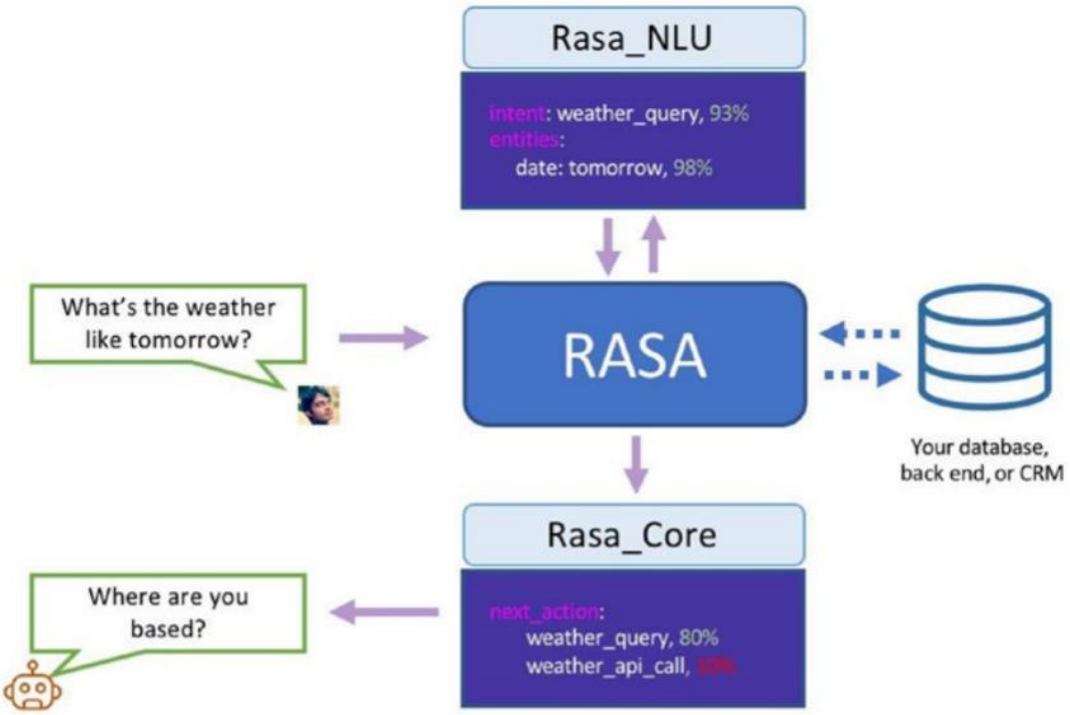

Figure 2 The flow of conversation using Rasa Core and NLU modules

(Rasa, 2021c)

The message is handled from two points: one is at the Core module that is used to manage the conversation and the second point is at the NLU module. In the next section, I will explain independently how each of the modules works.

3.2.1. Rasa Core

Rasa Core is used to receive and respond to requests. The module is vast with a flow-based approach in handling all requests, as shown in Figure 3.

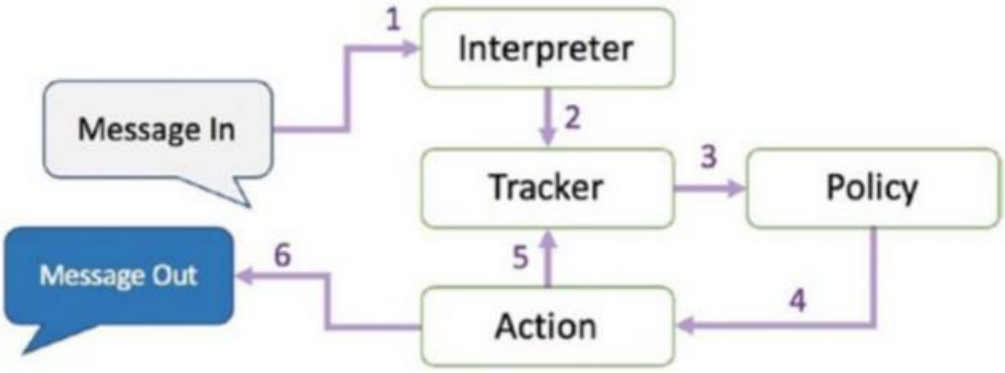

Figure 3. Rasa framework module

(Rasa, 2021d)

The Rasa framework works in six steps to give responses to messages and to handle all incoming requests. The process is the interpreter receives the message to convert it excluding any incoming original text, intents, and entities that are found. While the conversation is ongoing it is being tracked by the tracker that sends the new messages to the policy. The policy module then makes preparations for the response to the request. The response is passed to the tracker and action once it is ready in the policy. The state of the conversation is updated by the tracker and the response is sent back to the user by the action. (Sumir, 2019d)

3.2.2. Rasa NLU

Rasa Natural Language Understanding (NLU) is a module tool that works with intents and entities to extract or classify all messages coming from the user. It is fully open-source with its core purpose being chatbot development. It can be hosted as a service

for your chatbot. Rasa NLU allows you to train different types of modules from your data. Rasa NLU comes with two important parts:

- **Training:** Gives you the ability to train the module with any data you would like. Developing a chatbot that is specific to your business.
- **Server:** It is a service that enables the training for the chatbot. It can be hosted as an API and runs at the back end.

One of the major benefits of using the open-source NLU is that you do not need to share your data with third-party APIs like Google or Amazon to train your chatbot. As it is open source it gives you the ability to make changes to the models or develop your model by your likings. Its architecture allows it to run from everywhere as a service (Sumir, 2019e).

4. Results

4.1. Chatbots in education

The role of the chatbot gives hints into what the chatbot does. Several roles of chatbots were found and those are: “Teacher communication”, “Natural conversation”, “Student evaluation”, “Question & Answers”, and “Tutor”. These roles will be talked about in this section independently as they answer the main research question (how can chatbots be used in educational settings).

Throughout the research, there have been different types of chatbots used in educational environments that explain two main distinct categories, service-oriented and teaching-oriented chatbots. Service-oriented chatbots have found many successful implementations in other fields as well still in education also. Lola (Muñoz, 2018) is used to ease the burden of answering student queries during the enrollment periods at the University of Murcia in Spain. Dina (Santoso et. al., 2018) has a similar function for the admissions at the Dia Nuswantoro Semarang University and Whatsapp chatbot (Wisesa

and Suyanto, 2019) of Telkom University in Indonesia. Three other examples are Differ, CourseQ, and CEUBot (Brustenga, Alpiste, and Castells, 2019) of chatbots used as assistants that are used for admission processes. LTKABot (Mulyana, Hakimiy, and Hendrawan, 2018) is there to help with promotional materials and management of related courses that use a ChatOps paradigm whose task is to automate education. FAQ Chatbot (Ranoliya, Raghuwanshi, and Singh, 2017) is being used for answering FAQs from the universities website visitors and gives information about the university itself. LISA (Dibitonto et. al., 2018) is being used to give students an introduction to university life. Syllabus (Zoroayka, 2018) answers FAQs for online postgraduates. LibBot (Mckie and Narayan, 2019) is a library chatbot that can be extracted into other library systems outside of the university. The chatbot UCM3 (Griol, Molina, and Callejas, 2017) is a library chatbot that is adopted for mobiles and is used for computer sciences. FIT-EBot (Hien et. al., 2018) serves as an assistant to improve services, reduce costs, and create new services. It can read user intentions to give better answers and is set up to answer FAQs that can overwhelm the administration. As for the category of teaching-oriented chatbots they have seen a growth in number, their main purpose is to generate knowledge for specific topics and are used in both formal and nonformal education. Autotutor (Graesser et. al., 2005) is a chatbot that teaches multiple disciplines whose aim is to motivate learners, encourage learning through a turn-based conversation. Adequately named “Chatbot” (Benotti, Martinez, and Schapachnik, 2018) is a chatbot used to promote computer sciences, it has found success in a competition “Dale aceptar.” Where it showed great results promoting computer sciences among teenage girls. NerdyBot, StudyBuddy, and SmarterChild (Molnár and Szűts, 2018) are powerful examples of chatbots used in teaching and Duolingo and Ani (Brustenga, Alpiste, and Castells, 2019a) are an example of chatbots used in nonformal education. The role of education chatbots is not limited to assisting teachers they have been also implemented as Virtual Patients (Shorey et. al.,), who help train nurses by helping them work on their communication skills. Schmulian and Coetzee (Schmulian and Coetzee, 2019) is another example of chatbots developed visually (by the company ChatFuel) without IT knowledge for accountant training. All these chatbots were developed for educational settings to promote learning. There are 17 chatbot roles as found in and they will be

discussed individually. There were 17 chatbot roles found in Roos' (2018) paper each role will be discussed individually as well as the most common features found in chatbots in education.

Role: Tutor

The chatbot is used as a tutor. A tutor is typically a paid teacher or instructor who works privately with one student or a small group. In this case, chatbots provide extra help when students have a hard time dealing with a subject or guiding them in some part of the learning process. In summary to give additional, remedial instruction to someone. (Oxford, 2020). As mentioned in the paper from Ross (2018a) the chatbots with the role of a "Tutor" however were not a standalone role it came in combination with other roles. She explains the role as a chatbot being able to maintain a general conversation with students, showing them contents, and asking questions from learning materials. This by itself cuts to the core of what a tutor is meaning it should be only that and not include other roles instead. The other three roles that were matched together with the "Tutor" role were "Teacher communication", "Student evaluation", and "Question & Answer".

Role: Student evaluation

The role of this chatbot is to evaluate the student's progress or performance to help students improve or help the teacher track the development of students in groups. Two of the papers I have reviewed presented the role of "Student evaluation" (Mikic et.al., 2008; Doering, Veletsianos, and Yerasimou, 2008). Chatbots that could potentially serve this role would be able to provide feedback to students, correct their mistakes, and update their assessment data. These chatbots were presented with other roles included such as "Tutor" and "Question & Answer".

Role: Question & Answer

This role represents chatbots whose sole purpose is to answer student questions, most frequently topic-related questions. Many reviewed papers included this type of chatbot in their work. (Mikic et. al., 2008; Doering, Veletsianos, and Yerasimou, 2008; Heller

and Procter, 2009; Rossi and Carleti, 2011; DeeAnn, 2012; Soliman and Guetl 2013; Gang et. al., 2014; Kumar et. al.; Ranoliya, Raghuwanshi, and Singh, 2017a) This chatbot potentially contributes to learning by giving immediate responses to questions about library services and other sources. They are designed to guide researchers to appropriate resources to help them solve issues as a more advanced version of FAQs.

Role: Teacher communication

A chatbot that can be used to mediate student-teacher communication. By enabling students to contact the teacher via the chatbot in case something from the lesson is not understood well. The chatbot would first attempt to answer the students' questions on their own and in case that it cannot it sends a direct short message (SMS) to the teaching team. One paper used in their research a chatbot with the role of “Teacher communication” (Orlando and Giovanni, 2008).

Role: Natural conversation

This chatbot is presented in one of the papers (Ibáñez et. al., 2011) as a virtual assistant in a virtual world more precisely a Non-player character (NPC) that would engage in interactive dialogues with students this kind of engagement would contribute to the acquisition of listening and writing skills thus creating a “Natural conversation” chatbot. Many chatbots can engage in natural conversation but that is their feature, not their role.

4.2. Chatbot features

A chatbot's feature presents the capabilities of the chatbot. They are connected to the role of the chatbot however not all chatbots contain only features connected to their main role. The 17 features found in the literature review will be presented in Table 1. and elaborated on shortly in this chapter.

Demonstrate learning task	Animated gestures
Input as speech	Recommend learning materials
Holding topic specific conversation	Holding general conversation
Customize the chatbot	Question students

Conversational strategies	Answer questions
Point of interaction	Contact the teacher
24/7 availability	Content from other knowledge sources
Speech as output	Feedback support

Table 1. Chatbot features

Feature: Demonstrate learning task

The chatbot in this case displays how to do the task to the student making it more familiar to the student so he can grasp the concept. Soliman and Guetl (2013a) created a chatbot with this feature in their virtual world where the NPC does a task to demonstrate it to the user.

Feature: Animated gestures

The chatbot uses animated features to support the message, this chatbot feature is available only to chatbots that are embedded virtually like that in the case of Soliman and Guetl (2013b). The purpose of the animated gesture is to provide emotional support as well as to reinforce the message the chatbot is sending.

Feature: Input as speech

This feature enables the chatbot to accept speech as input for the messages. Giving blind learners the possibility to communicate with the chatbot on their own Kumar et. al. (2016a) created a chatbot just for this purpose.

Feature: Contact the teacher

This chatbot can provide means to contact the teacher when and if the students have trouble answering or following the course material. This feature is found in Orlando and

Giovanni (2008a) where the chatbot is used to send a short direct message (SMS) to the teachers.

Feature: Point of interaction

This chatbot is used to make interactions with the student and the learning environment. This feature is included in several papers to: "*Act as a central point of interaction between the learner and the environment providing verbal and non-verbal support to the learner."* and "*to perform interactive dialogues with students*." (Ibáñez et. al., 2011a; Soliman and Guetl, 2013c).

Feature: Speech as output

This feature enables the chatbot to output messages as speech. Three reviewed papers presented this feature in their work. As mentioned before it was used to enable blind people to use the platform on their own. All three papers had similar motives to enhance the learners' experience (Ibáñez et. al., 2011b; Soliman and Guetl, 2013d; Kumar et. al., 2016b).

Feature: Content from other knowledge sources

This feature allows the chatbot to communicate with integrated databases for example Wikipedia, Google, or any licensed database. In cases where the chatbot cannot answer questions from his available resources, it would look into these databases to try and answer the corresponding question. Four reviewed papers included this feature a quote from DeeAnn (2012) explains its usage: "*It is a tool for undergraduates and researchers looking for quick information and tips on searching databases and conducting research. As such, Pixel sends factual questions (what is the population of the US) to Google.".*

Feature: Feedback support

This feature allows feedback for students if they are having trouble following course material. It provides supporting feedback to both teachers and students, for teachers about for example students' progress, making sure that no student falls behind on

following the course in large groups. Mikic et. al. (2008) claims: "*This enables teachers to concentrate on those concepts that require more expertise and real human interaction*".

Feature: 24/7 availability

This feature is one of the main reasons why chatbots are getting so much traction, once created they do not necessarily require maintenance and they are available at all times to students. Even though this is the same for all chatbots DeeAnn (2012a) writes about this feature in their paper saying: "*Pixel will work 24 / 7 with less than 1 percent downtime, and will provide consistent answers. It searches across varied sources and brings together information in a similar way a librarian would work with a user.".*

Feature: Recommend learning materials

This kind of feature is implemented for chatbots that are included in an e-learning platform it would give recommendations for students that when looking for learning materials as well as simply presenting the content of a specific course. Fonte et. al, (2016) explain: "*When the student is viewing an exam question, he/she can ask the chatterbot for a recommendation about educational contents related to the concepts of the question.".*

Feature: Holding a topic-specific conversation

This feature enables the chatbot to converse it is commonly included and it is found in 7 of the reviewed papers. It enables the chatbot to make a conversation out of the information found in its database it can answer questions and in some cases ask questions as well. I have extracted quotes from Heller and Procter (2009a) "*The chatbot is programmed to chat in the first person about Freudian theory, concepts, and biographical events*" and Ranoliya, Raghuwanshi, and Singh (2017b) "*The chatbot can ask queries regarding college admission, about college information and other things related to academics.*".

Feature: Holding a general conversation

This feature enables the chatbot to hold conversations from a wide range of general subjects like the weather which is very hard to implement. It makes the chatbot feel more human in its communication. It can create trust between learners and the chatbot as in the case of Masmuzidin and Wan (2012) where the chatbot is used to: "*motivate children to stay longer since the chatbot maintained children's level of confidence and encouraged their learning"*.

Feature: Customize the chatbot

This feature is not so included and it enables personalization of the chatbot for example the chatbot could have a name, hobbies, hometown, and a birthday. This feature is included in one research where: "*The chatbot has an interface where teachers can select the resources from a structure of modules*".

Feature: Question students

This chatbot can ask students questions. By giving appropriate responses the chatbot can recognize the answer and provide additional information based on the students' answers. Fonte et. al. (2016a) gives a description of this feature where: "*If the student asks for exam questions related to specific concepts the chatterbot will search into a repository of exam questions chose ones related to the concepts specified by the student*".

Feature: Conversational strategies

This feature enables the chatbot to go back to some point of the conversation if he gets lost he then retains what was previously said in the conversation and carries on asking for input that he requires to keep the conversation going. The purpose of this feature is to keep the user focused on what is important in the conversation. Heller and Procter (2009b) write: "*The chatbot can return to a story after branching to a new location and also retains the parts of a story that have been told to prevent repetition*".

Feature: Answer questions

This is one of the most basic chatbot features and it is implemented in basically every chatbot it gives the chatbot the ability to answer a question or rather get into a conversation. Every reviewed paper includes this feature as this is the most common use case for a chatbot.

4.3. Rasa Q&A chatbot Nina

The chatbot was developed using the Rasa Open Source framework. It gives an introduction to each section of the website when asked. The chatbot can recognize questions and give appropriate answers by using Natural Language Understanding (NLU) technologies.

4.3.1. Testing the chatbot

Data validation verifies that no mistakes or major inconsistencies appear in the domain, NLU data, and story data. Here are the results of the data validation:

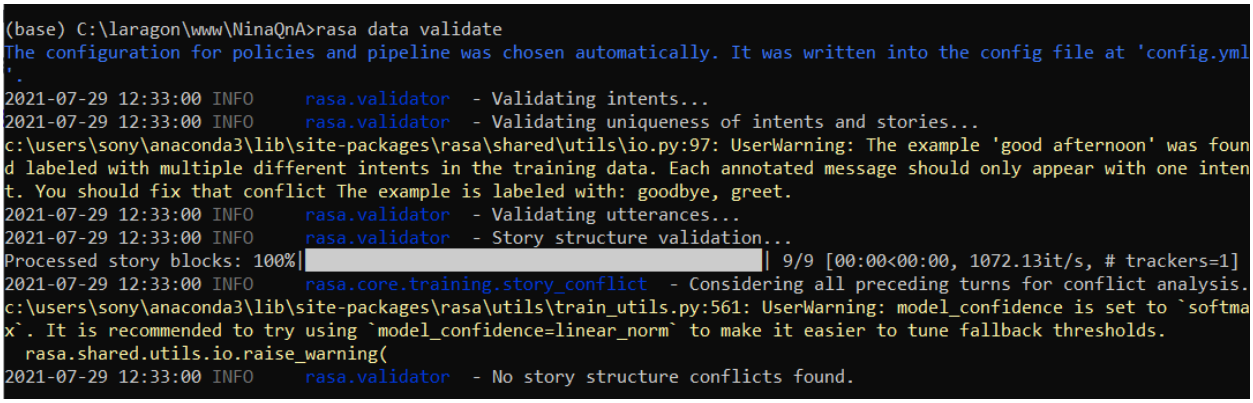

Figure 4. Data validation

The results show that no story structure conflicts were found in validating intents, utterances, and story structure.

Test stories determine how a chatbot will act in certain situations. They provide an entire conversation test results by matching that the given certain user input and the chatbot model will behave expectedly.

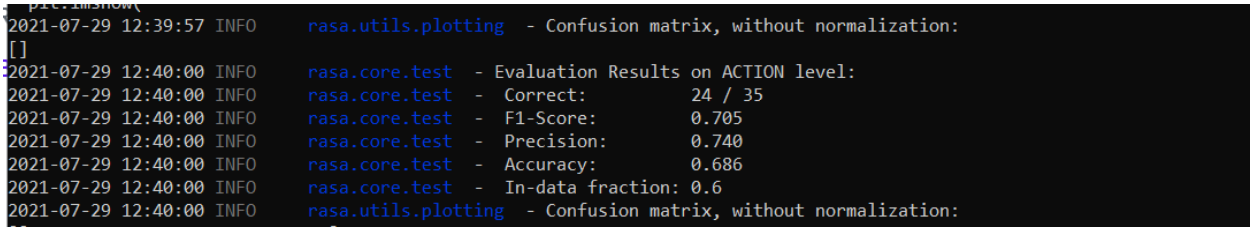

Figure 5. Evaluation results

The results of the test confirm that the chatbot has an accuracy report of 24/35 out of 135 test examples from 35 stories.

5. Discussion and findings

This section gives insight into the main findings of this research. 1. Chatbots are used in education serving different roles as service assistants or teaching assistants. 2. Chatbots are successfully implemented with good results as both service assistants and teaching assistants regardless of their faults and issues. 3. The study shows how to successfully implement a chatbot using Rasa explaining the methods of training a chatbot that comes with NPL as a common feature. 4. The most successful implementation to enhance the students learning experience was by the chatbots that are used to assist teachers or perform repetitive tasks.

6. Conclusion

By conducting the research this study has determined two categories of chatbots in education first service-oriented chatbots and teaching-oriented chatbots. There are various implementations of teaching-oriented chatbots. They have been built and tested for various audiences with different age ranges and in different settings. In addition, they

can assume different roles either as standalone teachers or teachers' assistants. Throughout the research, there has been a large number of language learning chatbots which is natural since conversation is an effective method of learning languages and having the ability to practice any time seems adequate. The study has also found implementations of chatbots into multiple platforms to increase its performance. In addition, the research has found chatbots being used to help learners with disabilities. Overall chatbots have been successfully implemented into different areas of educational settings serving different purposes. The research has also found that the most common evaluation method of chatbot's success was by doing student questionnaires. The results are overall positive for both service-oriented and teaching-oriented chatbots. The biggest challenge in developing a chatbot seems to be its training. The most frequently used technology was AIML a technology that can be used to build FAQ chatbots however chatbots today can be improved by using other technologies, for example, Rasa NLU. Studies are trying to solve these issues by providing automated solutions to chatbot training. Today chatbots come with many abilities such as: speaking in different languages, answering FAQs, improving the teacher-student experience. Another interesting finding is the personality of a chatbot and its importance for establishing emotional links between students and the chatbot making chatbots that are more personal being able to motivate students better. Hopefully, this research study will assist future researchers with knowledge of the use cases of chatbots in educational settings.

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9. Appendix

Appendix A.

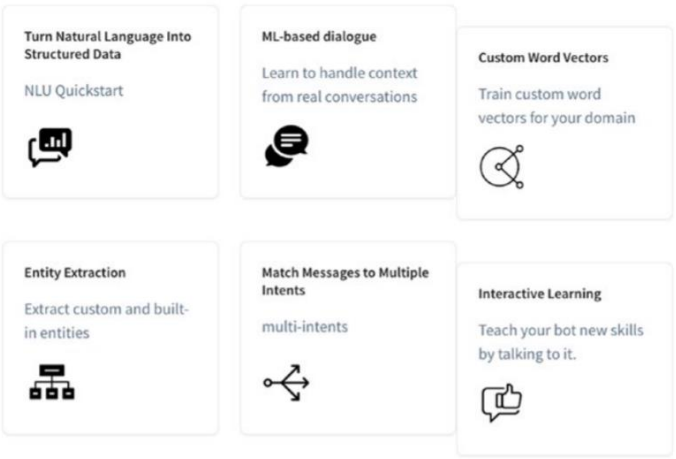

Figure 1. Functionalities of Core and NLU modules

Appendix B.

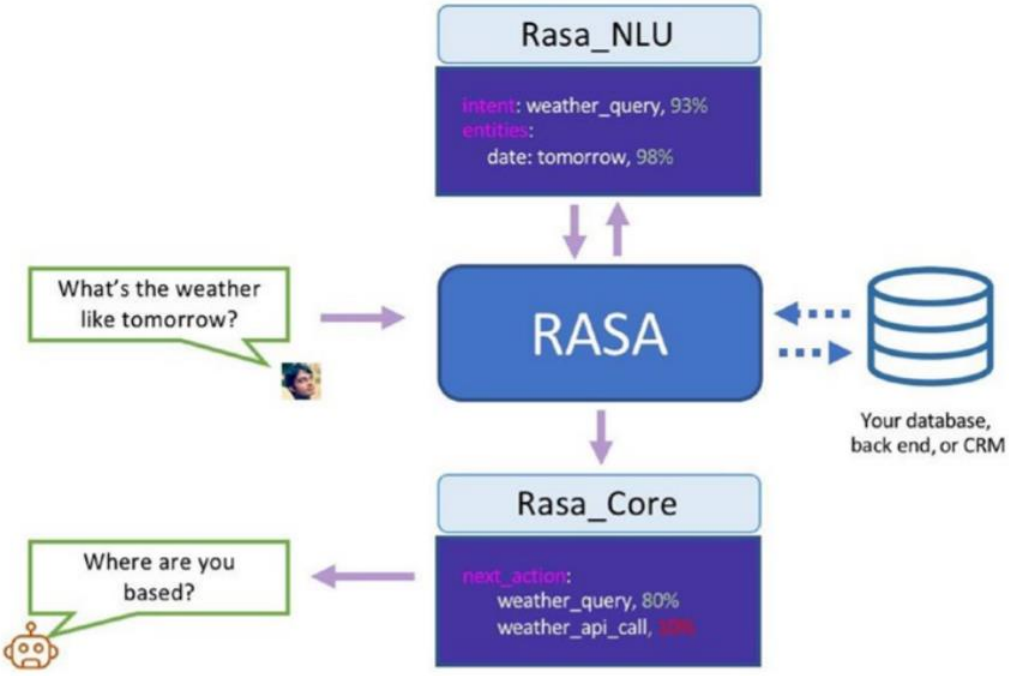

Figure 2. Flow of conversation using Rasa Core and NLU modules

Appendix C.

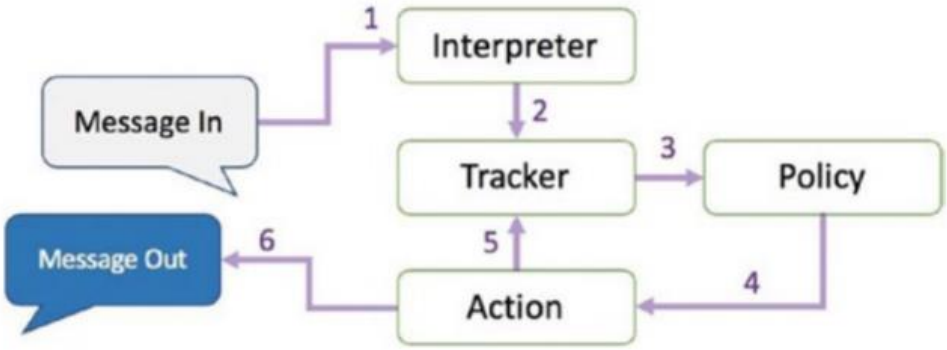

Figure 3. Rasa framework module

Appendix D.

```
(base) C:\laragon\www\NinaQnA>rasa data validate
The configuration for policies and pipeline was chosen automatically. It was written into the config file at 'config.yml
'.
2021-07-29 12:33:00 INFO     rasa.validator  - Validating intents...
2021-07-29 12:33:00 INFO     rasa.validator  - Validating uniqueness of intents and stories...
c:\users\sony\anaconda3\lib\site-packages\rasa\shared\utils\io.py:97: UserWarning: The example 'good afternoon' was foun
d labeled with multiple different intents in the training data. Each annotated message should only appear with one inten
t. You should fix that conflict The example is labeled with: goodbye, greet.
2021-07-29 12:33:00 INFO     rasa.validator  - Validating utterances...
2021-07-29 12:33:00 INFO     rasa.validator  - Story structure validation...
Processed story blocks: 100%|                                                  | 9/9 [00:00<00:00, 1072.13it/s, # trackers=1]
2021-07-29 12:33:00 INFO     rasa.core.training.story_conflict  - Considering all preceding turns for conflict analysis.
c:\users\sony\anaconda3\lib\site-packages\rasa\utils\train_utils.py:561: UserWarning: model_confidence is set to `softma
x`. It is recommended to try using `model_confidence=linear_norm` to make it easier to tune fallback thresholds.
  rasa.shared.utils.io.raise_warning(
2021-07-29 12:33:00 INFO     rasa.validator  - No story structure conflicts found.
```

Figure 4. Data validation

Appendix E.

```
2021-07-29 12:39:57 INFO     rasa.utils.plotting  - Confusion matrix, without normalization:
[]
2021-07-29 12:40:00 INFO     rasa.core.test  - Evaluation Results on ACTION level:
2021-07-29 12:40:00 INFO     rasa.core.test  -  Correct:          24 / 35
2021-07-29 12:40:00 INFO     rasa.core.test  -  F1-Score:         0.705
2021-07-29 12:40:00 INFO     rasa.core.test  -  Precision:        0.740
2021-07-29 12:40:00 INFO     rasa.core.test  -  Accuracy:         0.686
2021-07-29 12:40:00 INFO     rasa.core.test  -  In-data fraction: 0.6
2021-07-29 12:40:00 INFO     rasa.utils.plotting  - Confusion matrix, without normalization:
```

Figure 5. Evaluation results

Date	Time	Notes
3.5.2021	12h-14h	Getting introduced to Moodle by reading on LinkedIn Learning
4.5.2021	18h-20h	Getting introduced to Rasa by reading the development process
10.5.2021	10h – 14h	Exploring TTS (Tutoring Tools Systems), researching on ITS, learning about embedding live code editors, reading about technology in education
11.5.2021	11h – 15h	Reading about limitations and capabilities of technology in education and installing Moodle
12.5.2021	9h – 15h	Installing Moodle, debugging, trying to fix memory issue, styles not loading, and password button not working
13.5.2021	10h – 14h 18h-20h	Installing Moodle - setting permissions, fixing file uploads and block errors Exploring research topics, reading on AI's potential in education
16.5.2021	9h-14h 18h-20h	Implementing Vue CLI, using Vue in a Laravel project, creating the project, preparing to design the project, reading on design Reading on principles of good web design, going through slides about web design, looking at similar websites (-)
18.5.2021	9h-14h 18h-20h	Troubles with booting up the project, tried to implement Vue js with Tailwind without success, installing Laravel Jetstream Livewire as the scaffolding for the project. Started the project with Livewire Styled the frontpage, and started styling the tutorial pages
20.5.2021	9h-14h	Creating the content for the first four pages with styling, create

		the quizzes page started adding questions
21.5.2021	12h-14h	Researching on how to create a quiz with Laravel
24.5.2021	12h-14h 18-20h	Creating the quiz page, adding styles to it Scanning the pages for bugs and adding content to the quiz
25.5.2021	12h-15h	Researching how to implement a live code editor on to the website. Preparing for the English exam.
26.5.2021	12h-14h	Practicing English for the FCE exam
27.5.2021	12h-14h	Implementing Rasa
28.5.2021	12h-15h	Implementing Rasa
29.5.2021	12h-15h	Creating the exercise pages on the website
30.5.2021	12h-15h 20h-21h	Creating the exercise pages and giving them styling, reading how to create a chat-bot Reading about chat-bot development
31.5.2021	11h-14h	Learned how to install rasa, Installed rasa
1.6.2021	10h-14h 18h-20h	Following a tutorial on training Rasa, learning how to train Rasa
2.6.2021	11h-15h	Implementing Rasa
3.6.2021	12h-15h	Implementing Rasa, training Rasa
4.6.2021	12h-15h	Training Rasa to create an introductory chatbot
5.6.2021	12h-15h	Training Rasa to create an introductory chatbot
6..7.2021	12h-15h	Training Rasa to create an introductory chatbot
7.6.2021	10h-14h 19h-20h	Starting to do research, reading on role of AI in education, Reading on AI in education
8.6.2021	11h-14h 19h-21h	Gathering reading materials, writing an introduction Gathering reading materials
9.6.2021	11h-13h	Gathering reading materials

10.6.2021	11h-14h	Writing for the research
11.6.2021	11h – 14h 18h-20h	Gathering reading materials
12.6.2021	13h-15h 18h-20h	Reading articles
13.6.2021	11h-14h 19h-20h	Reading articles on opportunities for AI in education
14.6.2021	11h-15h	Reading articles on opportunities for AI in education
15.6.2021	11h-14h 18h-20h	Reading articles on AI
17.6.2021	13h-16h	Reading AI in education
20.6.2021	13h-16h 17h-19h	Writing on AI in education
21.6.2021	13h-16h	Writing on AI in education
22.6.2021	12h-15h 17h-19h	Finished writing, writing references
23.6.2021	12h-15h 17h-19h	Reading for revisions Paraphrasing and looking for new materials
24.6.2021	12h-15h	Training Rasa to create an introductory chatbot
25.6.2021	12h-15h 17h-20h	Training Rasa samples to create better replies
26.6.2021	12h-16h	Implementing Rasa to the website
27.6.2021	12h-16h	Testing Rasa
28.6.2021	11h-15h	Testing Rasa, building a CMS
29.6.2021	10h-14h 17h-18h 20h-21h	Testing Rasa, building a CMS
30.6.2021	10h-14h 16h-17h	Reading on Laravel Going through learning materials
1.7.2021	10h-14h 15h-18h	Building an SPA with Vue in Laravel Watching Laracasts Laravel from scratch 8
2.7.2021	12h-15h 18h-21h	Implementing forms to Rasa
3.7.2021	12h-16h 18h-20h	Implementing forms to Rasa
4.7.2021	12h-15h 19h-21h	Testing Rasa forms
5.7.2021	12h-14h 15h-18h	Gathering reading materials
6.7.2021	12h-15h	Writing conclusion and abstract

7.7.2021	16h-17h 21h-22h	Paraphrasing the introduction
8.7.2021	14h-17h 19h-21h	Creating a Rasa quiz
9.7.2021	14h-18h 19h-20h	Adding samples to Rasa quiz, Testing Rasa quiz
10.7.2021	15h-19h	Adding samples to Rasa quiz
11.7.2021	14h-18h	Successfully implemented Rasa quiz on the website
12.7.2021	14h-17h	Doing revisions on Rasa quiz
13.7.2021	13h-17h	Doing research
14.7.2021	14h-18h	Paraphrasing
15.7.2021	14h-18h	Doing research on chatbots in education
16.7.2021	11h-14h 20h-22h	Gathering reading materials on chatbots in education
17.7.2021	15h-18h 20h-22h	Gathering reading materials Analyzing reading materials
18.7.2021	17h-20h 21h-23h	Reading
19.7.2021	12h-14h 15h-16h 22h-23h	Reading
20.7.2021	15h-16h 20h-22h	Writing
22.7.2021	20h-22h	Writing
23.7.2021	15h—20h	Creating the Rasa FAQ chatbot
24.7.2021	14h-19h	Creating the Raas Q&A chatbot
25.7.2021	14h-19h	Creating Rasa Q&A chatbot
26.7.2021	14h-19h	Testing Rasa Q&A chatbot
27.7.2021	15h-19h	Adding stories to Rasa Q&A chatbot
28.7.2021	15h-19h	Writing the rules and intents for Rasa Q&A chatbot
29.7.2021	18h-20h	Testing Rasa Q&A chatbot
30.7.2021	17h-20h	Implementing several different chatbots versions
31.7.2021	16h-21h	Testing to see which version has the best results
1.8.2021	15h-18h	Successfully implemented Rasa Q&A to work with all story paths
2.8.2021	15h-18h	Final tests with Rasa
3.8.2021	16h-17h	Revisiting all materials
4.8.2021	15h-16h	Uploading the projects

Table 2. Logbook