

Chatbot in Education: Experience in Teaching Programming for Freshmen at University

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Abstract: *The fourth scientific and technological revolution has impacted almost all fields, including education. With the advent of Artificial Intelligence (Artificial Intelligence) technology, it is possible to integrate Chatbot systems into online education platforms where students can learn by technology. Chatbot technology is increasingly used for educational purposes to support the learning process of students, especially freshmen. By designing and installing Chatbot on e - learning platforms and Chatbot application to support teaching activities, the authors of this implemented an experimental course for 100 freshmen majored Information Technology at a university in Vietnam. The results of the study showed that learning performance in the experimental class was higher than one in the control class and the experimental class gave positive feedbacks with six questions Q1, Q2, Q3, Q4, Q5, Q6 about the system related to the course. From this result, it is partly proved that the use of Chatbot to support student's learning has potential in education in the future.*

Keywords: chatbot; artificial intelligence; higher education; e - learning; freshmen.

1. Introduction

Today, Artificial Intelligence (AI) has influenced the way we participate in daily activities (Adamopoulou et al., 2020). The rapid advancement of computing and information processing techniques has accelerated the progress and applications of AI, allowing computers to perform tasks by simulating intelligent behaviors of human being, such as reference, analysis, and decision - making (Duan et al., 2019). In particular, the application of AI in education is happening rapidly and expanding its sphere of influence (Roos, 2018). According to Okonkwo and Ade - Ibijola (2020), one of the most popular AI technologies used in teaching and learning is the Chatbot system. It is considered a useful technology to facilitate learning in an educational context (Clarizia et al., 2018, pp.291 - 302).

Several studies have shown the important factors that make Chatbots chosen in many fields, in which productivity is the most important driver. In education, Chatbots are more friendly and engaging for students, provides students with comfortable and efficient assistance, along with more engaging answers, direct responses to learner's problems (Ranoliya et al., 2017).

In the context that information technology in general and AI has been developing strongly for the recent decades, the use of Chatbot technology in education is one of the most important approaches to enhance and promote the experience of more personalized learning. In 2020, according to Statista's statistics, the smartphone penetration rate in Vietnam ranked 9th with 63.1%, higher than Indonesia and the Philippines (with 58.6 % and 37.7 % respectively). Vietnam is considered a high - growth digital economy market in Southeast Asia. Most of the students at university own a smartphone and regularly use the Internet.

The posed questions are:

- 1) What are the recent studies on the application of Chatbot in education?
- 2) What are the main benefits of Chatbot in education?
- 3) How to build Chatbot?
- 4) How is the student's assessment of Chatbot's support?

These questions will be answered in this article.

2. Literature Review

2.1. An overview of Chatbot

AI in Education (AIEd for short) was born around the 1970s (Kay, 2015). Researchers focus on research, development, and evaluation of computer softwares to improve teaching and learning. Long - term goals are defined to collect learner's feedback, assess learner's competency and causes of their weakness, individualize a person or a group of learners, and finally use AI techniques to explore and develop teaching - learning theories. AIEd plays an important role by combining science - oriented research (AI) and psychology/pedagogy (education). Figure 1 illustrates two alternative conceptions of AI + Ed: (left) AIEd is an amalgamation of AI and Educational Research; (right) AIEd as an independent, multidisciplinary field, defining its own goals and scope between the respective fields of AI and Education (Björn Sjärdén, 2015).



Figure 1: Two alternative conceptions of the association between AI and Ed (Björn Sjärdén, 2015)

While AI centers machine learning and human - like intelligence, education focuses on fostering learning

capacity and human intelligence. AIEd insights help bridge this gap by providing techniques to foster more effective and intelligent interactions with people to improve educational outcomes. Since its inception, AIEd has been interested in studying how AI techniques can be leveraged to create tools in order to personalize learning tailored to the specific needs of learners (Conati, PorayskaPomsta) & Mavrikis., 2018). Developing an AIEd system to the same level of efficiency as a private human tutor has been an area of interest for researchers since the earliest days of computing (VanLehn, 2011).

Among the applications of AI that are well known and used by many people is Chatbot. The concept of a chatbot began to gain popularity when Alan Turing proposed the Turing test ("Can machines think?") in 1950 (Turing, 2009, pp.23–65). In 1966, Eliza was created and is considered the first chatbot, acting as a psychotherapist and returning user words as questions (Weizenbaum, 1966). In 1995, Alice became the first Chatbot to be considered a "Human Computer" (Wallace, 2009). The development of modern technologies created Chatbots later, such as SmarterChild (Moln'ar & Szuts, 2018), Apple Siri, Amazon Alexia, IBM Watson, Microsoft Cortana, and Google Assistant (Reis et al., 2018). Since 2016, the rapid development of chatbots led to the creation of various types of Chatbot Systems for industrial use.

In recent times, there has been an increase in Chatbot applications on electronic platforms to support student's learning (Nayyar, 2019). Currently, there are many different definitions of Chatbot. Ciechanowski et al. (2019) define a Chatbot as a computer program that mimics and processes human communication, allowing people to interact with digital devices as if they were talking to a real person. It is either a dialogue mechanism that encourages collaborative learning (Ruan et al., 2019) or an automated system that responds to human queries (Rosruen & Samanchuen, 2018). Clarizia et al. (2018) define Chatbot as an intelligent agent that is able to interact with students to answer a series of questions and give appropriate answers (Clarizia et al., 2018). Chatbots are also seen as interactive or chat agents that provide instant feedback to users (Okonkwo & Ade - Ibijola, 2020; Smutny & Schreiberova, 2020).

Chatbots are increasingly being used to improve learner interaction in the current technological world where communication and many other activities are largely based on online platforms. The Chatbot system can be deployed as a mobile web application to aid in learning. Dsouza et al. (2019) argue that in the field of education, Chatbot is used not only to develop students' interactive skills, but also to support teaching on the basis of automation. This increases connectivity and efficiency in interactions (Ondas et al., 2019). They can easily provide a focused, personalized, and result - oriented online learning environment (Cunningham - Nelson et al., 2019), which is exactly what educational organizations need today.

2.2. Benefits of using chatbots in education

With the use of Chatbots in education, student's learning outcomes and happiness might be significantly improved

(Winkler & Soellner, 2018). Several studies have shown that Chatbots can be successfully deployed in the education sector (Duall & Kapros, 2020, pp.13–24; Hien et al., 2018, pp.69–76; Mor et al., 2018, pp.94–101; Ndukwe et al., 2019, pp.365–368; Okonkwo & Ade - Ibijola, 2020; Ranoliya et al., 2017; Ureta & Rivera, 2018).

Chatbot technology can be seen as an important innovation for e - learning. Specifically, in terms of quality, they are considered the most innovative solution in bridging the gap between technology and education. Chatbots create an interactive learning experience for students, much like a one - on - one interaction with a teacher. Through examining learners' behaviors and to track their improvement, bots play an important role in enhancing individual students' skills. Through published studies, it could be determined that Chatbots benefit the education system in many different ways, including:

a) Content integration

This means that the teacher/instructor can upload all necessary information (including specific topics; timetables for assignments; tests, aid tools and tests. . .) onto an online platform for easy access by authorized students. Chatbots can assist in providing relevant information to students. Specifically, teachers can inform students about upcoming school events that may interest them such as sports, seminars, and other activities. The results from the reviews indicate that several studies have documented the use of Chatbots in education to facilitate the integration of subject content so that students can easily access it anytime and anywhere (Akcora et al., 2018, pp.14–19; Wu et al., 2020).

b) Quick access

Chatbots help maximize student learning efficiency and achievement (Clarizia et al., 2018), and facilitate quick access to educational information (Wu et al., 2020). On the other hand, Chatbot could also be used as a source of social learning. In fact, students from different backgrounds could share their views and perspectives on a particular issue while the bots can still be adapted to individual problems (Hussain et al., 2018).

c) Motivation and interaction

In today's modern society, students tend to want to use their smartphones to access and read online content rather than reading textbooks or documents. When students are motivated by interactive systems such as Chatbots, they are allowed to learn in an enjoyable and comfortable environment (Chen et al., 2020; Pham et al., 2018). Learning with a conversational agent does not only annoy students, but also allow them to acquire knowledge in a more convenient way.

Class size in a university often affects how an educator delivers materials and how students interact in class. Smaller classes often allow students and educators to interact and have a more positive relationship (Lee, 2009). On the other hand, learners value their communication needs and regard this as an important contributing factor to improve learning outcomes and satisfaction (Dennen et al., 2007). Therefore, the use of Chatbot in educational support will help increase the level of student's interaction (Moln'ar & Szuts, 2018;

Adamopoulou & Moussiades, 2020; Albayrak et al., 2018). Furthermore, they could also play a key role in motivating students to work by sending regular notifications and reminders.

d) Immediate support

This is one of the most important advantages of using Chatbots for educational purposes. The use of Chatbots in education allows scholars and students to get quick answers to their queries (Alias et al., 2019). Research results by Okonkwo and Ade - Ibijola (2020) reveal that Chatbots can provide instant support in an individual's learning process, helping students automate their activities such as submitting homework, responding to emails (Molnar & Szuts, 2018; Murad et al., 2019) and getting instant answers to their questions (Sreelakshmi et al., 2019).

e) Multiple users allowed

Another important advantage of using Chatbot in education discovered is the ability to allow multiple users to access the system simultaneously. This means that multiple students from different locations can interact with a particular Chatbot without interruption and get the information they need. Rooein (2019) agreed and stated that a Chatbot is capable of handling multiple queries at the same time, saving user's time. One of the main benefits of using Chatbot for educational purposes is that it allows multiple users to access it at the same time (Wu et al., 2020).

f) Personalization support

In education, the use of Chatbot technology is one of the most important approaches to enhance and promote more personalized learning experience (Cunningham - Nelson et al., 2019; Su, M. H. et al. the., 2017). The Chatbot system can be deployed as a mobile application to aid in learning. Chatbots can instantly provide students with standardized details, such as course content, question and answer practice, etc. Chatbot technology can provide students with a personalized learning program and a more engaging learning environment (Benotti et al., 2017; Cunningham - Nelson et al., 2019). These systems can not only improve student engagement and support, but can also reduce the

administrative workload of faculty, allow them to focus on curriculum development and research.

2.3. Chatbot Frameworks

There are many platforms that make it quick and easy to build chatbots like Google's Dialogflow, Microsoft's Azure Bot Framework, Facebook's Bots for Messenger, and Amazon's Alexa. In addition, there are many other powerful Chatbot platforms that are widely used such as ManyChat, Chatfuel, Converable, GupShup. S. Raj (2019) outlining the following chatbot frameworks:

- 1) QnA Maker - a cloud - based framework provided by Microsoft that allows a simple Q&A chatbot to be developed based on FAQs, URLs and structured documents.
- 2) Dialogflow - a popular cloud - based framework provided by Google, very easy to use and allows integration with multiple platforms.
- 3) Rasa NLU & Core - an open source framework provided for the Python development environment.
- 4) Wit. ai - a cloud - based framework provided by Facebook, similar to Dialogflow but without many features. It works best when integrated with Facebook Messenger.
- 5) Luis. ai - a cloud - based framework provided by Microsoft that is functionally similar to Dialogflow and Wit. ai.
- 6) Botkit. ai - similar to Rasa as it is basically a programming library using Javascript, but it provides a GUI. Raj also details building a chatbot using Dialogflow and the RASA stack (Raj, 2019).

2.4. System Architecture

Based on studies (Colace, 2017; Clarizia et al., 2018), an electronic chatbot system based on the website <http://ailearning.edu.vn> is installed, the website's architecture could be shown in Figure 1, the interaction on the chatbot is shown in Figure 2 and Figure 3.

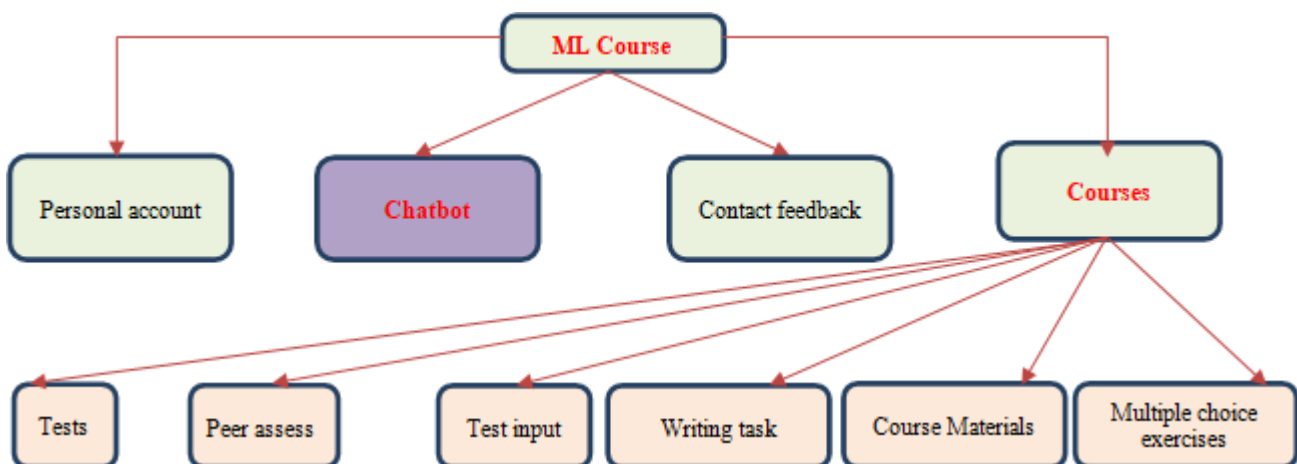


Figure 2: Structure diagram of the UML Course system

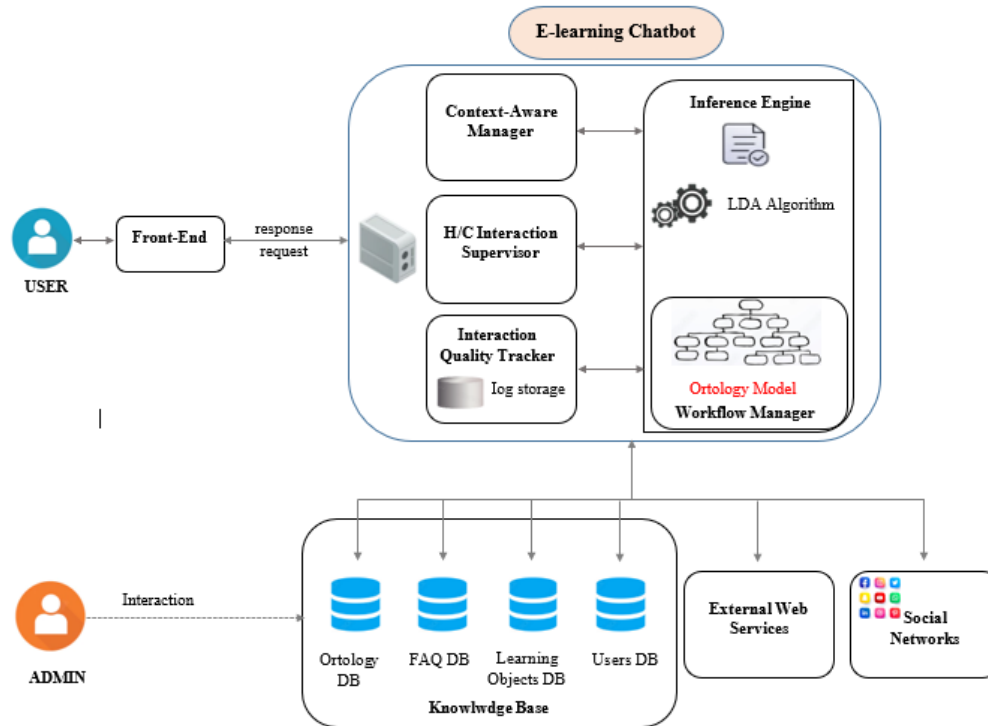


Figure 3: E - learning interactive system architecture (Colace, 2018)

3. Methodology

To evaluate the performance of the proposed system, a test was developed. The purpose of the test was to evaluate the system's effectiveness in recording freshmen's requests for a C/C++ programming course. Furthermore, the usability of the system was evaluated by the students at the end of the course. The implementation of Chatbot has been installed on the e - learning platform with the website: <http://ailearning.edu.vn> for students at the University of Danang - Vietnam - Korea University of Information and Communication Technology, Vietnam. A research course for General Informatics, C/C++ programming content was reviewed. The first class (the experimental class) includes 50 students and the second class (the control class) also has 50 students. During the semester, all 50 students in the experimental class used the Chatbot platform and the 50 students in the control class did not use the Chatbot platform. The test analysis is only done on students who have passed the test for the first time, 100% of students complete the test on the basic knowledge for the subject/module General Informatics for the students majoring in information technology. At the end of the experimental course, a survey of six questions Q1, Q2, ...Q6 was sent to the students who passed the exam.

In which,

Q1: The instant feedback of the Chatbot and the instructors on the website obtained through "the Chatbot helps me improve my learning".

Q2: Chatbot helps answer your questions quickly

Q3: Chatbot helps you navigate the lessons

Q4: Does the chatbot have accurate suggestions for lessons?

Q5: Chatbot gives an accurate suggestion, but it doesn't match your real needs

Q6: The Chatbot sometimes gives a wrong suggestion

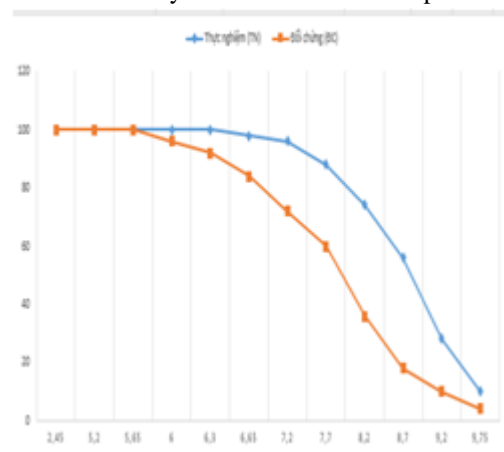
4. Results

The results showed that the performance of the Chatbot in providing accurate recommendations to users was evaluated. In particular, three different scenarios were considered:

- Chatbot gives accurate suggestions
- Chatbot gives an accurate suggestion, but it does not match the real needs of students
- Chatbot gives a wrong suggestion.

Assessment results of the students of the experimental group and the control group are shown in the graph and table below.

Table 1: Summary of the test's statistical parameters



Subjects	ĐC	TN
Mode	7.7	8.7
Median	7.7	8.7
\bar{X}	7.6	8.4
S (SD)	1,02	0.85
Independent t - test (p)	0,0013	<0,05
ES	0,81	>0,8

ES index = 0.81 > 0.8, so the influence of experiment and control is large.

- The results of the evaluation form under the criteria (Table 2):

5 - level Likert questionnaire method, descriptive statistics method is used to collect data and use SPSS software to process data to assess the reliability of observed variables. We conducted a survey on the satisfaction level of 50 students participating in the experiment. The formula $(Max - Min) / n$ is used to calculate the discriminant interval among the levels $(5 - 1) / 5 = 0.8$. Therefore, the rating level can be distributed as follows:

Table 2: Distribution of rating levels of the scale

Level	Mean Value \bar{x}	Degree of Agree
1	$1.00 \leq \bar{x} \leq 1.80$	Totally disagree
2	$1.81 \leq \bar{x} \leq 2.60$	Disagree
3	$2.61 \leq \bar{x} \leq 3.40$	Partially agree
4	$3.41 \leq \bar{x} \leq 4.20$	Agree
5	$4.21 \leq \bar{x} \leq 5.00$	Totally agree

Q1: The instant feedback of the Chatbot and the website instructors obtained through the Chatbot helps me improve my learning.

Q2: Chatbot helps answer your questions quickly

Q3: Chatbot helps you navigate the lesson

Q4: Does the chatbot have accurate suggestions for lessons?

Q5: Chatbot gives an accurate suggestion, but it doesn't match your real needs

Q6: The Chatbot sometimes gives a wrong suggestion

Table 3: Mean, Variance, and Hierarchy Ratings of Questions

Questions	Mean	Variance	Hierarchy
Q1	4, 36	0, 32	1
Q2	3, 84	0, 55	5
Q3	4, 28	0, 41	2
Q4	3, 7	0, 7	6
Q5	4, 24	0, 47	4
Q6	4, 26	0, 56	3

From the table of qualitative and quantitative evaluation results based on the test between the experimental and control classes and at the same time analyzing the independent t - test results (p), the p value = 0.0013 < 0.05 has reflected the clear difference between the mean scores of the experimental and the control classes through the support of Chatbot, which is unlikely to happen randomly;

The ES value when evaluated was 0.81 > 0.8, therefore, the impact of the study has had a great influence on the results of the experimental class and this study can be replicated.

The survey on the level of agreement when participating in the course with the support of Chatbot in Table 4 shows that: The highest average score is 4.36 in Question 1 (Q1) ($4.21 \leq \bar{x} \leq 5.00$). Students completely agree with the immediate response of the Chatbot tool, the lowest level of the mean value in Question 4 is 3.7 ($3.41 \leq \bar{x} \leq 4.20$) is of agreement, that is, students agree with "Chatbot has accurate suggestions for lessons". However, based on Table 4, it could be seen that with the average score of 4/6 questions, students completely agree, accounting for nearly 70%.

5. Discussion

Several studies have been done on Chatbot technology mainly on the use of Chatbot system for educational purposes, including Chatbots used to answer student's questions (Clarizia et al., 2018, Ranoliya. et al., 2017; Sinha et al., 2020). Thomas (2020) examined previous studies, in which chatbots benefit both learners and instructors. Through research, it has been shown that students are very satisfied with the support of the chatbot system, the website - based e - learning system has helped them improve their scores in learning. The interactions that the chatbot on the system has given timely responses to students, which confirms that the Chatbot is an intelligent agent capable of interacting with users to answer a series of questions and give appropriate answers (Clarizia et al., 2018). Studies have shown that Chatbots could be used to deliver course content to students through an online platform as a chat agent capable of providing accurate information to users (Akorae et al., 2018). Chatbots in education have personalized online learning and delivered learning materials to students everywhere everytime. Chatbots are good technological innovations that enhance students' interest in learning so that they can gain cognitive skills and achievement (Lin & Chang, 2020). In addition, AI - powered Chatbots can be used to create an automated and intelligent teaching system that allows teachers to analyze and evaluate student's learning competence. These chatbots assist teachers in assessing students' understanding of the topics by recording their answers and responses. Like classrooms, Chatbots provide students with study materials, tests, and quizzes.

The content - integrated ML - Course system refers to the ability of teachers to upload all necessary information about a particular topic such as conversations about programming problems in C/C++ onto an online platform for easy access by students. This includes the topics covered, as well as a timetable for assignments, supports, and tests.

6. Conclusion

The ML Course system integrated Chatbot has provided research and development support to students by appropriately responding to conversations about problems related to finding algorithmic problems in programming C/C++. The research is a part of the university curriculum for freshmen. And Chatbot technology integrated on E - learning system on the website <http://ailearning.edu.vn> is used to provide feedbacks when students need in order to reach an improved outcome.

This study provides its research results during the time of the Covid - 19 pandemic in Vietnam when courses using chatbots on website platforms were rarely conducted in Vietnam, especially in universities. However, the study successfully tested higher education - level freshmen. They were very satisfied and improved their learning performance and outcomes as well.

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