

Artificial Intelligence in University Education - Designing a Learning Model to Support the Interaction between Students and AI

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Abstract: *Personalization in learning plays an important role for learners, especially university students. This approach places more importance on the learning process than on the teaching process. Students learn in all experiences and with all other individuals, motivating learning and optimizing lessons, suitable for each student. However, in order for the personalized learning model to be truly effective, teachers need to innovate the teaching methods, the way of evaluating the student's learning process. One of which is the use of artificial intelligence (AI). The design of teaching with the support of AI is necessary to design a learning model and one of the important elements in this teaching model is AI Technology. This paper aims to propose a model that includes 3 factors: teachers, students and AI technologies. At the same time, the paper proposes systematic knowledge along with the design of ML Course system that integrates the KNN (K - nearest neighbors) machine learning algorithms to help students with suggestions matching students' cognitive level when performing exercises.*

Keywords: Artificial Intelligence; Education; teaching model; KNN algorithm

1. Introduction

The rapid advancement of computer technology and information processing has accelerated the progress and applications of artificial intelligence (AI) to enable computers to perform tasks through simulation of intelligent human behaviors, such as reference, analysis and decision-making (Duan et al., 2019; Topol, 2019). Today, AI has been applied to various fields such as image and voice recognition, decision making, natural language processing and translation and implemented in various forms such as computer programs, applications, embedded control systems in devices or robots. In recent years, AI has received attention from governments, researchers and educators (Popenici & Kerr, 2017). The development of information and communication technology has also contributed a strong impact on higher education (Ajami et al., 2020; Bates et al., 2020; Chen et al., 2021). The concept of Artificial Intelligence in Education (AIED) was first mentioned around 1970 (Self, 2016). The researchers' initial goal was to build a system called Intelligent Tutoring Systems (ITS) or AIED systems with the main goal of creating computer systems that can provide personalized teaching. AI applications in education have drawn researchers' growing attention from computer science and education fields with rapid progress in AI in recent years. As reported, experts predict that AI in education will grow by 43% between 2018 and 2022, although Horizon report 2019 Higher Education Edition (Educause, 2019) predicts that AI applications related to teaching and learning are expected to grow further.

According to Hwang (2014), providing personalized learning guidance or support to individual students based on their academic status, hobbies or personal characteristics are important goals of AIED. Through regular implementation of interactions and collaboration with students, building and

maintaining social relationships, as well as developing personalized guidelines, AI is increasingly having a stronger impact on the educational ecosystem.

Besides the advantages of using AIED such as creating new opportunities in designing effective learning activities, developing better applications or technology - tied learning environments, AI remains a challenge for most researchers and practices from both computer and education fields to implement relevant activities or systems (Kay, 2012). The challenges arise because AIED is a technology - intensive and multidisciplinary field, mainly (1) computer programming skills, techniques for simulating the intelligence of human experts; (2) Human knowledge and experience to make best evidence - based judgments and decisions to help solve individual learners' problems and help them learn better.

The following questions are planned to answer in the study:

- 1) What are AI's roles in education?
- 2) How does the interaction between AI and students in education take place?
- 3) What is the proposed learning model to support interaction between students and AI?

2. Overview

2.1. Overview of AI in education

AI was launched in the 1950s when John McCarthy held a two - month seminar at Dartmouth University in the U. S. In the workshop proposal, McCarthy first used the term "artificial intelligence" in 1956 (Russel & Norvig, 2010). Since its birth, AI has been continuously going through development processes and achievement of each subsequent stage is a result of inheritance, development of suitable parts

and reduction and correction of non - conforming parts from previous stages.

Technology helps create appropriate learning features and enhances personalization to increase learners' experience. Here are the main ways in which AI is gradually changing the education sector in a more positive direction:

(1) Smart "virtual" assistant

This could be the biggest AIED application. A number of comprehensive analysis studies have demonstrated the effectiveness of the smart tutoring system in promoting learning outcomes (Van Lehn, 2011). AIED contributes to freeing teachers from routine tasks, reducing the burden of monitoring all students as well as having extensive knowledge to support students in learning and discussion (Goksel & Bozkurt, 2019; Luckin et al., 2016; Roll & Wylie, 2016; Timms, 2016). Koedinger and Corbett (2006) presented five important aspects that a computer needs to fully function as a human tutor: (1) Problem solving and reasoning through the use of domain knowledge; (2) Understanding typical learning trajectories, misperception and unofficial knowledge; (3) Be able to follow the student's reasoning steps and recognize student's knowledge gaps; (4) Providing feedbacks, support when necessary and in suitable context; (5) Separating guidelines in a continuous review. With the help of AI, teaching and learning can take place anywhere, anytime. AI can replace lecturers in some cases. Koedinger and Corbett (2006) also said that providing "virtual" instructors and personalizing learning process by AIED offers more cost - saving capabilities than hiring a separate tutor for each learner.

(2) Learner's study personalization

Personalization of learning refers to guidance in which goals, roadmaps and speed of learning experience are optimized according to individual learners' needs, preferences and continuous performance. With this definition, the personalized learning process can be characterized by a cycle of four processes: (1) participation, (2) measurement, (3) interpretation and (4) adjustment. Personalization involves learners participates in a certain learning experience; from which their individual needs, preferences and performance could be measured. After the measures have been collected, they are explained relatively under some sets of standards or criteria. This interpretation is then used to announce specific adjustments to the learning experience that may differ among students in goals, routes and/or speed. Depending on how the learning environment is configured and the role of technology, in a certain context, such interpretations and adjustments could be made by the technology itself, teachers, or students.

Studies by Goleman (1996), Kowalski et al. (2011) showed that students' emotions such as confidence, boredom, confusion, stress and anxiety are strong predictors of achievement and affect their academic performance. Personalized teaching for individual learners begins with a timely and consistent instruction process with the perception and emotions of the students (Woolf et al., 2013).

Personalization could remove many barriers in learning and teaching. Students have different attributes and might be

unique, and students' ability to absorb lectures is also at different levels. Based on these attributes, theoretical learning models should be available to students. Instructors could set up learning models by evaluating tests that students could take and could set up different models to help learners progress. Each student could have his or her learning patterns that teachers could create by using the e - learning tool (Chang & Ke, 2013).

(3) Frequent responses by AI

In education, AI chatbots are used in collecting student's information related to hobbies, habits and methodology, even collecting common mistakes in a particular grammar point of students. Kowalski et al. (2011) pointed out that chatbots could play a useful role for educational purposes, as they are an interactive mechanism compared to traditional online learning systems. Students could constantly interact with the bots by asking questions related to a specific field. The chatbot in education could act as a dedicated "teacher assistant," specifically: (i) Chatbot is designed with a scenario of common question sequences; (ii) It can monitor the student's progress and self - study; (iii) It can give comments, responses for individual students; (iv) It can suggest personalized subjects, materials.

2.2. Analysis of AI models in education

In this section, four approaches to modeling by using AI to solve various problems in the current education system are presented.

- 1) Develop a new model by taking an identity approach to modeling program semantics in higher education. The researches of Chung & Kim (2016), Chanaa & El Faddouli (2021), Pástor et al. (2021) intended to arrange areas and topics of knowledge for each major by using the curriculum classification diagram as well as the academic identity. Based on the types of assessment such as skills, knowledge and attitudes, the model develops curriculum automatically.
- 2) Teaching quality modelling. Liu et al. (2020) developed a model for consensus of views for the whole e - learning for lecturers and they presented a comprehensive systematic approach to measure the importance of continuous satisfaction to maintain the use of e - learning in higher education institutions. The two - way relationship between factors related to e - learning continuing satisfaction is one of the successful methods that has been implemented.
- 3) Evaluation model: Queiroz et al. (2019) solved the problem of online evaluation of education and proposed a model using AI techniques such as Immersive Virtual Environment (Yang & Liu, 2022; Liu et al., 2021). AI system is designed to interact with e - learning platform through capabilities such as voice recognition and intelligent behaviors.

3. Suggested Model

3.1. Basis for model recommendation

In recent years, universities in Vietnam have promoted the application of advanced technology in general and AI technology in particular to improve the quality, efficiency of

teaching and learning. However, the application of AI to teaching assistance in universities remains a challenging goal as there is a lack of studies that provide information on how to design a teaching model with AI support as a

collaborative learning agent in classrooms. Based on studies on AI technologies and education technology, this study proposes an AI - assisted teaching model, including important components such as:

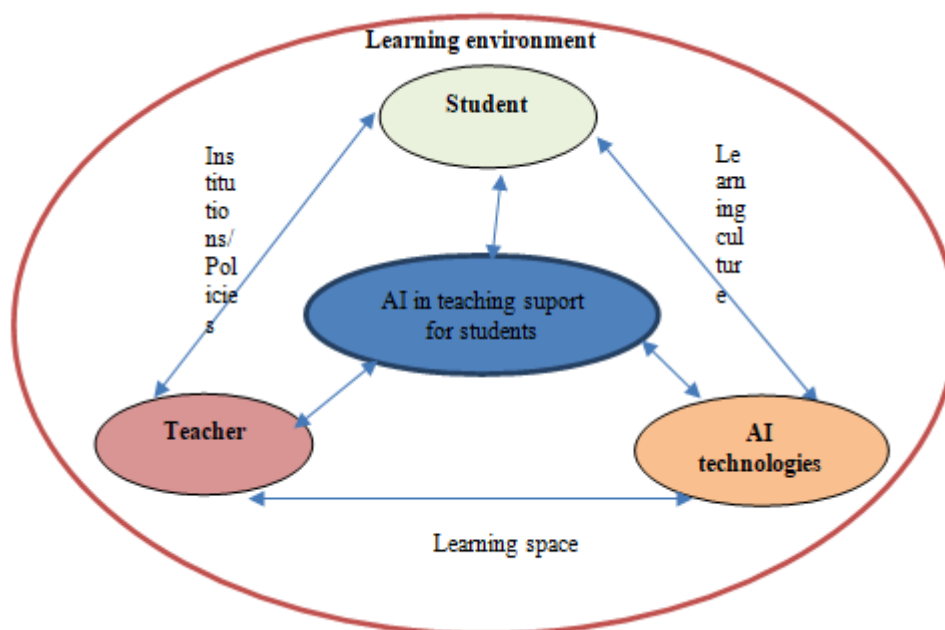


Figure 1: Teaching model with AI support

3.2. Explaining the components of the model

a) Student – AI – Teacher Collaboration

The above Student - AI - Teacher Collaboration model demonstrates the connection among 3 main components: students, lecturers and AI technologies. Students are considered to be an active learning agent in the mentioned model instead of only being able to acquire knowledge in a passive manner. The model also defines AI as another learning agent, instead of just a simple learning tool like before. Previous studies noted AI's human - like characteristics as a unique characteristic that is distinguished from traditional educational tools (Huang, 2018) and expands AI's roles in learning (Simler & Frischknecht, 2021). Instead of introducing the concept of interaction as a human - only process and technology as an intermediary, the model suggests theoretical possibility of AI as an interactive host directly exchanging information with students in the learning process (Guzman & Lewis, 2020). Interaction with AI is dynamic but not static, based on communication and interaction exchanged in a learning process and context.

Finally, teachers plays an important role in the formation and facilitation of the model and is simultaneously responsible for the learning process of students in class (Chaudhry & Kazim, 2021).

Regarding the role of teachers in forming and facilitating the mentioned combination model, Utterberg et al. (2021) described teachers as the controller of AI application in the classroom, including allowing students to interact with AI in classroom learning activities.

b) Learning environment

The learning environment refers to various places, contexts, and cultures in which students conduct learning. The term is often used as a more accurate or preferred alternative to class, which has more traditional and limited meaning with only a room with desks and blackboards. The term also covers the culture of a school or classroom, including how individuals interact and treat each other as well as how teachers can organize an educational environment to facilitate learning.

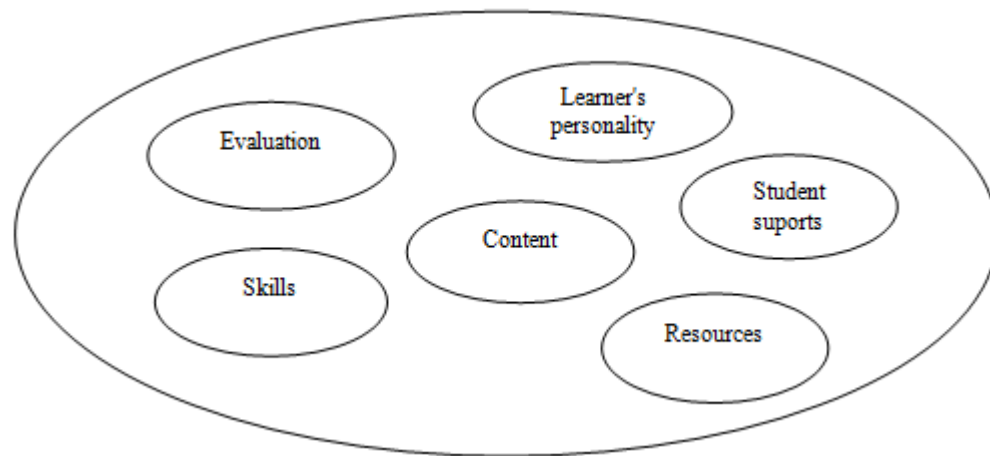


Figure 2: Components of the learning environment

In figure 2, William (Tony) Bates (2019) gives an example of a learning environment with the following elements:

- Characteristics of learners and their means of communication;
- Teaching and learning objectives;
- Learning support activities;
- Available resources such as textbooks, technology or study spaces;
- Evaluation strategies that will measure and promote the best learning;
- Learner's skills.

From a different perspective, we can define the learning environment consisting of the following 3 key components:

(1) Learning space

Firstly, in order for AI to successfully immerse itself in the classroom, an appropriate learning space must be built. The distribution of smart devices and the establishment of wireless network environment for classes is a part of the construction of full learning space for AIED. In addition, digital infrastructure (i. e. learning foundation) is considered necessary for this cooperative model (Wang & Cheng, 2021).

(2) Educational institutions and policies

Appropriate institutional and policy support is necessary for budget/financing, curriculum development/ pedagogical methods and legal/ ethical guidelines in AIED. In particular, time and cost for development and introduction of an appropriate methodology for implementing AIED poses a major challenge in public educational institutions. Without clear orientation and guidance of higher education

institutions on curriculum and pedagogical methods for AIED, it would be challenged for schools applying AI, new technology (Wang & Cheng, 2021). Furthermore, the use of AI in classrooms can cause a number of legal and ethical problems related to personal information and privacy. Therefore, institutional protection measures are necessary to protect students from damage and disputes (Okoye et al., 2020).

(3) School culture

School culture is an important environmental factor in cooperation between teachers, students and AI. AIED must be achieved through the common will of stakeholders in the education system. For example, teachers does not like to apply new technology after they receive negative feedback from colleagues, students and parents in school as well as due to their tight schedules to meet different roles at school. Therefore, it is important to develop a cooperative school culture that supports professional dialogue on the needs and importance of AIED and the use of AI for learning among different stakeholders (Kim et al., 2021a). Teachers recognize that it is essential to establish a cooperative learning culture as a basis for promoting the broad implementation of the students – AI – teachers cooperation model.

c) AI technologies

This section proposes a number of AI technologies under development and testing, which aim to improve education in terms of research and learning for learners. For teachers, they can get assistance from AI who is an assistant in teaching and become judges by giving feedback to students in a short period of time by using these technologies.

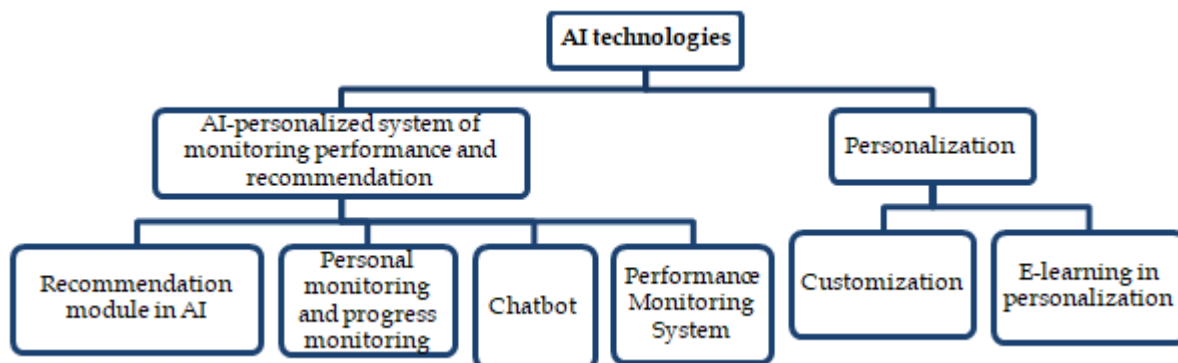


Figure 3: AI technologies

(1) AI - personalized system of monitoring performance and recommendation

- Recommendation module (RM): The purpose of RM is to provide students with recommendations during their learning process. One of the necessary steps to create a list of recommendations is to access students' history of what they seeked about educational content. To provide students with effective recommendations for the first time, RM needs initial data identifying what they want and searching for appropriate content.
- Personal monitoring and progress monitoring: Monitoring student's performance by using AI is to monitor what they are doing during their learning time. The system can track individuals, gives feedback and records based on the learner's progress, which means the system will evaluate the learner's actions and provide information about that type of student.
- Performance monitoring system: Different needs and learning styles of students are factors to consider when providing materials. The personalized e - learning environment should be available to provide materials to each student. However, this is not something that could be done easily due to its complexity. However, personalization can be done by tracking pages, products, and articles that students have read. Based on the connection between the sites and the results of those sites, AI can create a personalized environment (Kurilovas et al., 2014).
- Chatbot: There has been an increase in Chatbot applications on electronic platforms to support students' learning recently (Nayyar, 2019). There are now many different definitions of Chatbot. Ciechanowski et al. (2019) defined 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 a dialogue mechanism that encourages learning cooperation or an automated system for human question answering. Clarizia et al. (2018) defined Chatbot as a smart agent capable of interacting with students to answer a series of questions and give appropriate answers. In the field of education, Chatbot is used not only to develop students' interaction skills but also to support teaching on the basis of automation. This helps increase connectivity and efficiency in interactions. A number of outstanding benefits include: (1) content integration support; (2) quick access; (3) motivation and interaction; (4) instant support; (6) Personalization support (Okonkwo& Ade - Ibijola, 2021).

(2) Personalization

- Customization: One of the ways to customize the learning environment is to make recommendations to students. From that, they can choose what RM recommends. By selecting suggestions, they are making their preferences for the e - learning environment. Learning goal - oriented recommendation mechanisms can also create stable recommendations for students. When the student accesses the introduction, the suggestions will be more accurate for the student. This means that students have control over what they want and it also removes duplicate possibilities (Wan & Niu, 2018).
- E - learning in personalization: E - learning is a form of teaching and learning that students can access to learn materials through mobile phones, computers and tablets using the Internet. With this technology, Learning Management System (LMS) can be integrated into e - learning. The combination of LMS and AI opens up opportunities for research, collaboration, students - centered teaching and learning. E - learning is a part of the use of AI and LMS. E - learning can provide a platform for data mining, evaluation, analysis, and content creation for individuals. With the advancement of AI, e - learning can be raised to a new level.
- According to Deloitte's 2019 Global Millennium Generation survey, Millennial Generation (gen Z) will be a generation that values experiences, in which the trend of individualized experiences becomes a standard in all industries and services. In the education sector, the model of personalization of learning experiences has also emerged long ago and has grown more and more strongly in the 4.0 era. As analyzed above, individualization in education is a special way to tailor learning to each learner's needs, preferences and abilities, based on their individual characteristics. The benefits of personalization in learning can be described as follows:
- Increasing student's level of interaction with the system: Personalizing the learning experience helps the student become the decision maker (or partially) of his/her learning process. With AI support, the knowledge recommended by the system and delivered to students through the filtering process will closely match the needs that learners are looking for or need, thereby stimulating their interaction ability and speed of information memorization.
- Increasing the student's learning motivation by creating a new learning experience, in line with the trend. In the context that AI is becoming a trend that attracts a large

number of users, AI - integrated teaching or teaching support systems will attract students to use, providing opportunities for students to have new learning experiences, catching up with trends.

- Reducing the time to find learning complementary information: The process of personalizing the learning experience is based on studies of each individual's characteristics, strengths, weaknesses and qualifications. Therefore, the personalization method will help students save time from unnecessary concepts that are not suitable for their level and experience. Students' focusing on the necessary knowledge content will help them progress faster, shorten time for conquering their learning goals.
- Contributing to improve students' learning outcomes: Many studies have shown that personalization in

education can improve learning outcomes by changing the approach to learners. Personalization provides learners with more relevant materials, stimulates interaction with academic content, thereby improving their learning outcomes.

4. Building tools to personalize teaching models with AI support

4.1. Design of support system architecture diagram

System architecture: Based on studies (Clarizia et al., 2018), a ML Course system (Dinh Thi My Hanh et al., 2022) is designed as Figure 4, Figure 5, Figure 6.

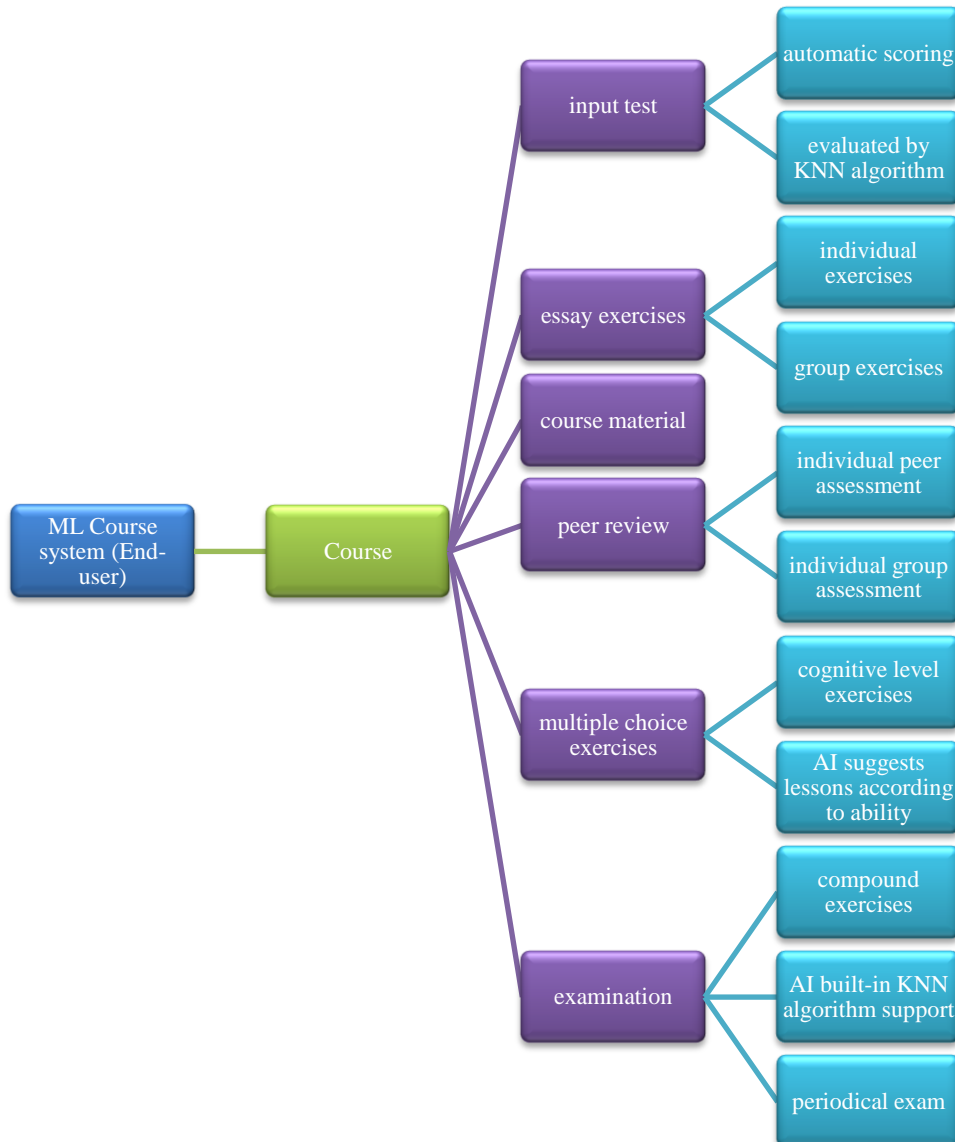


Figure 4: System architecture diagram (course organization hierarchy)

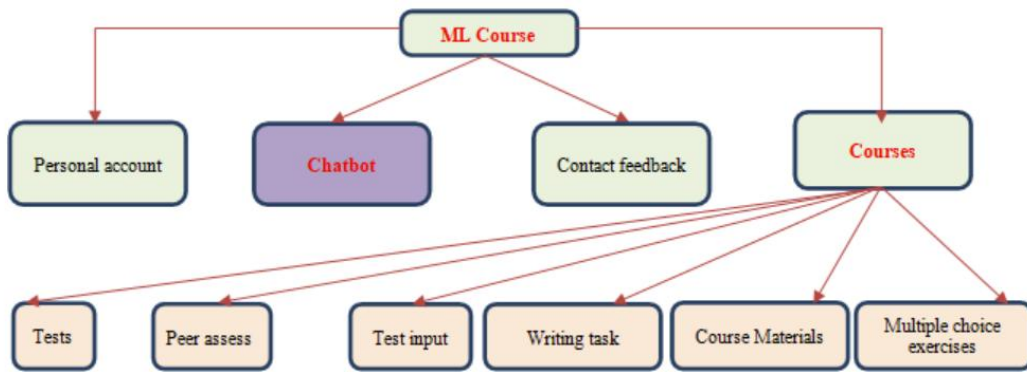


Figure 5: Structural diagram of the ML Course

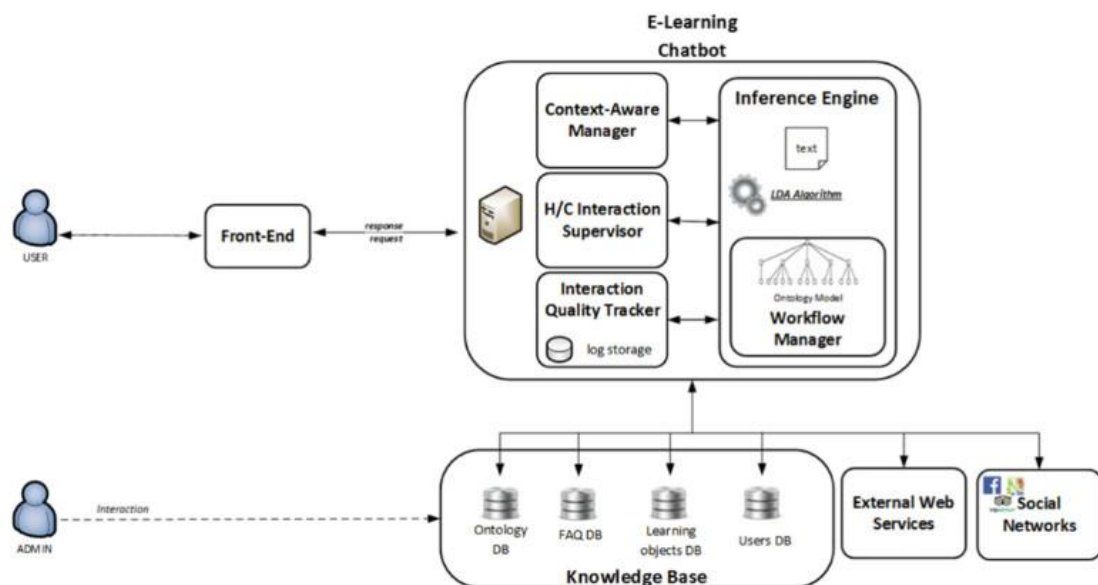


Figure 6: E - learning interactive system architecture (Clarizia et al., 2018)

The ML Course system is integrated with KNN machine learning algorithm to help students with suggestions matching students' level of awareness.

4.2. Results of the development of personalization support tools

A ML Course System with Chatbot integration and KNN (K - nearest neighbors) algorithm is a supervised machine learning algorithm. KNN algorithm commonly used in classification and regression problems) provided research and development support to students by appropriately responding to conversations about searching - related issues

to experimentally implemented subjects. In addition, the website <https://ailearn.com.vn/> provides a source of digital data and tests that assess the level of understanding of students, suggesting the knowledge contents that students are still uncertain through the system of tests.

An example showing personalization results through AI is below:

- (1) Firstly, students enter the system with a registered account or an account that has been issued from the beginning by teachers to see the courses opened, then select the courses that suit their needs to learn (Figure 7).

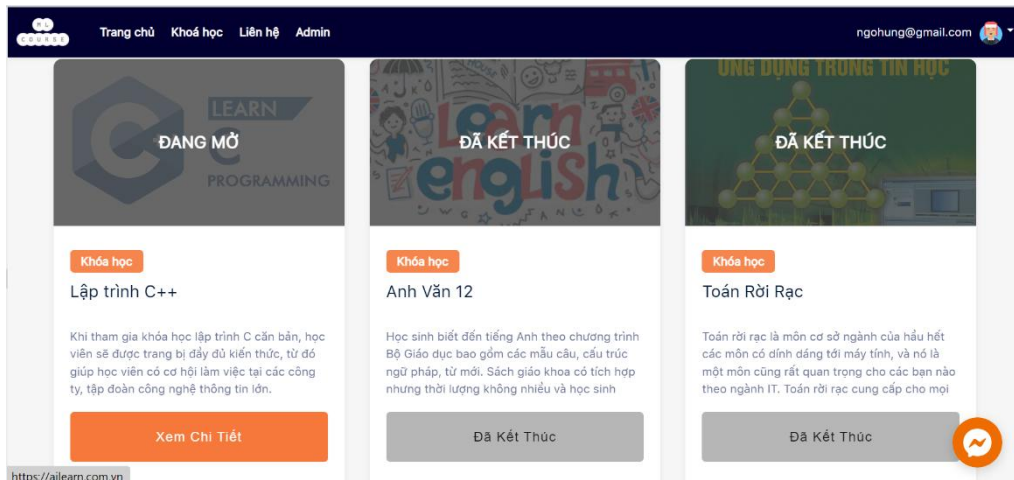


Figure 7: The interface of courses on the ML Course page

(2) Next, students take a placement test. The test toolkit is provided according to the student's learning progress in class (according to chapters, lessons. . . they have learned). This test will help students accumulate test scores. In case a

student failed to answer the questions in the test, the system will base the accumulated points in the process of doing that test to suggest appropriate answers (Figure 8).

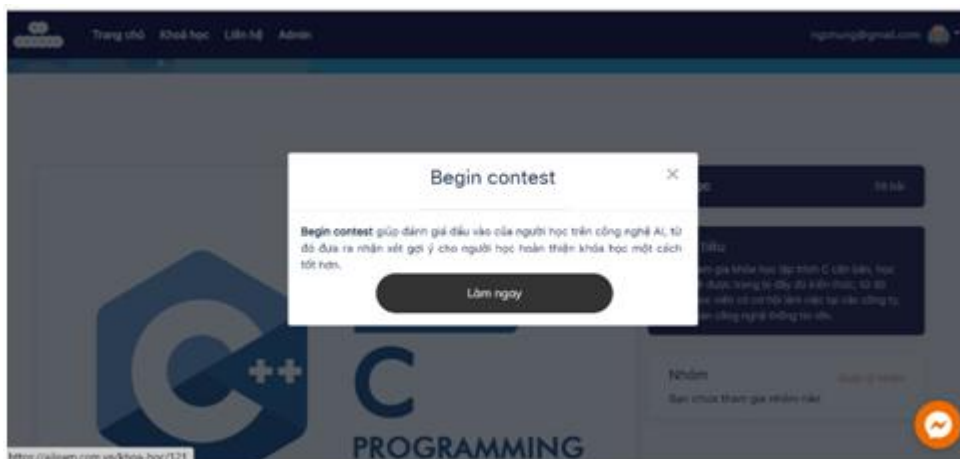


Figure 8: Notification of students' participation in the input test

(3) Finally, students choose "Bắt đầu" (means "Start") to join (Figure 9) and at the end of the task, AI will suggest exercises with the same level as the previous task for students to perform further (Figure 10). Each question can be designed according to its own difficulty level, when students perform leveled - questions, AI recommends related materials as well as suggests exercises appropriate for that task.

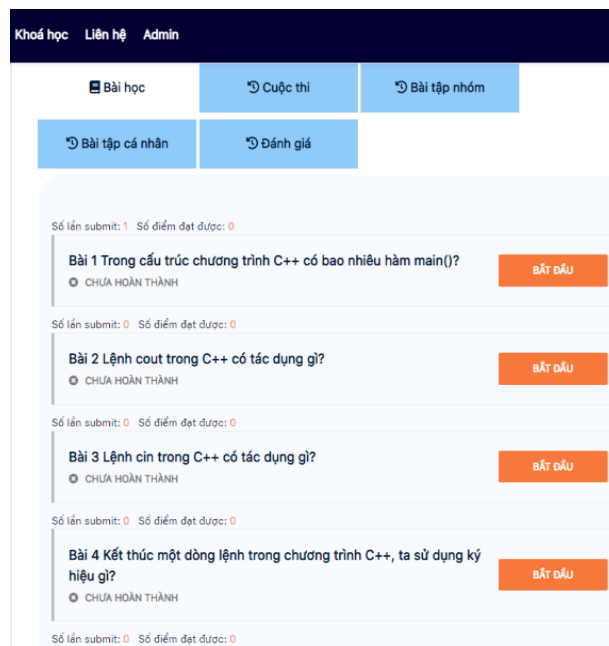


Figure 9: Student's Test Interface

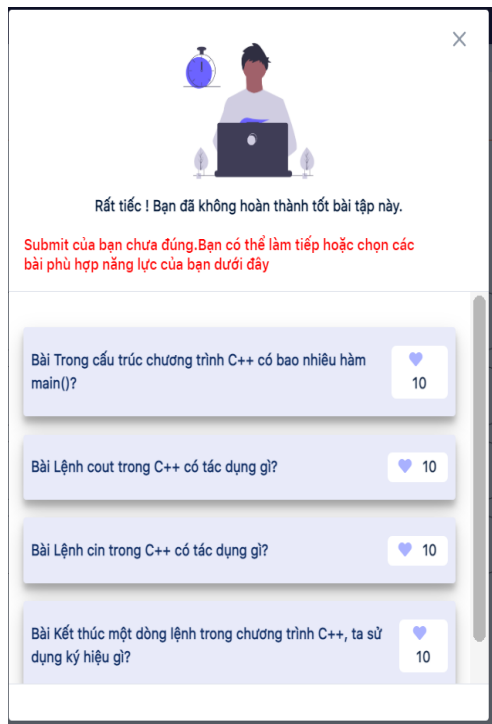


Figure 10: AI recommends similar exercises

5. Conclusion

A proposed teaching model for students with AI support will apply two major technologies of AI: chatbot and learning personalization to make appropriate recommendations to students regarding lecture, homework, and test systems. The teaching - learning process is placed in a comprehensive set of elements of the teaching - learning environment (appropriate policy institutions, learning spaces and school culture) to ensure that teaching and learning are highly effective. When implementing the above teaching model, students will well develop self - study and self - experience combined with learning under the guidance of instructors and the support of AI tools. In order to ensure high learning performance, in addition to the above factors, the students themselves must ensure IT skills, self - study ability, and self - experience.

The teaching design process with the support of AI should ensure the following basic principles: (1) Ensure human and machine interaction; (2) Ensure uniformity and science with the use of various teaching means; (3) Ensure effectiveness when implementing; (4) Ensure openness, orientation for learners; and finally, ensure the principles of the online course structure.

The AI - supported teaching model proposed by the author in this paper is a model in which there is a close combination and interaction between 3 factors: lecturers, students, and AI. These elements are located in a specific teaching - learning environment. In order to implement the above teaching model, it is necessary to design the course with elements in the teaching environment and means of instruction ensuring requirements; digital learning resources correspond to the teaching content and specific course and subject requirements.

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