Situation and Proposals for Implementing Artificial Intelligence-based Instructional Technology in Vietnamese Secondary Schools

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Abstract—This study evaluated the level of necessity for bringing AI into teaching, then assessed the implementation of those applications as well as how feasible and effective such implementation is at Vietnamese Middle Schools. The approach to assessing the current situation in this study is the perspective of Artificial Intelligence-based instructional technology (AI-bIT) that considers the teaching process to be a technological process with three core components being teaching means (the key media is AI), teaching methods and teaching skills. A sample of 119 teachers come from Middle Schools belonged to some cities/provinces in Vietnam responded this survey form. The survey data is illustrated by descriptive statistics of Mean and the Independent-Samples t-test for comparison of different opinions. Based on the findings, it was concluded that teachers' awareness of AI-bIT is quite good, but the actual implementation of AI-bIT is still low, so the feasibility and effectiveness of AI-bIT is not high. It was therefore, recommended that, for reaching the outstanding advantages of AIED in the world, Vietnamese secondary education needs to be invested in technical infrastructure, fostering qualifications and expertise for teachers, as well as piloting AI-bIT models for exploiting AIED in feasible and effective way at Middle Schools.

Keywords—artificial intelligence in education, artificial intelligence-based instructional technology, Vietnamese Middle Schools

1 Introduction

In recent decades, Artificial Intelligence (AI) has become a familiar term as it is applied more and more often in different areas of life. Despite having been existing for a very long time under various descriptions, there is not a unified definition of AI. Mccarthy (2007) defines Artificial Intelligence as "the science and engineering of making intelligent machines" or "a machine behaves in a way that could be considered intelligent if it were a human" [1]. The IGI Global describes AI as a field of study that focuses on artificially replicating the cognitive abilities of human intelligence to create software or machines which have the capability of performing specific tasks that are normally done by humans [2]. In a recent study by Saleh, Z (2019), Artificial Intelligence (AI) was considered a branch of computer science in which intelligence

is demonstrated by machines, as opposed to the natural intelligence of humans and other animals [3]. Some of the activities that artificial intelligence can perform include speech recognition, understanding and optimizing the student learning process, planning, and problem-solving [4]. These definitions of Artificial Intelligence have specified the characteristics of AI such as predictability and adaptability; decision intelligence, supplementing human intelligence, providing insights and improving performance; application of algorithms for continuous learning; empowering people to rethink the ways data is analyzed and information is integrated and then applying these insights to make better decisions. In conclusion, AI can be defined as a branch of computer science, intelligence developed by humans with a goal to enable computers to perform intelligent behaviors like humans, thus, supporting people to perform tasks more easily, quickly, and conveniently.

AI's application in education and teaching dated back to the 1970s. It was known as Artificial Intelligence in Education or AIED. There are various definitions of AIED. Habib (2019) refers to Artificial Intelligence in Education as the "application of artificial intelligence technology in the field of education and its use in student learning at school" [5]. The Social Community on Artificial Intelligence in Education (2010) considers it an interdisciplinary field of study "at the boundaries of computer science, education and psychology". AIED encourages extensive research and advancements of interactive and adaptive learning environments for learners from all demographics [6]. Binar Kurnar Prahani (2022) stated that AIED could make massive innovation in education system [7]. According to the Encyclopedia dictionary, AIED has three fundamental meanings: firstly, "education for understanding AI", implying developing the competence at understanding and processing AI; secondly, "education using artificial intelligence", suggesting the application of artificial intelligence to effective teaching and learning in different subjects; thirdly, "AI expert training", indicating education experts in developing AI and teachers specialized in AI [8]. In this research paper, the group of authors will focus on the second meaning of AIED, in which AIED is considered as the application of artificial intelligence in education in order to assist teachers, educators, and schools in performing tasks such as teaching, assessment, administration, research, etc., support students to learn easily, conveniently as well as motivate and inspire them in studying.

After being implemented in education, AI evolves into an artificial intelligence-based Instructional Technology (AI-bIT). Therefore, in this research paper, AIED is examined from the perspective of modern instructional technology, which will be utilized as the theoretical basis to evaluate the current situation and prospects of AIED implementation in secondary school teaching in Vietnam. In modern instructional technology, three core components of AI-based instructional technology are teaching media (AI technology), teaching methods (combining methods and principles of AI application with pedagogical theory during the teaching process to increase effectiveness and quality of teaching), and teaching skills (teacher's skills, techniques, inventions empowered by AI-based teaching systems to accomplish the corresponding quality and effectiveness) [9]. When evaluating the impact of AI-based instructional technology, our research team will analyze the roles of these core elements in AI-based instructional technology; assess teacher's awareness of its necessity; consider the technical infrastructure readiness for this technology to be applied at educational institutions;

examine its feasibility and effectiveness through teacher's hands-on experiences as seen in Figure 1.

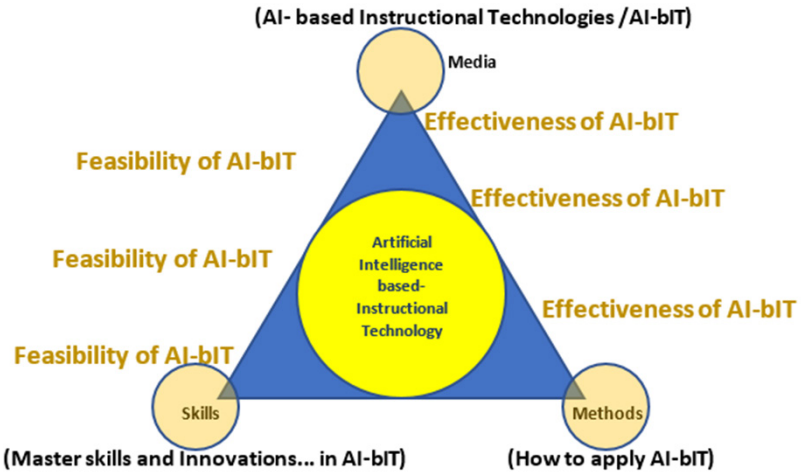

Fig. 1. Model of artificial intelligence based-instructional technology

In order to assess the current situation and recognize prospects of AI-bIT in Vietnamese secondary schools, our research team has taken the following steps:

- Finding and selecting common features of AI applications in teaching and learning around the world;
- Developing a set of criteria to evaluate the actual situation of implementing AI-bIT in Vietnam;
- Conducting surveys and collecting opinions from secondary school teachers in some provinces and cities in Vietnam on AI-bIT;
- Analyzing the survey results to have a comprehensive picture of the current implementation of AI-bIT in Vietnamese secondary education and propose solutions for its application in secondary schools and Vietnamese education.

2 Features of AI-based instructional technology

The first feature of AI-bIT is the ability to analyze learners' behaviors, thereby indicating their emotions and learning motivations. As argued by Jagadeesh Kengam (2020), AI allows teachers to understand the student's mood or comfort level during class through the use of Gesture Recognition Technology [10]. As AI's level of sophistication improves, the machine can interpret the student's facial expressions or gestures and help the teacher to recognize if the student is having trouble understanding the lecture. To facilitate easy follow-up for learners, the teacher could adjust the content or delivery of the lesson accordingly. Regarding the analysis of learner's behaviors and emotions, another study by Saravana Kumar (2019) mentions the application of AI in developing lecture robot system's features such as face, gaze, and gesture detection which helps to

direct learner's attention, boost concentration, and improve the understanding level [11]. With the support of sensors, eye trackers and face detection technology, classes conducted by lecture robots can regulate students' attention. Furthermore, according to Steven Duggan (2020), education systems using AI are unlocking opportunities for students with disabilities, altering their educational chances, and increasing their level of engagement [12]. One of the recent AI-driven improvements is the application that studies, analyzes, and describes the surrounding environment of vision-impaired students through mobile devices. These AIED-supported applications can identify the student's friends and acquaintances and even interpret their emotions through facial expressions and posture. In addition, through the implementation of AIED, studies on academic performance reveal numerous reasons why students from all educational levels are unable to graduate. Underperforming academically is one of the many causes. For some of these, academic underperformance is considered a consequence rather than a cause for students dropping out of school. If schools and institutions are able to identify and predict which students are on the verge of dropping out, they can take prompt preventive actions, enabling schools to allocate their limited resources more effectively and calculatedly. To achieve that, schools could leverage AI to ingest data from assorted databases–including information systems student (SIS), learning management systems (LMS's), and behavior or attendance reports–and gain insights updated in real-time. In this regard, AI facilitates timely prediction about improvements or difficulties that learners encounter while studying.

The second feature of an AI-based educational system is its ability to assist teachers in innovating, save their time and effort, and facilitate their working process. A study conducted by Jagadeesh Kengam (2020) suggests that AI, which is previously applied to grade multiple-choice questions, could be further developed to evaluate written forms of answers like paragraphs or statements. It makes a teacher's job less challenging and less time-consuming, allowing them to spend more time assessing students' individual academic performance and improvement [10]. Furthermore, AI-applied teaching software introduces instant essay assessment enabled by collecting essays into a central database. Newly-added essays are graded in comparison to the existing essays stored in the database. Another study by Sachin Bhbosale et al. declares that AI-powered educational technologies can effectively automate various tasks. Regular or even "mundane" tasks of teachers should be resolved with AI's support, allowing teachers to spend more time and effort creating and innovating [13]. Similarly, Meng Guo (2020) points out that in an AI-applied educational system, students' self-assessments on their own academic performances help reduce time pressure on teachers when it comes to correcting students' papers. With more time in hand, teachers can evaluate students' overall performances, timely adjust their pedagogical methods and teaching process to their abilities [14]. According to Steven Duggan, AI can save teachers a considerable amount of time allocated to data analysis and collation—an arduous chore as data is updated continuously and various success factors and data sources need to be taken into account [12]. Provided with a detailed picture of each student's improvement, education can quickly identify gaps, challenges and solutions, helping students achieve better results, as well as delighting and connecting every member in the classroom. AI can be employed to generate up-to-date reports for schools, parents, guardians, and students themselves, hence saving valuable time for educators at the 'other end' of

the process. All stakeholders can avail such reports when needed, instead of periodic reports summarizing the past performance during the school year. These reports are more accurate and up to date than traditional reports or assessments. Removing arduous administration work can make a positive impact on hiring and retaining educators. On average, teachers spent 3 to 5 hours per day completing tasks outside the classroom such as grading tests and papers, planning lesson contents, and doing administrative work. These time-consuming tasks are the primary reason for teacher attrition; therefore, AIED application contributes by removing disincentives and encouraging top talents to join educational career paths. Furthermore, Meng Guo (2020) reveals that advanced Artificial Intelligence facilitates accurate personalization in education to the highest degree [14]. Artificial Intelligence can deploy big data to track and record various learner data, then model, analyze and evaluate their performances. Learners can efficiently involve and provide data to assist teachers in improving pedagogical methods and strategies. Specially, in other research of Zhiwei Shi (2022), the application of artificial intelligence and big data into online education can support the learning path planning algorithm so reduce the time that teacher manage students in online courses [15].

The next educational advance empowered by AIED is the distinctive ability to create a smart learning environment and personalize learning pathways for individuals. According to Steven Duggan, thanks to efficient usage of AI, Data Analysis, and Machine Learning, educators can create an engaging and immersive learning experience, tailor learning pathways for each student by using augmented intelligence and insights gained from their use [12]. Moreover, by analyzing all available data and delivering detailed information, AI-powered education systems develop personalized learning pathways for learners. Research by Wayne Homes et al. (2019) suggests that AI, using pedagogical and domain knowledge and responding to individual students' misconceptions and successes, maps out an optimized step-by-step learning process through the available activities and learning materials [16]. As students continue learning, the difficulty level is adjusted accordingly and automatically. In addition, students also receive clues and instructions. All the mentioned functions are developed to help students learn the given topic more effectively. According to Steven Duggan et al, AI, Data and Analytics, and Machine Learning create opportunities for educators to access information and gain valuable insight into important aspects of students' progression as well as other factors which possibly indicate changes in their learning attitudes, levels of engagement and performances [12]. Moreover, Jianxin Liao (2021) showed that the learning model based on artificial intelligence project has more effects than the general learning model [17]. In addition to ingesting and interrogating tremendous amounts of data, AI is also able to make connections between diverse data sources, thereby, helping to identify which areas may require real-time interventions or additional assistance. In a broader sense, AI could devise a learning path that is tailored to each student and designed to fit their strengths, weaknesses, talents, and challenges. This possibility leads to an immense consequence. With truly personalized learning, students can reach their full potential in an optimal environment. This form of learning can impact their academic achievements, attitudes towards educational institutes, engagement levels, feeling of being cared for and valued as well as their happiness and well-being.

The fourth feature of AI-bIT refers to supporting learners with intelligent tutoring and teaching assisting methods. According to Ali Alkhatlan (2018), Intelligent Tutoring Systems (ITS) are computer programs using AI techniques to develop intelligent tutors who know how to teach, what they teach, and whom they teach by simulating human tutors [18]. Research by N. M. Saravana Kumar in 2019 regards AI as the backbone of intelligent tutor systems featuring Natural Language Processing (NLP) [11]. It promotes qualities, i.e. resolving conflict statements, self reflecting, raising creative questions, answering profound questions and making choices. Wayne Homes et al. in 2019 were in complete agreement that the applications of AI in Intelligent Tutoring Systems (ITS) were among the most common systems in education [16]. ITS offered step-by-step tutorials that were individualized for each student through topics in well-defined structured subjects. Regarding the view of Jagadeesh Kengam, instead of providing students with printed study materials or websites with complicated information for what could be related, educational institutions gradually abandon traditional learning methods and employ voice assistants. A voice assistant could be used at home for any specific academic purposes. He stated that this was a groundbreaking application of AI [10]. Some examples of voice assistants are Google Assistant, Cortana from Microsoft, Siri from Apple and Alexa from Amazon. These voice assistants help students to directly interact with educational materials that are available on the internet and in the supported devices without teacher involvement.

The last common feature of AIED in this research paper is the ability to detect irregularities in the learning environment to adjust learning strategies and help learners adapt. According to N. M. Saravana Kumar (2019), AI could recognize an instance of categories, concepts or patterns. Inference, planning, and execution are some of its remarkable abilities. Moreover, it is capable of observing how ideas are implemented, identifying environmental irregularities then modifying their plans [11]. A research conducted by Nwana classifies six functions of student models used in ITS. The first function is Corrective, which refers to AI's ability to eliminate bugs in the student's knowledge. The second function when applying student models to ITSs is Elaborative that helps fulfill the student's incomplete knowledge. Thirdly, AI assists in adjusting the instructional strategy based on the actions and performances of students, which is called Strategic. The fourth function is Diagnostic that diagnoses bugs in the student's knowledge. Predictive is another key function, which defines how students are likely to respond to a system of actions. The last function is Evaluative that undertakes a general assessment of students. Student models played a role as a source of information about the student. This source inferred aspects of the student's behavior that could not be observed from the model. A so-called inference would reconstruct misconceptions in the student's knowledge by putting an interpretation on his/her actions. It is indicated in ITS that incomplete knowledge is not the root cause of incorrect behavior. Knowledge could advance presenting a challenge to the tutoring system [19]. As a consequence, the supposedly incorrect presentation method of students' knowledge is highly recommended to be added into student models for necessary amendments. Being executive or runnable is regarded as a significant function of student models, which makes accurate predictions on a specific student in a given context. As a result, this function allows ITS to provide instructional interactions with students as an integral part of its architecture. These interactions possibly involve correcting misconceptions, giving

individualized feedback, and suggesting a particular knowledge unit to explore. The representation of domain knowledge could form the student model. The knowledge would be divided into units and, hence the mastery level of each unit would be assessed by the student model. The system is able to compare the state of students' knowledge to experts'. Accordingly, adjustable instructions would be proposed to improve students' inadequate skills. So, the impact of using ITS creates instructional interactions between students and teachers as a new social space like other uses of ICTs to construct and support students' perceptions in the educational technologies-based learning environment [20].

In short, there are five common features of AI-bIT implemented by AIED-related research and development experts all around the world, including AI's abilities to (1) analyze learners' behaviors, thereby, reflecting their feelings and learning motivation; (2) to support teachers to be creative, save time and effort, and improve work performance; (3) to create a smart learning environment and personalized learning for students; (4) to support students with intelligent tutoring methods and teaching assistants; (5) to detect irregularities in the learning environment to adjust learning plans and help learners adapt.

To evaluate the ability to apply AI-bIT to teaching in secondary schools in Vietnam, the authors developed a set of criteria to assess the middle school teachers' perception of the necessity of these common features. A survey on the implementations of AI-bIT models at their current schools was conducted afterward. As a result, those teachers have a chance to evaluate the feasibility and effectiveness of these applications. Based on these ideas, in the next section, we would like to introduce in detail the research methods and evaluation results.

3 Research methodology

- The purpose of research: Based on the overview research on AIED, the authors have selected five most common features of AI-based Instructional Technology (AI-bIT) and determined that the goal of the research was to evaluate the possibility of putting AI-bIT with 5 common features into the practice the teaching process of middle school in Vietnam.
- Research tool:
  In order to evaluate the five above-mentioned features of AI-based instructional technology, the authors have established a set of criteria using a 5-level Likert scale to investigate 4 evaluation categories when applying AI-bIT in secondary education in Vietnam, including Level of Necessity, Level of Implementation, Feasibility, and Effectiveness. A detailed coding of those criteria that have been used as the research tool of the paper will be presented in Table 1.
- Survey method:
  Based on overview research and theoretical basis, the research team has proposed a set of criteria for evaluating AI-based instructional technology. The questionnaire using these criteria is created using Microsoft Form and emailed to teachers from many secondary schools in Vietnam in order to collect their opinions. The collected data will be visualized and analyzed on statistical software to review those teachers'

opinions from different cognitive levels, their opinions on the deployment progress of teaching aids based AI technology, and their assessment of the feasibility and effectiveness of AI-bIT.

Table 1. Criteria for evaluation the features of AI-based instructional technology

	Sense of Assessment	Necessity	Implementation	Feasibility	Effectiveness
Feature 1.	AI's abilities to analyze learners' behaviors, thereby, reflecting their feelings and learning motivation	I1.1	I2.1	I3.1	I4.1
Feature 2.	AI's abilities to support teachers to be creative, save time and effort, and improve work performance	I1.2	I2.2	I3.2	I4.2
Feature 3.	AI's abilities to create a smart learning environment and personalized learning for students	I1.3	I2.3	I3.3	I4.3
Feature 4.	AI's abilities to support students with intelligent tutoring methods and teaching assistants	I1.4	I2.4	I3.4	I4.4
Feature 5.	AI's abilities to detect irregularities in the learning environment to adjust learning plans and help learners adapt	I1.5	I2.5	I3.5	I4.5

– The population of the survey: The research team has surveyed middle school teachers and administrators. According to statistics from the official website of the Ministry of Education and Training of Vietnam, there were 347,816 secondary school teachers and administrators across the country in the school year of 2019–2020, of which 119 participated in the survey. According to the sample calculator, the survey had a deviation of +/–10%, thereby achieving a 90% accuracy with a 95% confidence level at the maximum value of $p = 0.5$ on all survey participants [21].

Some characteristics of the survey population:

In Figure 2.a, 91 out of 119 teachers and administrators participating in the survey are female, accounting for 76.5%, while the remaining is male, accounting for 23.5%. It can be seen that the number of female teachers is more than three times higher than that of male teachers. Figure 2.b depicts the age of the survey subjects. A majority of teachers and administrators are aged between 35–45 accounting for 58% (69 out of 119) and including those who are highly experienced and proficient with great creativity. 31 out of 119 participants comprising the second highest level of 26% are under 35; all of whom are capable of learning professional skills, improving them and quickly adapting to changes and technological innovation. The group from 45 to 55 years of age, having rich experiences, contributions, and dedication to share, accounts for 13.5% with 16 participants. The last group accounting for a small percentage of 2.5 consists of 3 over-55-year-old senior educational staff who are well-experienced, and yet they may encounter some obstacles in approaching advanced educational technology. It can be

seen that there is a wide age range among survey participants, some of which can easily adapt to AIED, while some have the advantage over teaching experience and practice.

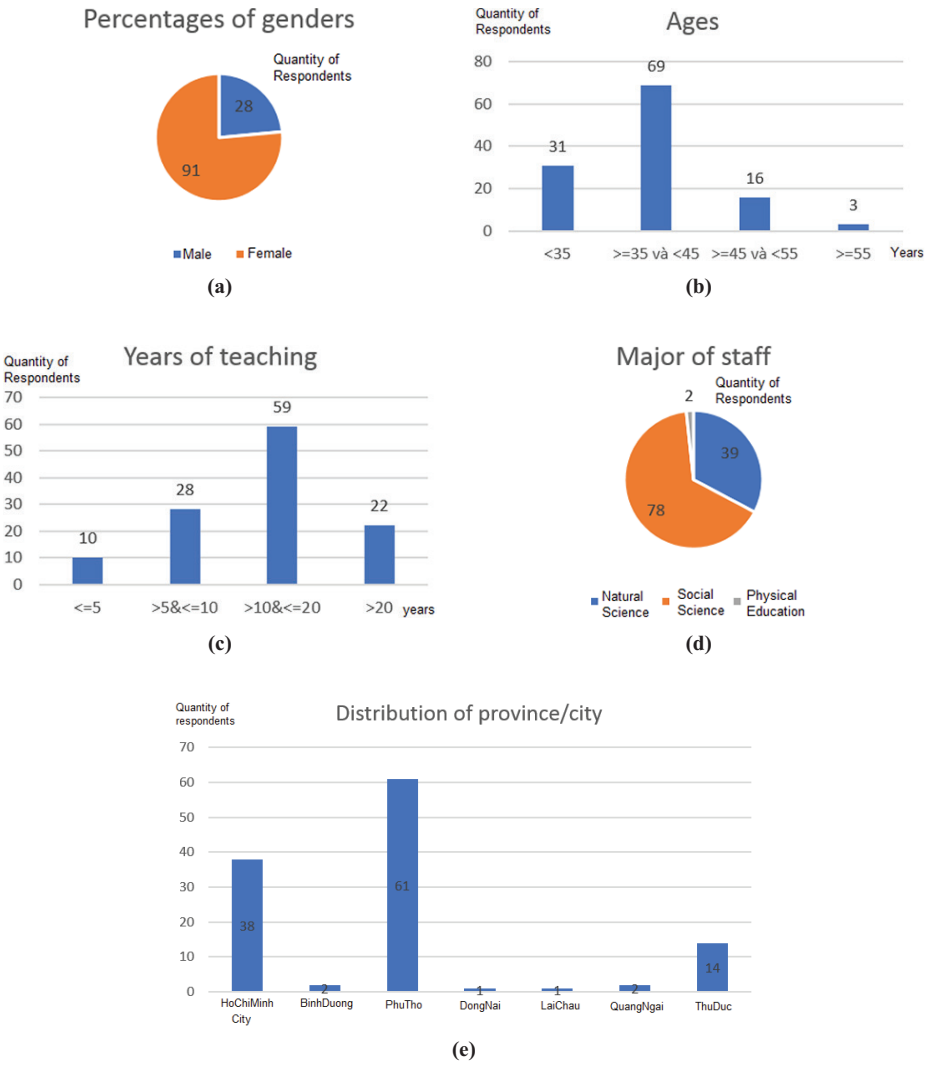

Fig. 2. Characteristics of the survey population

Furthermore, corresponding to age, Figure 2.c represents that there were 59 teachers and administrators with 10–20 years' experience comprising the highest level of 49.5%. Secondly, the cadre of officers with 5–10 years' experience includes 28 participants accounting for 23.5%, followed by 22 in the over 20 years group (18.5%) and 10 in the less than 5 years group (8.5%) respectively. The survey subjects consist of mostly senior teachers and administrators; therefore, the findings are expected to have practical application associated with the working process of teachers. However,

as shown in Figure 2.d, a majority of participating teachers are related to Social Sciences subjects making up 65.5% (78). Meanwhile, the number of Natural Sciences teachers participating in the survey accounting for 32.7% is half as many as that of the Social Sciences group. The rest are 2 physical education teachers. It can be seen that the majority group has little hands-on experience with advanced educational technologies such as AI due to their limited exposure to natural sciences. Nevertheless, if they are open-minded towards the effectiveness of AI, this is considered as an opportunity to apply technology innovation to teaching, to enrich and diversify lesson contents, to facilitate teacher-student interactions, and to help learners experience efficient learning supporting systems, especially with social subjects.

Figure 2.e illustrates the number of participating teachers from different provinces and cities. If these provinces and cities are divided into two groups, one of which is the group of strong economically developing regions accounting for 45.4% with a total of 54 teachers including Ho 38 from Chi Minh City, 2 from Binh Duong province, and 14 from Thu Duc City. The other group consists of 65 teachers covering a large proportion of 54.6% that comes from fair economically developing regions. Hence, the ratio of teachers representing these two economic regions makes a little difference. They will be representative to assess the cognitive level, implementation level, feasibility, and effectiveness of AI-based instructional technology according to the conditions of socio-economic development of each region.

From a brief description of the characteristics of participating teachers, three following statements are made by the authors:

Statement 1: Male teachers show less limited perception than their female colleagues concerning the necessity of AI applications.

Statement 2: The AI-based instructional technology is deployed more effectively at schools in provinces and cities with stronger socio-economic development.

Statement 3: Natural Sciences teachers show less limited perception than those from the Social Sciences group regarding the effectiveness of AI-based instructional technology.

4 Research results

4.1 The cognitive evaluation of secondary school teachers on the necessity of AI applications in secondary education in Vietnam

Based on a five-level Likert scale which is Not necessary (1) – Less necessary (2) – Necessary (3) – Quite necessary (4) – Absolutely necessary (5) to investigate the necessity of 5 popular features of AI applications in teaching, the mean of statistical results analyzing responses from 119 secondary school teachers participating in the survey are described in the following Table 2.

Table 2. Descritive statistics of mean of the cognitive evaluation

Items	N	Mean	Std. Deviation	Ranking
I1.1	119	3.4202	.93424	3
I1.2	119	3.4538	.89013	1
I1.3	119	3.4118	.91514	4
I1.4	119	3.3866	.91234	5
I1.5	119	3.4286	.88845	2
Valid N (listwise)	119			

According to the statistical report on the mean found when assessing the necessity level of five common features, the participating teachers reveal that the necessity of "AI's ability to support teachers' creativity, save time and effort, and improve their performance" comprises the highest level with the mean of 3.4538 (I1.2); followed by "its application in order to detect irregularities in the learning environment to adjust learning strategies and help learners adapt" with the mean of 3.4286 (I1.5). The third place refers to the function that "AI can analyze learners' behaviors, thereby reflecting learners' emotions and learning motivation" with the mean of 3.4202 (I1.1). "AI's ability to provide a smart learning environment and personalized learning" lies in fourth place. The mean of "AI's ability to support learners with intelligent tutoring and teaching assistants" is 3.3866 < 3.4 (I1.4). The mean indicates that participating teachers have not recognized the need for this feature in teaching and showed a lack of awareness of using AI chatbots as virtual teaching assistants or tutors. As a result, secondary school teachers in Vietnam have little chance to approach smart tutoring applications or AI-based teaching assistants.

4.2 The evaluation for implementation AI's application; the feasibility and effectiveness of AI-based instructional technology in Vietnamese secondary education

By using a five-level Likert Scale (1-Not yet implemented, 2-Rarely, 3-Sometimes, 4-Often, 5-Always) to assess the mean of AI-bIT implementation in secondary schools where participating teachers work, the statistical results are presented in the Table 3.

Table 3. Descritive statistics of mean of the implementation AI's application

Items	N	Mean	Std. Deviation	Ranking
I2.1	119	2.1008	1.27821	5
I2.2	119	2.5210	1.38911	1
I2.3	119	2.4370	1.41804	4
I2.4	119	2.4454	1.43029	3
I2.5	119	2.4538	1.38238	2
Valid N (listwise)	119			

The results of how participating teachers rate the implementation of AI in secondary schools are arranged in the following rank order: firstly, AI's ability to support teachers to be creative, save time and effort, and help them work more easily (I2.2); next, to detect irregularities in the learning environment to adjust learning plans and help learners adapt (I2.5); thirdly, to support learners with intelligent tutoring methods, intelligent teaching assistants (I2.4); fourthly, to create a smart learning environment and personalized learning for learners (I2.3); and, finally, to analyze learners' behaviors, thereby, reflecting their feelings and learning motivation (I2.1). However, it can be demonstrated in the results that these five features mentioned in the survey have not yet been implemented in Vietnam even at basic level since the mean of assessments only reaches 2.521 to the max which is very small compared to 3.4 (the mean indicating a basic implementation level).

Table 4. Descritive statistics of mean of the feasibility of AI-bIT

Items	N	Mean	Std. Deviation	Ranking
I3.1	119	3.2269	.92459	2
I3.2	119	3.3277	.88403	1
I3.3	119	3.3277	.92158	1
I3.4	119	3.3277	.93073	1
I3.5	119	3.2269	.96055	2
Valid N (listwise)	119			

To evaluate the feasibility of applying AI-bIT to secondary education in Vietnam, the research team used a Likert scale questionnaire with 5 levels (1-Not feasible, 2-Less feasible, 3-Feasible, 4-Very feasible, 5-Absolutely feasible) and obtained the survey results as in Table 4.

The middle school teachers participating in the survey demonstrate enough confidence in the feasibility of the five above-mentioned features of AI in education, because the mean of the assessed values is less than 3.4 (acceptance threshold). However, compared to the results of the implementation evaluation, the feasibility is expected to be more promising since the values are approximately 3.4. In these assessments, the group of participating teachers perceives a greater degree of trust in AI applications supporting teachers to be creative, saving time and effort, and improving work performance (I3.2); providing a smart learning environment for students, personalizing learning (I3.3); supporting learners with intelligent tutoring systems and teaching assistants (I3.4). In contrast, they have a lower degree of trust in the feasibility of the remaining two applications of AI which are to analyze learners' behavior, reflect their emotions and learning motivations (I3.1), to detect irregularities in the learning environment to adjust learning strategies and help students to adapt (I3.5).

Evaluating the effectiveness of applying AI-bIT to secondary education in Vietnam by a Likert scale questionnaire with 5 levels (1-Not effective, 2-Less effective, 3-Effective, 4-Very effective, 5-Absolutely effective) and obtaining the survey results as Table 5. The mean of the effectiveness evaluations of AI in supporting learners with the intelligent tutoring method and teaching assistant is most appreciated (I4.4); followed by applications that provide a smart learning environment and personalized learning for

students in the second place (I4.3); thirdly, supporting teachers to be creative, saving time and effort, and improving work performance (I4.2). AI's ability to detect irregularities in the learning environment in order to adjust learning strategies and help students adapt lies in fourth place (I4.5). The last position belongs to applications that analyze learners' behaviors for reflecting their emotions and learning motivations afterwards (I4.1). Similar to the general assessment of the feasibility of AI's five applications in education, participating teachers also are uncertain about their effectiveness since the mean of the assessed values is less than 3.4 (acceptance threshold). The values of the effectiveness and feasibility assessment are also approximately 3.4.

Table 5. Descritive statistics of mean of the effectiveness of AI-bIT

Items	N	Mean	Std. Deviation	Ranking
I4.1	119	3.1429	.83652	5
I4.2	119	3.2941	.83720	3
I4.3	119	3.3025	.87870	2
I4.4	119	3.3193	.90134	1
I4.5	119	3.2017	.88853	4
Valid N (listwise)	119			

4.3 The differences by gender regarding the necessity of artificial intelligence-based instructional technology

The research team used the Independent-Samples t-test to compare the mean of the necessity assessment for AI application in secondary school education between male and female teachers who participated in the survey. Statistical results are described in the Table 6 below.

Table 6. Group statistics of mean for neccessity of AI's application in teaching

Items	Gender	N	Mean	Std. Deviation	Std. Error Mean
I1.1	Male	28	3.8214	.90487	.17100
	Female	91	3.2967	.91280	.09569
I1.2	Male	28	3.6786	.94491	.17857
	Female	91	3.3846	.86627	.09081
I1.3	Male	28	3.7143	.97590	.18443
	Female	91	3.3187	.88039	.09229
I1.4	Male	28	3.6429	.91142	.17224
	Female	91	3.3077	.90299	.09466
I1.5	Male	28	3.7143	1.01314	.19147
	Female	91	3.3407	.83293	.08731

(Continued)

Table 6. Group statistics of mean for neccessity of AI's application in teaching *(Continued)*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
I1.1	Equal variances assumed	1.182	.279	2.665	117	.009	.52473	.19687	.13483	.91462
	Equal variances not assumed			2.678	45.225	.010	.52473	.19596	.13011	.91934
I1.2	Equal variances assumed	2.098	.150	1.537	117	.127	.29396	.19127	–.08484	.67275
	Equal variances not assumed			1.467	41.929	.150	.29396	.20034	–.11036	.69827
I1.3	Equal variances assumed	3.688	.057	2.026	117	.045	.39560	.19522	.00899	.78222
	Equal variances not assumed			1.918	41.436	.062	.39560	.20623	–.02075	.81196
I1.4	Equal variances assumed	1.198	.276	1.714	117	.089	.33516	.19557	–.05214	.72247
	Equal variances not assumed			1.705	44.553	.095	.33516	.19654	–.06080	.73112
I1.5	Equal variances assumed	5.585	.020	1.970	117	.051	.37363	.18970	–.00207	.74932
	Equal variances not assumed			1.775	38.893	.084	.37363	.21044	–.05206	.79931

As illustrated in the table, the Sig. value in the I1.5 criterion of the Levene's test (F test) = 0.020 < 0.05, the variances are not equal across the two groups, we rely on the t test results in the Equal variances not assumed line = 0.084. Thus, regarding the necessity of AI's ability to detect irregularities in the learning environment to adjust learning strategies and help students adapt, male and female teachers hold different opinions. Specifically, the importance of AI is more appreciated by male teachers than their female colleagues do. There is no difference between the two groups of male and female teachers in terms of the level of the necessity of other applications.

In short, the 1st statement is only true for the following case: Male teachers show less limited perception than their female colleagues concerning the necessity of AI applications detecting irregularities in the learning environment to adjust learning strategies and help students to adapt.

4.4 The differences between two groups of teachers from provinces and cities with different levels of socio-economic development regarding the extent to which AI-bIT has been deployed in secondary school

It can be seen that provinces and cities where participants live and work could be divided into two basic groups: a group of strong economically developing provinces and cities such as Ho Chi Minh City, Thu Duc, and Binh Duong with a total of 54 participating middle school teachers and a group of medium economically developing ones namely Lai Chau, Phu Tho, Quang Ngai, Dong Nai with 65 teachers. Using the Independent-samples T-Test, the survey on the level of implementation of AI-bIT in Vietnamese secondary schools shows the results in Table 7.

As indicated in the table, the Sig. value in the I2.1 criterion of the Levene's test (F test) = 0.001 < 0.05, the variances are not equal across the two groups, we rely on the t test results in the Equal variances not assumed line = 0.022. The Sig. value in the I2.3 criterion of the Levene's test (F test) = 0.023 < 0.05, the variances are not equal across the two groups, we rely on the t test results in the Equal variances not assumed line = 0.835. The Sig. value in the I2.5 criterion of the Levene's test (F test) = 0.032 < 0.05, the variances are not equal across the two groups, we rely on the t test results in the Equal variances not assumed line = 0.460.

Table 7. Group statistics of mean for implementation AI-bIT

Items	Economically Developing	N	Mean	Std. Deviation	Std. Error Mean
I2.1	strong	54	1.8148	1.08287	.14736
	medium	65	2.3385	1.38380	.17164
I2.2	strong	54	2.4259	1.34026	.18239
	medium	65	2.6000	1.43396	.17786
I2.3	strong	54	2.4074	1.31060	.17835
	medium	65	2.4615	1.51118	.18744
I2.4	strong	54	2.3333	1.34585	.18315
	medium	65	2.5385	1.50080	.18615
I2.5	strong	54	2.3519	1.27616	.17366
	medium	65	2.5385	1.46924	.18224

(Continued)

Table 7. Group statistics of mean for implementation AI-bIT *(Continued)*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
I2.1	Equal variances assumed	11.425	.001	–2.263	117	.025	–.52365	.23135	–.98182	–.06548
	Equal variances not assumed			–2.315	116.613	.022	–.52365	.22622	–.97168	–.07562
I2.2	Equal variances assumed	.338	.562	–.679	117	.498	–.17407	.25636	–.68178	.33364
	Equal variances not assumed			–.683	115.348	.496	–.17407	.25475	–.67868	.33053
I2.3	Equal variances assumed	5.297	.023	–.206	117	.837	–.05413	.26217	–.57334	.46507
	Equal variances not assumed			–.209	116.768	.835	–.05413	.25873	–.56655	.45828
I2.4	Equal variances assumed	2.468	.119	–.778	117	.438	–.20513	.26380	–.72757	.31731
	Equal variances not assumed			–.786	116.291	.434	–.20513	.26114	–.72234	.31208
I2.5	Equal variances assumed	4.734	.032	–.732	117	.466	–.18661	.25504	–.69170	.31848
	Equal variances not assumed			–.741	116.752	.460	–.18661	.25173	–.68516	.31194

Thus, there is a difference between groups of strong and medium socio-economic development provinces and cities in the level of AI deployment to analyze learners' behavior, thereby reflecting their emotions and learning motivations; providing smart learning environment for students, personalizing learning; and detecting irregularities in the learning environment to adjust learning strategies and help students to adapt. Particularly, teachers from medium economically developing provinces and cities have assessed the level of AI implementation better than those in strong economically developing places. The level of development of other applications supporting teachers to be

creative, saving time and effort, improving work performance, and supporting learners with intelligent tutoring methods and smart teaching assistants discerns no difference between these two groups of regions.

In consequence, the 2nd statement is unreliable because it could be demonstrated in the result that teachers assess those provinces and cities with great economic growth have not implemented AIED as strongly as medium economically developing regions.

4.5 The differences by specialization in the effectiveness of AI-based instructional technology

The research team continues applying the Independent-Samples T Test to assess the differences by specialization in the effectiveness of AI-based Instructional Technology. The survey results on 119 middle school teachers in Vietnam are listed Table 8 below.

As reflected in the Table 8, the Sig. value in the I4.5 criterion of the Levene's test (F test) = 0.036 < 0.05, the variances are not equal across the two groups, we rely on the t test results in the Equal variances not assumed line = 0.388. Accordingly, regarding the effectiveness of AI in detecting irregularities in the learning environment to adjust learning strategies and help students to adapt, the two groups of Natural Sciences and the Social Sciences express different thoughts. In particular, Social Sciences teachers find it more effective than Natural Sciences teachers do. With respect to the effectiveness of other applications, no difference between both groups was present.

Correspondingly, in the 3rd statement, the discrepancy by specialization in the effectiveness of AI in secondary school teaching in Vietnam only exists in AI's ability to detect irregularities in the learning environment to adjust learning strategies and help students to adapt. Thus, AIED for secondary school teachers in Vietnam will not have much distinction in accordance with different specializations.

Table 8. Group statistics of mean for effectiveness of AI-bIT

Items	Specialization	N	Mean	Std. Deviation	Std. Error Mean
I4.1	Social Sciences	63	3.1270	.94172	.11865
	Natural Sciences	45	3.1556	.67270	.10028
I4.2	Social Sciences	63	3.2698	.90173	.11361
	Natural Sciences	45	3.3111	.70137	.10455
I4.3	Social Sciences	63	3.3016	.92693	.11678
	Natural Sciences	45	3.2889	.78689	.11730
I4.4	Social Sciences	63	3.3016	.97773	.12318
	Natural Sciences	45	3.3556	.80214	.11958
I4.5	Social Sciences	63	3.2540	.96667	.12179
	Natural Sciences	45	3.1111	.74536	.11111

(Continued)

Table 8. Group statistics of mean for effectiveness of AI-bIT *(Continued)*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
I4.1	Equal variances assumed	1.512	.221	–.174	106	.862	–.02857	.16406	–.35384	.29670
	Equal variances not assumed			–.184	105.999	.854	–.02857	.15535	–.33656	.27942
I4.2	Equal variances assumed	1.096	.298	–.256	106	.798	–.04127	.16092	–.36032	.27778
	Equal variances not assumed			–.267	105.181	.790	–.04127	.15440	–.34740	.26486
I4.3	Equal variances assumed	.946	.333	.075	106	.941	.01270	.17011	–.32455	.34995
	Equal variances not assumed			.077	102.786	.939	.01270	.16552	–.31558	.34098
I4.4	Equal variances assumed	.794	.375	–.304	106	.762	–.05397	.17741	–.40571	.29777
	Equal variances not assumed			–.314	103.900	.754	–.05397	.17168	–.39441	.28648
I4.5	Equal variances assumed	4.490	.036	.830	106	.408	.14286	.17207	–.19828	.48400
	Equal variances not assumed			.867	105.335	.388	.14286	.16486	–.18401	.46973

5 Discussion and conclusion

Statistical results revealed that middle school teachers have the consciousness of the necessity of five prominent features of AI in middle school education at a decent level with the mean of the necessity of five features as follow: Mean (I1.1) = 3.4202; Mean (I1.2) = 3.4538; Mean (I1.3) = 3.4118; Mean (I1.4) = 3.3866 and Mean (I1.5) = 3.4286. Nevertheless, the assessment of AI implementation in current teaching practice in secondary schools is considerably low, the mean of the assessment of the level of

implementation is only from 2.1008 to 2.521; the mean of the feasibility and effectiveness of AIED evaluated unexceptionally, the mean of the feasibility is from 3.2269 to 3.3277 and the mean of the effectiveness is from 3.1429 to 3.3193. It is conspicuous that secondary school teachers in Vietnam have shortly updated information through the mass media and on the Internet about breakthrough technologies for teaching and readily adopt advanced teaching applications. This is an advantage of Vietnamese education in the innovation in teaching and learning methods. Nonetheless, according to the survey, the current implementation of AI-bIT in secondary education in some provinces and cities across Vietnam is considered as inadequate, which attests to the limited usage of AI in secondary schools so that teachers could employ, experience and enrich teaching and learning with its merits. This consequence might be due to the school's management department that has not approached and adapted to new applications of AI in education, they continue guiding the application of teaching methods namely presentations, B-learning, etc., in teacher training institutions. In addition, accessing and applying AI technology in teaching requires a considerable amount of time, effort and financial support which is also a major challenge for secondary schools in Vietnam, especially the public schools to invest in these groundbreaking teaching technologies. Furthermore, the inexperience in the application of advanced teaching technologies, including AIED when training teachers, could prevent young teachers from accessing AIED. Most of the teacher training programs face insufficient practice of modern technology such as AI, Game-based Learning, VR/AR, etc.; therefore, pedagogical college students have not been instructed about these applications. Junior teachers who have just graduated are unable to access and master AI's applications in teaching and learning [as also stated in 22].

In the research results, when conducting an assessment of the necessity of AI's ability to detect irregularities in the learning environment to adjust learning strategies and help students to adapt, the two groups of male and female teachers share different perspectives. Since male teachers have many opportunities to access modern teaching technologies, they regard the usage of AI to support learners to adapt as important, but female teachers are not entirely convinced. This might be the consequence of using AI to analyze learners and the learning environment to detect irregularities and make adaptive adjustments is a complex and sophisticated task and requires teachers to have superior technical skills. This is a difficulty for secondary school teaching that is same as other online learning challenges because of the rapid development of modern information technologies [23]. However, it is surprising to the authors that when conducting the assessment in groups of different socio-economic development provinces/cities, the outcome revealed the implementation of AI in education in advanced economically developing provinces and cities are not as well as medium economically developing areas. This could be attributable to the fact that in the under-performing economically regions such as Phu Tho, Quang Ngai, Dong Nai, Lai Chau, the participating teachers have not yet approached many advanced teaching technologies, hence they highly evaluate the deployment of AI in teaching, while teachers in the strong economic development province and city have more opportunities to access current technology, they have been employing other technologies namely B-learning, educational games, VR/AR, etc., thus they consider AI technology is infrequently accessed in teaching. This finding also appears in the research on effects of online role-play teaching practice on learners'

availability for resources can that helps to provide teachers with more scientific and effective guidance and improve students' autonomous learning effect and learning resources [24]. In this study, the authors also compared the perception on the effectiveness of AIED from teachers of two different professional areas, Social Sciences and Natural Sciences. It is illustrated that there is the slight difference in the effectiveness of AIED in teaching in line with different specialties which is also a surprise, especially, teachers in the field of social sciences are inclined to appreciate the effectiveness of AI in teaching, especially the application detecting irregularities in the learning environment to adjust learning strategies and help students to adapt. The result indicates that the application of artificial intelligence in teaching is not a cognitive obstacle for teachers in different specialties, but a tremendous opportunity to conduct training, foster awareness and professionalism in applying AI in teaching for middle school teachers. These findings also indicate that AI can be used to provide this support the effectiveness in teachers' work practice as same as the results in Chounta report [25].

Accordingly, with the strengths of AI-bIT in improving the quality and effectiveness of teaching as analyzed in the characteristics of AIED in the world, it is necessary to take measures in order to implement AI-bIT into secondary school teaching in Vietnam promptly. The first solution is to provide practical applications and products of AI in no time so that teachers could readily apply them in education. In the author's research, we aim to build an AI Chatbot that can be used as a "Virtual Teacher", an "Intelligent Tutor" or a "Teaching Assistant" to support students to learn Chemistry. This AI Chatbot can be designed with a scenario of conversation sequences in the form of text, audio or images, supporting teachers to respond promptly to many students at the same time for daily tasks such as lesson plan, chemical formula, and chemical reaction equation. AI Chatbot will allocate lessons into different scenarios, class schedules, exam schedules, etc. for learners. Besides, AI Chatbot could help teachers track students' learning and self-study progress. Chatbot, especially, could provide comments and feedback for each student, thereby helping teachers to evaluate each student in the direction of personalized learning. The second measure we propose is to include the content of AI-bIT manuals in student training programs at pedagogical universities so that students can master the applications of AI technology in teaching. Thirdly, short training programs and seminars are highly recommended to instruct teachers to utilize AI technology in teaching. The fourth proposal of the research team refers to new framework and regulations for schools to deploy AI in teaching. The research team also suggests that the Ministry of Education and Training of Vietnam support in terms of time and finance for educational institutions and schools to research the applications of AI in education. Finally, all participants in the Vietnamese education system ought to change their perspective about the implementation of new educational technologies in place of current teaching means and methods.

In conclusion, the findings published in this research paper will suggest the trends of applying AI in teaching as an advanced educational technology contributing to Vietnamese education. Concurrently, the educational administrators could consider that the prospect and the necessity of developing AI-based instructional technology are inevitable and require a systematic investment plan. Optimistically, with these findings on the current status and prospects of AI-bIT in Vietnam, the applications of AI in teaching in Vietnam will be deployed and developed professionally and methodically

in the coming years. This contributes to improving the quality and effectiveness of teaching, affirming the efficiency of the teaching innovation process in the direction of utilizing cutting-edge educational technologies.

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