Artificial Intelligence and the Advancement of Thai Education in Crisis: Achieving SDG 4 Through Flexible online Learning Modalities

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Abstract

Due to natural and environmental disaster situations make Thai higher education institutions implement preventive measures by online teaching and learning. And now field of AI in Education is growing and changing rapidly and reshaping instructional practices. Therefore, this research article aims to study in 2 topics: 1) to study the application of AI in education management and 2) to propose guidelines for developing a flexible AI-enhanced online education systems to accommodate natural and environmental disaster situations. Using qualitative methods, documentary research which select 27 empirical studies for analysis and in-depth semi-structured interviews. There are seven key informants which was selected by purposive sampling including administrator, artificial intelligence technology expert, instructor and students. Data was analyzed by using content analysis. This study shows that AI in education from this research can be categorized in 4 types as follows: creating learning content, serving as teacher assistants, providing personalized learning (tutoring) and supporting assessment in online learning. The result for guideline are divided into four categories: i) policy preparation ii) personnel preparation iii) data preparation and iv) technology preparation. In summary, the study highlights the importance of AI as a catalyst for resilience and flexibility in higher education during crises. By integrating AI, Thai higher education can ensure learning continuity, enhance instructional effectiveness, and support the achievement of SDG 4 by promoting inclusive and equitable quality education with lifelong learning opportunities for all. Recommendations for Policy Formulation 1)Establish a national AI-education framework with mandatory AI literacy and data ethics. 2)Ensure privacy protection under PDPA and prioritize rural infrastructure development. 3)Require AI-supported online learning systems as disaster-response backups. 4)Create inter-institutional agreements and standardized emergency protocols.

Keywords: artificial intelligence, AI in education, online teaching, online learning

Introduction

Sustainable development in education represents one of the United Nations' key objectives under the Sustainable Development Goals (SDGs), specifically SDG-4, which focuses on "ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all" (UNESCO, 2016). However, achieving this goal continues to face numerous obstacles, particularly during natural and environmental disaster situations. Between July 2024 and April 2025, Thailand experienced a series of disasters that severely impacted the safety of citizens and

students alike. These included PM2.5 particulate matter exceeding standard levels for several consecutive days in Bangkok during August 2024 (Pollution Control Department, 2024), heavy rainfall causing significant flooding in key areas of Bangkok in October 2024, and a 7.2 Richter scale earthquake centered in Myanmar with tremors felt throughout Thailand in March 2025 (Thai Meteorological Department, 2025). The Ministry of Higher Education, Science, Research and Innovation directed Thai higher education institutions to implement preventive measures and establish operational guidelines during these situations to ensure educational continuity and minimize impacts on student learning (Ministry of Higher Education, Science, Research and Innovation, 2024). Online teaching and learning thus became the most appropriate educational channel, leading all educational institutions to suspend in person instruction and transition to online teaching modalities.

In this context, online teaching and learning has become a necessary alternative with an increasingly prominent role, particularly in situations where face-to-face learning cannot be arranged. It also creates safety for learners, instructors, and staff. Furthermore, it ensures "Uninterrupted Learning" while the education system must maintain flexibility and accommodate sudden changes (Means et al., 2009). This is confirmed by Naz & Murad (2019), who state that learning is abstract and currently there are new educational methods developing over time that impact teaching approaches. Students continue to acquire knowledge without traveling, reducing health risks, while maintaining access to learning resources anywhere and anytime. As for instructors, they have developed new technologies and diverse teaching methods which is implemented, enable students to learn effectively while making the experience enjoyable and engaging. Instructors therefore play a crucial role in determining learning outcomes for students (Taylor, 2017). Questions arise regarding whether and how instructors have developed their teaching methods, whether and how the teaching process has changed, and whether new technologies have been implemented. The answers to all these questions lie with the instructors themselves. Klongklaew et al. (2023) studied and researched online teaching and learning in Thailand, finding important noteworthy issues: both learners and instructors must prepare in advance before class time; instructors must prepare teaching materials suitable for online communication; measurement and evaluation methods must adopt new formats; and learning outcomes for students were at moderate levels. Meanwhile, in the Philippines, Toquero, C. M. (2020) and Alibak and Talebi (2019) stated that online teaching and learning has fundamentally transformed the education system, as multiple factors now involved differ from classroom learning in every dimension, particularly regarding learning atmosphere and two-way interactive relationships. This aligns with the research conclusions of Yuktananda, T. (202) who stated that in online teaching and learning, instructors must effectively convey knowledge to learners, employ appropriate teaching methods and gestures to create interest, and ensure lessons offer novelty and modernity to attract learners' interest and make online learning enjoyable.

Artificial Intelligence (AI) technology has emerged as a crucial tool and technology supporting teaching and learning while addressing widespread changes, particularly Generative AI such as ChatGPT, Gemini, Claude, and Perplexity. These systems are specifically designed with the capability to create new content from existing databases through data processing. Currently, AI technology is being applied across multiple domains including medicine, economics, transportation, and education. AI technology can analyze learners' learning needs, create adaptive learning systems to enhance learners' experiences, and provide personalized recommendations to

learners. Furthermore, it can guide instructors in adjusting teaching strategies, helping teachers understand learners' learning processes and suggesting approaches to support students (Pakdee, S. & Phetmalhkul, T., 2024). Additionally, Kamalov, F. et al. (2023) concluded that deep learning through AI transforms teaching formats, as AI technology can certainly promote learning and improve learning achievement outcomes. Consequently, some countries have clearly announced policies, such as Finland becoming the first European Union country to announce a national AI policy with the goal of having 1% of its population complete an online AI course developed by the University of Helsinki and consulting firm Reaktor. This goal was achieved so rapidly that other countries such as Sweden and the Netherlands implemented similar initiatives (Nittaya Taweecheep, 2024). AI has participated in the education sector through learner behavior analysis, personalized learning recommendations, intelligent tutoring systems, and real-time learning assessment systems (Holmes et al., 2019). Similarly, Natriello (2017) stated that AI assists in content adaptation, creating teaching methods and activities appropriate to each learner's capabilities, all of which have potential to promote educational quality and equity.

Given the emerging challenges and the critical necessity for online teaching and learning, coupled with the increasingly unavoidable importance of AI technology, this study addresses the following research questions:

(1) How should the application of AI in managing online learning be effective?

(2) What approaches should be adopted for developing flexible AI-enhanced online education systems to accommodate natural and environmental disaster scenarios?

The research findings will provide essential information for developing online teaching and learning that incorporates AI technology applications to support education in achieving sustainable development goals under SDG-4.

Research Objectives

1. To study the application of AI in education management.
2. To propose guidelines for developing a flexible AI-enhanced online education systems to accommodate natural and environmental disaster situations.

Research Methodology

Research Design

This study was performed using the document analysis from qualitative research methods and phenomenological approach from the direct experiences of individuals, allowing individuals to reflect on their opinions and explain the stories and experiences they have encountered related to online teaching, including administrators, experts in AI technology, teachers and students.

Data Collection

Researchers are important tools in collecting data. The data collection procedure of this study in outlined as follows:

1. Literature Review: Data were collected from research articles, academic papers, theses, reports, and relevant documents. The research team conducted a search all of Thai and English publications that contain term “artificial intelligence”, “AI”, “AI in education”, “online learning” in their title, abstract or keywords with selection criteria limited to publications from 2022-2025.

2. In-depth Semi-structured Interviews: Key informants for this research which were from Sripatum University (private higher education institutions) in Thailand included:

2.1 Artificial Intelligence Technology Expert (n=1): A technology specialist with expertise in artificial intelligence and experience in applying AI in educational management

2.2 teacher (n=3): Higher education faculty members who are responsible for teaching and learning, having utilized online teaching formats during natural and environmental disaster periods and have applied artificial intelligence (AI).

2.3 Students (n=3): Learners who studied during natural and environmental disaster situations A total of 7 key informants participated in this study, selected through purposive sampling. Each interview lasted approximately 40-60 minutes, with participants informed in advance. The research team conducted interviews until data saturation was achieved, where no new doubts arose and no additional information emerged. And the research team exercised caution regarding their own feelings and opinions. It is hereby confirmed that the research findings resulted solely from the narratives obtained from the informants.

Data Analysis

This research is a qualitative research. All collected data: from the synthesis of all documents, interviews and written records were studied repeatedly and categorized according to the research framework using inductive analysis and content analysis techniques.

Research Results

To synthesis the application of AI in education management, The results are:

1) predictive modeling,
2) intelligent analytics,
3) assistive technology,
4) automatic content analysis and
5) image analytics. Crompton and Burke (2023) found five usage AI in higher education:
   1) assessment/evaluation,
   2) predicting,
   3) AI assistant,
   4) intelligent tutoring system and 5) managing student learning.

The interviewees expressed their opinion that in online learning, they wanted AI to help with content, assistant, tutor, and assessment. So this study summarizes AI in education by synthesizing literature research and interviewee responses, which are categorized as follows: “creating learning content, serving as teacher assistants, providing personalized learning (tutoring), and assessment in online learning. AI applications in the mentioned categories and their contexts of use are described in this section.

This mainly explains the application of AI in education management which data from synthesis document and in-depth interviews with artificial intelligence technology expert.

The information is summarized as follows:

The components of online teaching can be divided into 4 areas: lesson content, learning management system, communication, and learning assessment. The participants in online teaching are teachers and students which the teachers is the one who gives advice and the students is the one who receives the content and knowledge. (Thokaew, T. and Ruangmontri, K., 2022; Khlaisang, J. & Koraneekit, P., 2016; Alibak, 2019) And the teacher (private university) is the most factor of successful in online learning. (Chaikalaya. R., 2023)

AI applications can understand and interact with human language and visual information. (Hamal et al., 2022; Peltonen et al., 2022). So AI can helps create and personalize content for each learner through adaptive learning and automatic content generation, such as topics, exercises and learning materials that suit students' learning styles.

The rapid development of Artificial Intelligence (AI) across various fields has made it an essential technology in the digital era. Teachers and students can choose from a variety of AI tools based on their needs and proficiency. These tools are widely used in education, research, content creation, and business to enhance productivity and creativity. Below is a categorized list of AI applications with their purposes, key features, and example tools:

1. Data Analysis & Research

Purpose: Analyze texts, summarize information, and support research activities

Key Features: Natural language understanding, processing large documents, multilingual support

Example Tools: ChatGPT, Claude, Gemini (content summarization); Julius AI (expert data analysis); SciSpace Copilot, Elicit (research reading and translation); Perplexity AI (referenced research)

2. Video Creation & Editing

Purpose: Convert text into videos or create AI avatars for presentations

Key Features: Generate short videos, animations, and virtual presenters

Example Tools: Pika Labs, Sora (OpenAI) (text-to-video); Synthesia (virtual narrators); Lumen5, Animoto (automated editing)

3. Graphic Design & Art

Purpose: Create artworks, graphics, and templates

Key Features: Background removal, text-to-image conversion, automatic design generation

Example Tools: Canva (user-friendly AI layouts); Adobe Firefly, Designs.ai, Fotor AI Art Generator

4. Voice & Audio Tools

Purpose: Voice cloning and speech synthesis for realistic audio

Key Features: Multilingual voice generation, tone and emotion customization

Example Tools: ElevenLabs, VoiceRex Pro (realistic voices); Murf.ai, Play.ht, WellSaid Labs

5. Writing & Content Creation

Purpose: Automatically generate written content such as articles, ads, or social media posts

Key Features: Tone adjustment, multilingual support, topic-based content creation

Example Tools: ChatGPT, Jasper AI, Brain Pod AI (article writing and replies); Copy.ai, Writesonic, Rytr, Anyword (commercial content)

6. Education & E-Learning

Purpose: Personalize learning experiences and support teaching

Key Features: Adapt content to learner levels, provide real-time feedback, automatic grading

Example Tools: Khanmigo (Khan Academy AI tutor); DreamBox Learning, Squirrel AI (adaptive learning); AI Virtual Tutors, Quillionz, Gradescope (grading and Q&A)

As a result of the evaluation based on documentary research and expert reviews on the contexts by which AI applications are used in online education. It's found that: Ouyang et. al. (2022) shows 4 main functions of AI applications in online higher education: 1) prediction, 2) resource recommendation, 3) automatic assessment and 4) improvement of learning experiences.

While Salas-Pilco and Yang (2022) focused on AI applications in Latin American higher education.

1. Creating learning content

Because of creating online learning materials requires long-term planned work of a professional teachers, and content creators. Content, lessons and learning media content should be designed to provide immediate feedback to learners to stimulate them to learn according to the specified objectives. Media and learning resources should be novel and stimulate learners' interest. AI helps to quickly collect data from various sources. Teachers can create lesson plans more easily and efficiently in various forms such as learning media, VDO, games to attract more learners and make them more interested and have more fun. Interviewees reinforced this view, AI's utility in overcoming human limitations: *"AI can process thousands of pages of text in minutes, something I couldn't even imagine doing manually" (Participant 1, 12 years of experience).* However, each AI has different limitations, so teachers should not use only one AI for all teaching. For example, Microsoft Bing can generate images, while Free ChatGPT cannot generate images. As one interviewee noted, *"I use more than 2 AI because of some AI cannot build game but popularly ChatGPT I use to solve my homework's" (Participant: Student).*

2. Serving as Teacher Assistants

To Create a personal assistant for routine or repetitive tasks. AI can replace teachers to help with academics and another. because AI can provide accuracy, fast processing, and emotionless. AI assistants can provide instant support and guidance to students, answer their questions and provide feedbacks (Rui & Badarch, 2022; Tonbuloglu, 2023). Therefore, the role of teacher can be changes to controller, and responsible for providing the necessary information to promote learning to students or focus on tasks that are important and create more value.
And this is what AI assistant can do:

2.1 Answering general questions and FAQs: AI can quickly and accurately answer frequently asked questions, reducing the burden on instructors to repeatedly address the same queries. One of interviewee said that *"AI can help the teacher which in case they must answer or check exercise repetitively (Participant 1, 12 years of experience)."*

2.2 Managing administrative task to help instructors to focus on teaching: AI can assist with administrative duties such as scheduling, tracking student progress, managing documents, or sending reminders. One of interviewee said that *"Teachers reduce the workload of having to answer repetitive questions or grade large amounts of work (Participant 1, 12 years of experience)."*

2.3 Generating Learning Materials and Exercises: AI can create supplementary learning content like lesson summaries, quizzes, flashcards, or even practice problems tailored to a student's knowledge level. One interviewees support utilized of AI *"I accept AI which has helped me to get more quizzes and summaries lesson (Participant 5, 20 years of experience).*

2.4 Language Translation: For non-native speakers, AI can help translate learning materials or provide bilingual support to improve comprehension. As on interviewee remarked *" I use AI to help translation from English to Thai or from Thai to English (Participant, student)"*

2.5 Writing Assistance: AI can help with grammar and spelling checks, and offer suggestions for improving essays or reports. As on interviewee explained *" I am not good at writing, which requires both grammar and spelling. Having this AI to help me to do my job much more smoothly (Participant 4, 17 years of experience)."*

2.6 Data Collection and Analysis: AI can gather data on student learning outcomes and behaviors, providing instructors with insights to refine their teaching strategies.

ChatGPT, one of the popular leading generative AI tools, can be used to create learning content with answers on any topic. This productive AI application can create text or content that can be used as content in online education, summarize key points of a topic text.

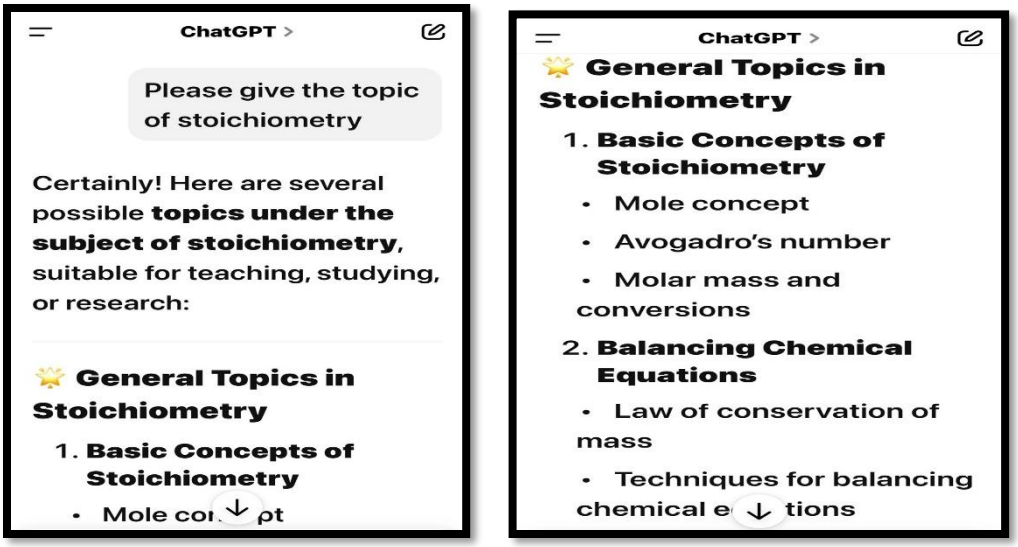


Figure 1 Basic Chemistry AI Application

Applications such as Basic Chemistry (Figure 1) where instructors write prompts for ChatGPT to identify subtopics in the main topic, Stoichiometry.

3. Providing Personalized Learning (tutoring)

Sometimes when students have questions or can't do exercises and want to approach the teacher, they find that the teacher may not be available or does not have time to explain further. Due to this limitation, AI has been used to create applications that help tutor students further as follows:

3.1 Personalized Learning:

3.1.1 Adapting to Learning Styles of each student: AI can analyze each student's learning style, speed of learning, and strengths/weakness to create a customized learning path. As the answer of one interviewee described *"AI have many data but I fear AI will be replacing human judgment with data outputs that someone don't fully and deeply understand" (Participant 5, 20 years of experience)*. And one of interviewee confirmed this by stressing that "*Private universities have diverse students. Some have strong knowledge bases, while others have weak knowledge bases. Therefore, if students can be separated, it will be good. It will help students achieve their goals (Participant 4, 17 years of experience)."*

3.1.2 Adjusted Content for each student: AI can present content, examples, or exercises that specifically address individual needs, making learning more efficient. *Tailoring content to each learner is a good thing because it is very difficult for teachers to do. Teachers have a large teaching load and a large number of students each semester. (Participant 4, 17 years of experience)*

AI-enabled applications such as solved mathematic (Figure 2) which student give equation through AI helps enhance analytical thinking skills, solving exercise questions in a step-

by-step manner. Therefore, it can be considered as personalized learning where learners can adjust their own learning style through the online platform. One interviewee, who specialized in artificial intelligence expressed frustration with AI's limitations *"If learners only use AI to solve problems, they will lack analytical thinking and problem-solving skills. and in addition, nowadays get showing that they cannot distinguish between real and false information" (Participant 5, 20 years of experience).*

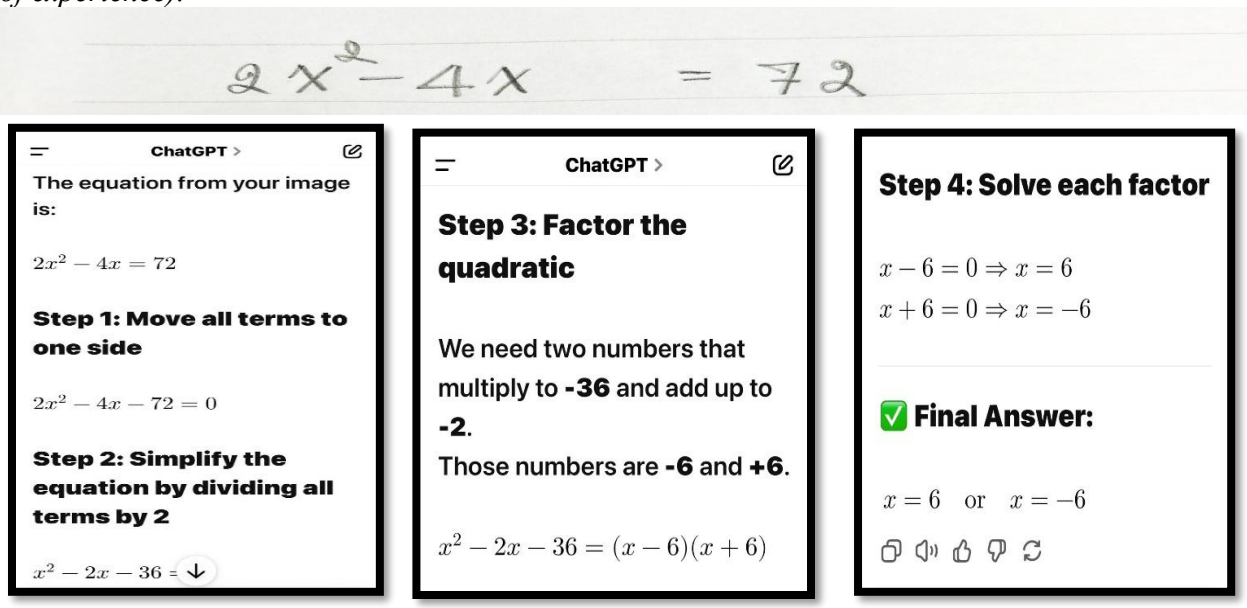
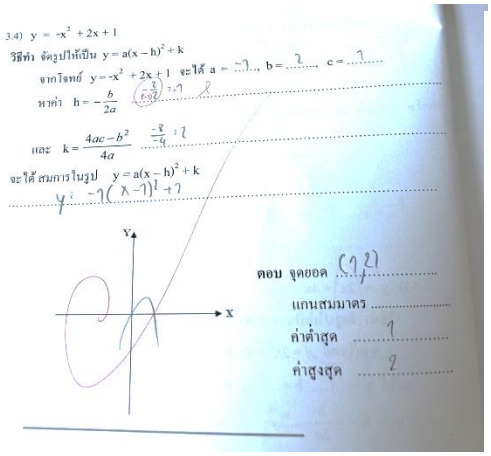


Figure 2: Basic Chemistry AI Application

3.2 Instant Feedback:

3.2.1 Automated assignment and test grading: AI can instantly grade exercises or tests and provide detailed feedback on errors and ways to improve. This was also echoed by the interviews that *"AI is so rapidly more than human's feedback really." (Participant 1, 12 years of experience).*

3.2.2 Guiding to Solutions: If a student answers incorrectly, AI can offer guidance or hints rather than direct answers, encouraging self-problem-solving. For example, Figure 3 which incorrected answer but AI can guideline to help and provides suggestions and information to stimulate thinking, rather than giving direct answers. One interviewee said that *"one day I use AI to solve equation and suggest, I agree it (Participant 4, 17 years of experience)."*



3) Completeness (8/10)

- **Essential Elements:** All crucial steps for finding the vertex form and vertex properties are included.
- **Graph:** A visual representation is provided, which is a good addition to check the algebraic solution.
- **Summary:** The summary box for vertex, axis of symmetry, and min/max value is helpful.

Figure 3 AI : encouraging self-problem-solving

3.4 All-day all-time Availability:

3.4.1 Students can access AI for help or guidance at any time, whether they encounter a problem late at night or on a weekend. This ensures uninterrupted learning.

3.4.2 Creating a Safe Learning Environment:

Students might feel more comfortable asking questions they might be judged for by instructors or peers, or that they might be too shy to ask in a classroom setting.

3.5 Identifying Knowledge Gaps:

AI can pinpoint (accumulated points from formative assessment) where students lack understanding and provide targeted lessons or exercises to bridge those gaps.

3.6 Motivation and Engagement:

AI can detect when students lose interest and provide encouragement or present engaging content to recapture their attention.

4. Assessment in Online Learning

“teachers’ beliefs about human and AI assessment should be strengthened”

Assessment in online learning using Artificial Intelligence (AI) tools has become an increasingly important strategy for enhancing educational effectiveness, especially in higher education. AI systems can significantly assist instructors by automating administrative tasks such as grading, performance tracking, and feedback generation. This allows instructors to dedicate more time to designing and implementing meaningful learning activities (Rui & Badarch, 2022; Naidu & Sevnarayan, 2023).

Students benefit by receiving immediate feedback, preliminary grades, and formative comments anytime and anywhere. Moreover, AI tools can offer diverse perspectives in their feedback, enabling students to gain deeper understanding of course content—supporting personalized and continuous learning even when instructors are not available in real time. In particular, platforms such as Gradescope (Thavirath, 2025; Tonbuloglu, 2023) demonstrate how AI can be applied to automatically evaluate multiple-choice and multiple-answer questions. This automation reduces instructors’ workload and streamlines the assessment process, making it more efficient.

Beyond traditional grading, AI also plays a transformative role in redefining educational assessment models. The integration of AI in exams, quizzes, and other forms of evaluation may prompt a reevaluation of institutional assessment policies. As AI-generated content becomes more prevalent, traditional assignments and examinations may no longer be sufficient or relevant, thereby challenging the foundations of conventional assessment methods (Gorichanaz, 2023; Morjaria et al., 2023; Geerling et al., 2023).

Importantly, the use of AI by students does not necessarily equate to academic dishonesty if transparency is maintained. Students should be encouraged to declare how AI tools are utilized in their submissions, thereby fostering responsible and ethical use (Perkins, 2023). Furthermore, AI can be repositioned as a tool for self-assessment and independent learning. For instance, ChatGPT can support students by generating reflective questions, rubrics, and ideas, encouraging them to take ownership of their learning process. As noted in one interview, "Students can use AI by learning by themselves," emphasizing AI's potential in promoting autonomous, inquiry-driven education.

While AI tools enhance the efficiency and responsiveness of online assessment, their integration must be guided by thoughtful policy reform, ethical guidelines, and pedagogical intent to ensure that both learning and evaluation remain authentic, equitable, and student-centered.

To propose guidelines for developing a flexible AI-enhanced online education systems to accommodate natural and environmental disaster situations

Guidelines for developing a flexible AI-enhanced online education systems are divided into the following main topics: 1) Policy preparation 2) Personnal preparation 3) Data preparation 4) Technology preparation. The details as follow:

1. Policy preparation

- Executives and relevant agencies should clearly define policies and guidelines for the use of AI in education to create a framework for appropriate practices and promote the responsible and fair use of AI, as well as ethical use. (Amiri et al., 2025)

- Policies should support infrastructure development and investment in AI technology to make education truly accessible. *(Participant 3, 20 years of experience)."*

2. Personal preparation

- Create a better understanding and vision for teacher and staff. Train and educate teachers and staff on the basic concepts of AI and the benefits that AI can bring to teaching.

- Accept, adapt, and be open to change and the use of AI in the education system. (Holmes et al., 2021) *(Participant 4, 17 years of experience)*

- Build skills and capabilities in AI application: Teachers, staff and students develop digital skills and data literacy to effectively use AI (Amiri et al., 2025)

- There are supporters/assistants in AI application: Establish a technical support team and AI experts to assist and promote the use of AI in educational institutions. (Liu et al., 2023)

3. Data preparation: manage data to be of high quality, secure, and ready for AI analysis and use.

4. Technology preparation: develop appropriate technological infrastructure to support efficient and stable AI usage.

In addition, experts and teachers are reminded of the precautions in using AI in terms of:

1. Privacy and Data Protection

AI systems often collect and analyze students' personal data, such as learning behavior, performance, and preferences. This raises concerns about the privacy and security of sensitive information. Clear policies regarding data collection, usage, and protection—aligned with regulations like GDPR or national data protection laws—are essential.

2. Algorithmic Bias

AI can reflect or amplify biases present in the training data, potentially leading to unfair treatment based on gender, race, language, or socioeconomic background. This may result in unequal recommendations, assessments, or learning outcomes for certain student groups.

3. Overdependence on Technology

Excessive reliance on AI tools may reduce students' and teachers' engagement in critical thinking, creativity, and interpersonal skills. AI should complement—not replace—human interactions and pedagogical judgment in the learning process.

4. Transparency and Explainability

Many AI systems function as "black boxes," providing outputs without clear explanations. In educational settings, it is vital that AI systems offer transparency and explainability, particularly in areas like student assessment and personalized learning recommendations.

5. Equity and Access (Digital Divide)

Students in remote or underprivileged areas may lack access to digital infrastructure, devices, or digital literacy, leading to increased educational inequality. AI-driven education must be designed inclusively, ensuring equitable access for all learners.

6. Impact on the Role of Teachers

There is concern that AI might replace certain roles of teachers. However, AI should be positioned as a supportive tool rather than a substitute. Teachers remain essential for emotional support, social interaction, and the design of meaningful learning experiences.

Research Discussions

The study findings indicate that preparing for the application of artificial intelligence (AI) in education must begin with the establishment of clear and comprehensive policies. This aligns with the recommendations of Amiri et al. (2025), who emphasize the importance of policy frameworks that promote responsible AI use while considering data security and investing in appropriate infrastructure to support AI integration in education systems.

Regarding personnel readiness, the research highlights that fostering understanding and a positive vision of AI among educators and staff is crucial for effective acceptance and adaptation to new technologies (Amiri et al., 2025; Holmes et al., 2021). Furthermore, developing skills and competencies in AI application is essential for educators to effectively and safely utilize AI tools in supporting teaching and learning processes (Lau et al., 2023). This is consistent with the approach of establishing technical support teams to assist AI implementation in educational institutions.

Additionally, the considerations for AI adoption in education encompass several critical aspects such as adequate budgeting, ethical use of AI, data privacy and security, defining the scope and limitations of AI, which are widely recognized in scholarly literature as factors that ensure sustainable and beneficial AI deployment (Holmes et al., 2021; Amiri et al., 2025).These findings correspond with Holmes et al. (2021), who stress the importance of ethics and transparency in AI use within education, as well as caution regarding AI limitations to prevent potential errors.

Research Suggestion

Recommendations for Policy Formulation

1. Establish a national AI-education framework with mandatory AI literacy and data ethics.
2. Ensure privacy protection under PDPA and prioritize rural infrastructure development.
3. Require AI-supported online learning systems as disaster-response backups.
4. Create inter-institutional agreements and standardized emergency protocols.

Recommendations for Further Research

1. Conduct long-term studies on academic performance and critical thinking with AI.
2. Investigate dependency risks and learning sustainability in varied populations.
3. Develop culturally-adapted Thai AI models with local dialects and values.
4. Integrate Buddhist ethics into AI algorithms.
5. Compare Western tools with Thai-specific AI in educational settings.
6. Support evidence-based AI innovation through national research funding.

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