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MEASUREMENT AND EVALUATION AND AI IN TECHNOLOGY AND ENTREPRENEURIAL EDUCATION: AN IMPACT ASSESSMENT

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Abstract

The overwhelming influence of artificial intelligence (AI) on various human activities in contemporary times cannot be over-emphasized. This study seeks to explore the influence of AI on measurement and evaluation (M&E) and entrepreneurial technology education (ETE), and determine the extent to which innovations can be achieved when AI is integrated into M&E for improved teaching and learning of ETE. Primary data are sourced using questionnaire and focus group discussion, involving 120 professionals in Information Science, and Measurement and Evaluation Departments. Observation and introspection are the other primary sources utilized. Selected library and internet print materials constitute the secondary data sources. Survey design and mixed method are employed along with their suitable analytic tools. The analysis shows that although the adoption of AI for educational purposes is still currently

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low in developing nations like Nigeria and Cameroon, integrating AI into M&E is a pathway to attaining appreciable innovations in ETE. The study concludes that combining AI with conventional epistemological approaches to scientific and non-scientific education can yield more results than the otherwise. It recommends sustained integration and use of AI for M&E, ETE and other spheres of education.

Introduction

Artificial intelligence (AI) is a technological innovation of the 21st century, which is making waves in all spheres of society. It is being integrated into different sectors of society. The prospects of AI are much more than its challenges. Following its proven benefits in various spheres, there has been an increase in the advocacy for the integration of AI into different endeavors. Studies have shown that the integration of AI into any endeavor can yield positive results, bringing to place betterment, innovations, optimization, efficiency, spending less time and resources on tasks, cost reduction, and so on. Such studies include Akinola (2024), Akinola et al. (2024), Awofadeju et al. (2024), Kareem et al. (2024), Kodete et al. (2024), Nwosu et al. (2024), Okusi (2024a&b), Pasupuleti et al. (2024), Thuraka et al. (2024), Juhrich (2023), Ivanova et al. (2023), Regona et al. (2023), Itam et al. (2021), Kochovski and Stankovski (2021), Artificial Intelligence Bangladesh (2020), Yigitcanlar et al. (2020), and Adie & Odoh (2018).

The presence of AI in various spheres is affirmed by Ro (2018), who notes that AI is most beneficial to healthcare, education, agriculture, smart mobility and technology, and smart cities. In view of the huge benefits of AI, this study proposes its (significant) integration into Measurement and Evaluation (M&E) so as for the field to be benefiting from AI. It seeks to ensure new world orders in the field of M&E and ETE through its scholarly contributions. By influencing changes, the study will contribute to availing the field of the innovations offered by AI. That is, as its advocacy, arguments and findings lead to betterment in the adoption of AI in M&E, the technological innovations offered

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by AI would be benefited by professionals and stakeholders concerned with the undertakings of M&E.

Problem Statement

In spite of the growing integration of AI into different spheres, its commonly attested prospects, and the considerable extent of its integration into different endeavors, AI is yet to be integrated significantly into M&E as well as ETE. The current gap in literature on AI in M&E and ETE is another problem of concern to this study. Given the foregoing backdrop, this study advocates the integration of AI into M&E at a significant extent. Its advocacy is aimed at creating as well as increasing awareness about AI among professionals of M&E, fostering its significant and sustainable adoption, and contributing to literatures on AI in general and AI in M&E and ETE in particular.

Aim and Objectives

This study is aimed at exploring the influence of AI on measurement and evaluation (M&E) and entrepreneurial technology education (ETE). Its specific objectives are to:

i. Draw evidence from extant studies to show that the integration of AI into M&E can bring forth innovations and improved teaching and learning of ETE.
ii. Examine the extent to which AI is currently integrated into M&E.
iii. Discuss the prospects and challenges of AI integration.
iv. Suggest ways of ensuring significant and sustainable integration of AI into M&E.

Research Questions

The following questions are designed to guide the study:

1. Is there substantial scholarly evidence to show that the integration of AI into M&E can bring forth innovations and improved teaching and learning of ETE?
2. To what extent is AI currently integrated into M&E?
3. Do the prospects of AI outweigh it challenges?
4. Are there several ways of ensuring significant and sustainable integration of AI into M&E?

Gap in Literature, Contribution and Novelty

The current vast gap in literature on the integration of AI into M&E, especially in developing nations like Nigeria and Cameroon, motivated this research work. The study is also motivated by the current insignificant integration of AI into M&E. It argues that the integration of AI into M&E across tertiary institutions in both developing and developed nations is currently nothing to write home about. In other words, the integration of AI into M&E has remained low since its emergence across developing and developed nations alike. While some countries are yet to integrate AI into M&E, those that have done so already are yet to make the integration significant.

Furthermore, the study observes that to make the integration of AI into M&E significant, more research studies should be done to bridge the knowledge gap, increase awareness about it, improve and optimize M&E activities using AI, and contribute more to entrepreneurial technology education through AI-driven M&E. The study makes the following postulations:

- There exists substantial scholarly evidence to show that the integration of AI into M&E can bring forth innovations and improved teaching and learning of ETE.
- The extent to which AI is currently integrated into M&E is low or insignificant.
- Although AI has prospects and challenges, the former outweighs the latter.

- There are several ways of ensuring significant and sustainable integration of AI into M&E.

Artificial Intelligence

Artificial intelligence (AI), as Ro (2018) notes, is the capability of machines to intelligibly undertake decisions, thinking, learning, perceiving, and problem-solving tasks, which were exclusively undertaken erstwhile by humans. This description makes it clear that the present study advocates a space for machines to intelligibly operate and carry out some of the tedious tasks carried out by human beings in the field of M&E and ETE. The National Strategy for Artificial Intelligence Bangladesh (2020) states that AI demonstrates that machines have the capacity to perform varied tasks, such as learning, reasoning or critical thinking, seeing, strategic performance, and basic leadership. Thus, the integration of AI into M&E means using the machines to carry out tasks in the field in similar ways and manners with those of human beings.

AI is an evolving innovation making consistent huge advances in various human endeavors and phenomena where applied. It has been impacting on various spheres of life. AI, Ro (2018) notes, is most beneficial to healthcare, education, agriculture, smart mobility and technology, and smart cities. This study observes that M&E and ETE, as integral fields of education, benefit from AI too. They are supposed to benefit much more from AI, if adopted significantly. According to the National Strategy for Artificial Intelligence Bangladesh (2020), AI has the following six strategic pillars:

- Research and development,
- Re/Skilling AI workforce
- Digital and data infrastructure,
- Ethics, data privacy, security and statutory regulations,
- Funding and acceleration of AI adoption, and
- Industrialization for AI technologies.

The table below contains some of the popular AI technologies making waves in different spheres, which can do same in M&E in particular and ETE as a whole:

Table 1: Some popular AI technologies

AI Technologies	Citations
Automated Machinery Systems	Akinola (2024)
Computer Vision	Akinola et al. (2024) Kodete et al. (2024)
Deep Learning	Alsakka et al. (2023) Ivanova et al. (2023)
Digital Image Analysis	Okusi (2024a&b)
Faster R-CNN	Pasupuleti et al. (2024)
Machine Learning	Regona et al. (2023)
Natural Language Processing	Thapaliya and Bokani (2024)
Reinforcement Learning	Vantara (2020)
Robotic Process Automation	Wusu et al. (2022)
Source: Author, 2024	

Each of the above mentioned AI technologies has several techniques or sub-technologies. Although there are many AI technologies, the above listed ones are considered to suffice for the others. The integration of these technologies into M&E would bring forth different technological innovations to the field of M&E, ETE and the education sector as a whole. There are challenges to the adoption of AI technologies. The challenges of AI adoption are highlighted in the following Table 2:

Table 2: Constraints AI Adoption

Challenges	Citations
Research gap **Lack of appreciable extent of expertise in AI application**	Ro (2018)

Challenges	Citations
Low level of awareness **Discouragement to AI adoption** **Cybersecurity threats** **Lack of regulations and ethical compliance governance** **Inadequate collaboration**	
Poor technical-know-how	Akinola et al. (2024) Gul et al. (2020) Jones et al. (2020)
Compatibility constraints during integration	Wu et al. (2021)
Fear of displacement from employment and the complexities of implementation	Bock et al. (2018)
Lack of resources	Gul et al. (2020), Jones et al. (2020)
High cost	Zou et al. (2018)
Source: Authors, 2024	

From the Table 2 above, it is understood that scholars are largely unanimous on the challenges to the adoption of AI. For example, some of those identified by Ro (2018) are also pointed out by some other scholars/authors in the table. To get the best of AI, the identified challenges have to be addressed accordingly.

Theoretical Framework

The study is rooted in the Innovation Diffusion Theory (IDT), propounded by Rogers (1962). Everett Rogers developed IDT to explain the processes of innovations and their adoption. Although it is a theory in social sciences, its application stretches to other broad fields, including information technology,

communication sciences, new media, computer science, applied sciences, and so on. Baker (2012) and Luhamya et al. (2017) argue that IDT captures the various other theories of media an information technology. Luhamya et al. (2017) hold that Roger's IDT is the foundation of the following theories of technology integration: Technology Acceptance Model, Technological Pedagogical Content Knowledge, Technology-Organisation-Environment, Theory of Reasoned Action, Theory of Planned Behaviour, and Unified Theory of Acceptance and Use of Technology.

IDT explains how, why and the extent to which an innovation is adopted. According to Rogers (1962), there are procedures through which any innovation is adopted in a social system. He identified five categories of adopters viz: "innovators, early adopters, early majority, late majority, and laggards" (p. 150). Basically, IDT explains how an innovation, an idea, a product, or a new phenomenon gains the interest of the masses, gets adopted and diffused, and the extent to which it is adopted, including the processes it (Roger, 1962; Katz et al., 1963; Bittner, 1984; Robert et al., 2016; Robert, 2017; Nwode, 2022). Innovations get diffused through the following stages: awareness, interest, evaluation, and trial and adoption (Roger, 1962). The adoption of an innovation is said to be influenced by an agent.

The agent helps members of the public to decide on the best ways of adopting an innovation (Roger, 1962; Bittner, 1984; Robert, 2017; Yeboah et al., 2015). This is to say that the adoption of an innovation, such as AI innovation, is influenced by an agent. The influence exerted by an agent either makes or mars the adoption of innovation by members of a given society or a group. This point highlights why the adoption of AI technological innovations remains low among some societies, groups, organizations and individuals. The agent influences increase in the adoption of an innovation (Goodhart et al., 1975; Barwise et al., 1982; Bittner, 1984). The agent can be a societal institution like the media, new and old media alike. This is captured by Katz et al. (1963), who

have noted that the diffusion of an innovation takes place through channels, such as mass media and other social structures.

As Bittner (1984) has rightly noted, media can create awareness about an idea, a process, an innovation, a system, a practice, or thereabout, and influence the audience into adopting it. Upon influence, interest in it is developed. After developing interest in it, adoption follows. The adoption at first is a trial, which comes up after an evaluation of the innovation, process, system or thereabout. It is noted that the adoption or diffusion of an innovation is only possible when it is considered innovative (Bittner, 1984). The implication of the foregoing is that since AI technologies are innovative, this study considers AI integration into M&E worthwhile. Being innovative, its diffusion into M&E is possible. It is in order to exploit the innovations offered by AI in the field of M&E that this study advocates the adoption of AI in M&E.

This study considers the IDT as a framework for describing the processes and stages of adopting AI in the field of M&E as well as ETE. In the context of this study, IDT describes the need for adopting AI innovations in the field of M&E as well as ETE. The above noted process and stages of innovation adoption and diffusion apply to the adoption of AI into M&E. Thus, it is apt to have adopted IDT for this study. The study is concerned with technology innovations offered by AI. Although the UTAUT is the most adopted theory of computer and AI discourses in contemporary time, the adoption of IDT is considered more apt because it captures the other aforementioned six popular theories.

Related Studies

There are many related studies on AI in the education sector. Several of them are presented hereafter. They are considered to suffice for the many others. Accordingly, while affirming the prospects of AI in the education sector, Nwosu et al. (2024) express worries over the abusive use of AI by students. Their study argues that effective use of language, persuasive language, other language-based techniques, and critical literacy can be used to ensure ethical use of AI

by students. The result of its analysis shows that students can become critically aware and conscious of using AI ethically if their teachers consistently educate them in ethical and disciplined direction, using critical literacy, persuasive language and other language-based techniques. These techniques, the study submits, can be used sustainably to drastically reduce the rising ethical issues of AI usage in the education sector.

Nwadinobi's et al. (2024) study examines the impact of AI on the effectiveness of undergraduate students. It reveals that AI exerts positive impact on students of tertiary institutions by making them to be effective in undertaking their academic activities, including improved academic performance. Thus, the study lends credence to the assertion of the present study that AI has the capacity to impact M&E, thereby optimizing and improving the activities undertaken in M&E and ETE. Just like the present study, it calls on stakeholders in the education sector to help increase the integration of AI into teaching and learning activities, while at the same time making concerted efforts to address the associated challenges. Oyeyemi et al. (2024) explores the perceived effects of AI tools on the academic performance of students in public universities in Anambra State, showing a positive correlation between AI tools and students' learning abilities. It is also proven that AI tools impact positively on and increase critical thinking abilities in students and make them to develop problem-solving skills. It follows that AI technologies can do the aforementioned in the field of M&E and ETE. Thus, the advocacy for sustainable integration of AI into M&E is worthwhile and result-oriented.

Adams et al. (2023) confirm that different techniques, including developing ethical guidelines, have to be devised and deployed sustainably for mitigation of the ethical issues associated with or arising from the misuse of AI. Their study proposes the following techniques: pedagogical appropriateness, AI literacy, children's rights, and teacher well-being. These apply to M&E and ETE. They can be realized in these fields. As such, it is quite evident that studies abound that affirm the possibility of integrating AI into educational fields, such

as M&E and ETE, for the realization of innovations. The study by Niedbała et al. (2023) examines ChatGPT, a generative AI tool. The study aims at determining the extent to which ChatGPT language model can be applied in the learning process for full- and part-time students. It proves that ChatGPT is revolutionizing the way information is being sourced and used for personal and professional purposes. It is also proven to be a viable AI tool for carrying out different tasks. The study submits that ChatGPT language model is more beneficial to full-time students, as a result of which they differ in their chat ability and functionality from those of their contemporaries of part-time. As such, integrating AI into M&E would undoubtedly bring forth innovations in the broad field of ETE. The benefits go beyond the education setting to other sectors of society.

Nguyen et al. (2023) look at ethical principles of using AI in education. Their study discusses the looming debate on ethical principles and guidelines for using AI in the education sector. It indicates that AI has the potentials of transforming the education sector with its activities. It emphasizes that AI techniques have been offering a better understanding of students' performance and learning challenges. Basically, the study considers both prospects and challenges of AI. It urges stakeholders to find lasting solutions to the ethical issues of AI usage in the education setting. Kushmar et al. (2022) engage with AI in English language learning, with a view to ascertaining the extent to which AI techniques can be used effectively for teaching learners the language and to determine how effective they can be applied in the language learning class. Their study indicates that AI has been transforming different educational activities, increasing effectiveness and competitiveness, and empowering teachers and students across all tiers of education. It also states that with AI, content instructions and tests have got better in the education system in the 21st century. Kushmar's et al. (2022) study concludes that human wisdom is largely required in using AI for language learning. This means that any issues affecting AI can be addressed by human beings.

Ayanwale et al. (2022) explore the factors that influence teachers' readiness to adopt and teach AI to students alongside their behavior towards it. The factors found are: anxiety about AI, perception of its usefulness, consideration of the social benefit of AI, the attitude towards using AI, perceived confidence in teaching AI, the significance of AI, behavioral intention, and the readiness for AI. It concludes that these factors determine the use or adoption of AI. The study highlights why AI adoption is worthwhile and should be done significantly. The noted factors are no doubt what account for the current state-of-art in the adoption of AI in M&E and ETE in Nigeria, Cameroon and other developing nations and some developed nations. The study by Alimi et al. (2021) examines the extent to which students in Kwara state are aware of AI usage for learning purposes. It reveals that majority of the students were not aware of AI for learning purposes, and the students' low awareness and use of AI has no gender gap or disparity, as both female and male students involved in the investigation showed poor awareness and use of AI. For the study, awareness determines the extent to which students use AI and other 21st century technological innovations. It urges teachers and other agents of socialization to increase the creation of awareness about the use of AI among students.

Huang (2021) identifies the benefits of AI, highlighting the different uses of AI tools for educational purposes. The benefits include assisting students to keep track of studies, create result-oriented academic plan, acquire problem-solving and critical thinking skills, and identify educational needs that foster self-reliance and growth. Huang (2021) indicates that the benefits of AI are why tertiary institutions in Nigeria and most other parts of the world are increasingly adopting AI tools for educational purposes. It is for this reason that the present study advocates the integration of AI into M&E for innovations in ETE. Umoren's et al. (2021) study examines the interface between human and artificial intelligence skills in relation to students' social networking and human-centered behavioral intentions in Lagos State. The results demonstrate that

students' level of approval for AI is currently low, while their level of social networking correlates with AI analytical skills. The study suggests that more research studies on the influence of human behaviors on AI skills should be carried out to determine the interface between two types of intelligence. The implication of the foregoing is that AI and human intelligence interact for more productive results in various spheres, including teaching and learning. Be it so, there is need to integrate AI into M&E. Doing so would bring innovations to place in ETE.

Jain and Jain (2019) show that adopting AI in tertiary institutions amounts to putting up ways of increasing the learning capacities of students and improving teachers' teaching modalities. The study emphasizes the prospects of AI as what inform its adoption. It calls on authorities of tertiary institutions in Udaipur, Rajasthan as well as beyond to adopt AI tools for innovations in teaching and learning, so as to attain more significant teaching-learning outcomes. By showing that, the study lends credence to the present one that AI has the capacity to transform and optimize the M&E field, thereby offering different technological innovations to ETE as a whole and M&E in particular. Finally, Fokides and Mastrokoukou's (2018) study points out that students taught using tablets outperformed over their counterparts taught without using tablets. For the study, students taught using augmented reality features do better than those taught without these features. The implication of the study is that the use of AI and smart technologies for teaching impacts positively on learners. It follows that students of M&E and ETE taught using AI technologies would do better.

Methodology

The study adopted survey design and mixed method. The method involved the combination of qualitative and quantitative approaches alongside their suitable allied techniques. Questionnaire and focus group discussion were used to source primary data from 120 professionals in Information Science, and

Measurement and Evaluation Departments of two colleges of education and one university in Southeastern Nigeria. The colleges are Nwafor Orizu College of Education, Nsugbe, Anambra, Nigeria and Federal College of Education, Eha-Amufu, Enugu, Nigeria. The university involved is Ebonyi State University, Abakaliki, Nigeria.

Out of the 120, 60 participants each are from the two Departments respectively. Observation and introspection are the other primary sources. Selected library and internet print materials constitute the secondary data sources. These were subjected to systematic review and content analysis. Both review and analysis of the secondary data focused on thematic concerns alone. Content analysis was also employed in synthesis and analysis of the primary data. The suitable analytic tools, which are associated with the adopted design and method, were deployed for the analysis of the primary data. These include interpretive, descriptive and statistical techniques.

Data Presentation and Analysis

Here, data from the gathered questionnaire are presented and analyzed. The variables used are Strongly Agreed (SA), Agreed (A), Strongly Disagreed (SD) and Disagreed (S). Only the 99 (82.5%) duly filled and returned questionnaires were put into consideration and used hereunder for presentation and analysis. That is, out of the 120 questionnaires administered, 99 were duly filled and returned, while 21 (17.5%) were discarded because they had one issue or the other.

Table 3: Integrating AI into M&E can bring forth innovations

Variables	Frequency	Percentage
SA	67	67.7
A	32	32.3
SD	____	____
D	____	____

Total	99	100%

Source: Researcher's Field Survey, 2024

Responses obtained for Research Question 1 show that scholarly evidence abounds for the justification of the claim that the integration of AI into M&E can bring forth innovations, and improve teaching and learning of ETE. The finding, obtained from all the 99 (100%) respondents, reflects those of the empirical studies presented under 'Related Studies' above. Indeed, since many studies affirm the capacity of AI to optimize and transform various activities across all human endeavours, the finding from the above Table 1 is empirical and commonly attested to in the literature.

Table 4: The extent to which AI is currently integrated into M&E is low.

Variables	Frequency	Percentage
SA	39	39.4
A	41	41.5
SD	____	____
D	19	19.1
Total	99	100%

Source: Researcher's Field Survey, 2024

The extent to which AI is currently integrated into M&E is determined to be low. The proof is obtained from 39 of 39.4% respondents, who agreed strongly, and 41 of 41.5%, who agreed but not strongly. Put together, 80 of 80.9% of the 99 of 100% total proved that the extent to which AI is currently integrated into M&E is low. The responses of the 80 of 80.9% are sustained over those of 19 (19.1%). While the former responses are substantial, the latter responses are inconsequential.

Table 5: The prospects of AI outweigh its challenges.

Variables	Frequency	Percentage
SA	71	71.8
A	28	28.3
SD	____	____
D	____	____
Total	99	100%

Source: Researcher's Field Survey, 2024

The Research Question 3 is answered and the Objective 3 met, as all the respondents agreed that the prospects of AI outweigh its challenges. While 71 (71.8%) agreed strongly, 28 (28.3%) agreed but not strongly. No responses were received for SD and A. Thus, the responses, which have no opposites, are upheld. Therefore, since the prospects of AI outweigh its challenges, the dire need to integrate it into M&E for the realization of innovations in ETE cannot be overemphasized. It follows that the advocacy of this study is apt and supported by the respondents.

Table 6: There are several ways of ensuring significant and sustainable integration of AI into M&E.

Variables	Frequency	Percentage
SA	99	100
A	____	____
SD	____	____
D	____	____
Total	99	100%

Source: Researcher's Field Survey, 2024

As evident in Table 6 above, it is quite true that there are several ways of ensuring significant and sustainable integration of AI into M&E. All the

respondents concurred with the researcher on the point. The implication of this finding is that since different measures abound, the failure to do so is a question of unwillingness to integrate it into M&E and ETE in Nigeria and elsewhere.

Table 7: The following ways can be deployed to ensure significant and sustainable integration of AI into M&E.

Variables	Frequency	Percentage
(i) Research and writing, **(ii) Creating awareness about AI and its prospects and challenges using both new and old media, and various written and oral means of communication** **(iii) Conferences, seminars, workshops, webinars, etc.**	11	11.1
(iv) Stakeholder involvement, decisiveness, actions and support to institutions, departments, groups and individuals **(v) Interdisciplinary collaboration** **(vi) Favourable policies, and funding AI technologies and training personnel to be armed with the technical-know-how**	15	15.2
All of the above	73	73.7
None of the above	____	____
Total	99	100%

Source: Researcher's Field Survey, 2024

The ways identified by the researcher for ensuring significant and sustainable integration of AI into M&E are affirmed by all the respondents. Three sets of responses were obtained. For 73 of 73.7% respondents, having the highest ratio, all the variables (i-vi) are ways of ensuring significant and sustainable integration of AI into M&E. Additionally, while 11 (11.1%) chose only options (i)-

(iii), the 15 (15.2%) other respondents picked options (iv)-(vi) as the ways through which the integration of AI into M&E can be ensured. Based on statistical prominence, the 73 (73.7%) have it, while the others serve as supplements. By confirming the above listed ways of ensuring significant integration of AI into M&E for innovations in ETE, the present study is novel both qualitatively and quantitatively.

Conclusion

On the whole, this study has shown that although the adoption of AI for educational purposes is still currently low in developing nations like Nigeria and Cameroon, integrating AI into M&E is a pathway to attaining appreciable innovations in ETE. The study submits that combining AI with conventional epistemological approaches to scientific and non-scientific education can yield more results than the otherwise. The expected results are the innovations. These include optimizations, efficiency, accuracy, large data-based M&E, performance analysis, cost reduction, saving time and resources, etc. in M&E in particular and ETE as a whole. Thus, the integration of AI into M&E is of great value to the field as well as ETE as a whole.

Recommendations

The following recommendations are made:

i. All hands must be on deck to pursue the realization of sustainable and significant integration of AI into M&E for technological innovations in ETE and other spheres of education.
ii. Government and stakeholders in the sector should encourage the integration of AI into the field.
iii. Government and donor international agents should fund the purchase of AI technologies and the training on how to use them in Nigerian and Cameroonian tertiary institutions.

iv. Tertiary institutions in Nigeria, Cameroon and the like other nations should begin to run AI courses, as many of those in countries like UK, US, China, Korea, etc. are doing already.

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