Jurnal Pengabdian Masyarakat Formosa (JPMF)
Vol. 5, No. 2 (April) 2026: 119 - 128

Competency Improvement : Integration of Artificial Intelligence (AI) in Deep Learning

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A R T I C L E I N F O

Keywords: Artificial Intelligence, AI, Deep Learning, Competency, Economics

Received : 09, February
Revised : 10, March
Accepted: 28, April

A B S T R A C T

The training aimed to improve teachers' competence in integrating artificial intelligence (AI) into deep learning, especially for economics teachers who are members of MGMP Economics. The activity began with coordination, needs assessment, implementation of face-to-face activities, simulation and continuous online assistance. Participants were introduced to AI concepts, editing applications, and the practice of using artificial intelligence-based educational tools. Questionnaire quantitative data and qualitative feedback were analyzed using the IBM 27 SPSS, and showed positive responses from participants. The results also show understanding of the material, perceived benefits, and readiness to apply AI in the classroom. However, the diversity in digital readiness points to the need for project-based and sustainability training.

INTRODUCTION

The world of higher education is undergoing a transformation with the emergence of advanced technology, namely artificial intelligence (AI). In recent times, publications in the field of artificial intelligence in higher education have increased sharply, of course this reflects technological advances and their wider use. Researchers in the field of AI uncovered four main areas in AI, predictive analytics, adaptive learning, automated assessment, and educational experiences (Yunina, 2023; Zawacki-Richter et al., 2019). These findings will certainly change the teaching and learning process by adjusting individual needs, increasing engagement and improving student learning outcomes (Siminto et al., 2023).

In the utilization of AI in learning, one example is the Intelligent Tutoring System (ITS), providing real-time feedback and delivering appropriate content, this system even competes with human tutors (Pappas & Drigas, 2016). Likewise, adaptive learning frameworks and AI based analytical learning can be used to monitor continuous performance, providing proactive interventions to learners (Guo et al., 2024; Ouyang et al., 2023). Automating student work assessments and providing feedback as needed simplifies the academic process, allowing educators to focus on more meaningful interactions with students (Chen et al., 2020).

The latest developments, the emergence of many artificial intelligence platforms, one of which is Chat-GPT, highlight the role of AI that not only streamlines administration, but also in streamlining the learning process and curriculum design (Roméro et al., 2024). So that overall, this technological advancement indicates a shift in the way of thinking that artificial intelligence is not only a tool but is the main driver in the advancement of education, especially in higher education.

The use of artificial intelligence in education has emerged as a force in economic sustainability. With the efficiency of resource allocation used, AI contributes to lowering dropout rates at various levels, increasing retention, and equipping learners with essential and useful skills in a changing labor market. A more personalized learning environment is at the heart of the big change in the world of education, because utilizing AI can adapt to students' learning styles, speed, and needs, so that it is more equal and inclusive (YADAV, 2025). This adaptability provides an opportunity for educational institutions to allocate resources to those who need it most, ensuring learners can receive timely and effective support.

Research in the field of artificial intelligence, in addition to contributing to education, is also related to economic sustainability which emphasizes ethical frameworks, sustainable skills development, government policies that encourage equitable access in society (Kumar et al., 2025). Over time, with the increase in demand for AI-related professions, higher education must adjust its curriculum so that it can prepare students to face new roles in sustainable industries. However, the integration of sustainability in research and educational programs that focus on the utilization of AI is still fragmented (Kumar et al., 2025). The misalignment between education, economics and AI risks producing

graduates with less competencies in line with the principles of sustainability that are essential to building a resilient economy.

Although AI is widely researched in its application in higher education, its integration with economic sustainability is still less explored in depth. Interdisciplinary studies linking education, technology, economics and sustainability are indispensable to guide government policies, enrich curricula and ensure that AI advances can provide benefits to long-term economic resilience. But much of the research is still concentrated in social sciences and computer science, often ignoring the broader implications of AI use for sustainable economic practices. This raises key questions about the dominant areas in AI research and higher education, as well as the extent to which AI adoption and economic sustainability are being discussed. On the other hand, countries, the United Kingdom, China, the United States, India and Turkey make significant contributions in this field, the global network remains fragmented, limiting the potential for knowledge exchange and innovation between countries. Further questions are which countries and institutions play a significant role in shaping AI research in higher education, as well as what kind of international collaboration networks influence it. Ultimately, while AI adoption provides clear benefits in the world of learning and the efficiency of Institutions, integration with economic sustainability, especially in economics and business education curricula, is still underexplored. This underscores the need for an in-depth study of AI-related research in higher education that includes the issue of economic sustainability and identifies gaps in connecting AI competencies in the curriculum aimed at sustainability.

IMPLEMENTATION AND METHODS

The training program is carried out in the context of Community Service, using a phased approach that is integrated with each other. The series of activities began with coordination activities with partners, namely the chairman of MGMP Economics as a representative of teachers and members of the organization. Furthermore, analyze the needs of partners who will be used to prepare materials that are in line with the target. The core stage is hands-on training combined with interactive lectures, simulations of key activities and hands-on practice in applying AI. Furthermore, there is an intensive mentoring phase that is carried out online through the WhatsApp group application so that the activities and materials that have been provided are more effective. The evaluation of the activity was carried out comprehensively by sending a participant response questionnaire to collect quantitative data and direct suggestions from participants as supporting qualitative data. Participant response data was processed descriptively using the IBM SPSS Statistics 27 application to measure improved understanding and satisfaction, while qualitative data were processed using thematic analysis to identify challenges and follow-up needs. The validity of the test is verified through triangulation of data sources, including questionnaires, observations, and discussion documentation, resulting in a holistic and accurate evaluation.

Figure 1. Research Flow

RESULT AND DISCUSSION

Community Service Activities were carried out according to the previously planned schedule. Referring to the stages that have been planned in advance, starting with the first stage, namely Coordination with Partners. Coordination was carried out, among other things, to find out the problems faced by the Partners, namely the Economics Subject Teacher Deliberation Team (MGMP) in Sidoarjo Regency represented by the chairman of MGMP, Mr. Ainur Rofiq. The results of the discussion with the PKM team with representatives of the MGMP team are in line with the results of previous research found by related researchers regarding the ability to use Artificial Intelligence (AI) in the implementation of deep learning for teachers, especially those who are members of the MGMP Economics team in Sidoarjo Regency, East Java. The interview was conducted offline and online using ZOOM media with the Economics Subject Teacher Conference (MGMP) in Sidoarjo Regency who also conveyed the problems faced by teachers that were often discussed together during the regular meeting of the Economics Subject Teacher Meeting (MGMP) in Sidoarjo Regency (Indonesia).

In addition to discussing the problems faced by the Economics Subject Teacher Conference (MGMP) in Sidoarjo Regency, at this stage the PKM Team and Partners discussed the determination of the schedule for the implementation of training activities that can be carried out and the desired implementation location. The results of the coordination set several materials and schedules that have been agreed upon by the PKM team and partners, including material on theory and practice on the use of advanced Artificial Intelligence (AI) technology in the implementation of deep learning in economics subjects at the high school level by the main teachers who are members of the MGMP Economics team in Sidoarjo Regency. East Java. The second step of the PKM FEB Unesa Team is to prepare material delivery media that will later be used during the training activities. The material is made as effective and interactive as possible to create interaction between the resource person and the trainees.

In addition, the pkm team also prepares equipment and equipment as well as facilities and infrastructure to support the implementation of activities, including preparing event details, event concepts, documentation, equipment (LCD, additional cables, whiteboards, mic, speakers), training rooms, hand outs, souvenirs and so on. Pre-implementation preparation of activities is compiling administration including making invitation letters, borrowing classrooms, equipment (LCD, mic, speakers), designing activity flyers, activity posters, certificate designs, assignment collection gforms, whatsapp groups, gform

feedback questionnaires for implementation activities, and others. The socialization of the event was carried out by disseminating information through the WA Group of Economics Subject Teacher Deliberation (MGMP) throughout Sidoarjo Regency and through online flyers. Socialization information contains details of activities including materials, resource persons, details of implementation times, place of implementation, registration links and contact persons.

The third stage is the training implementation stage, the training is carried out directly (offline) and continued with intensive assistance online through WAG (WhatsApp Group). The presenters have prepared interesting ppt and hand out material displayed during the implementation of the activity. In addition, participants also directly practice applying the knowledge that has been gained and receive direct assistance from resource persons. The offline workshop was held at the Sidoarjo Regency Sports High School Auditorium on Saturday, May 10, 2025 starting at 7.30 am. Here the resource persons are the economic education pkm team consisting of Wida Wulandari, Prof. Dr. Waspodo Tjipto Subroto, M.Pd, Eka Hendi Andriansyah, Riza Yonisa Kurniawan, and Albrian Fiky Prakoso. Participants were also given the opportunity to ask questions directly to the resource persons related to the material that had been presented. Participants were very active in asking questions, namely about how to use artificial intelligence in the implementation of deep learning.

After the implementation of the offline artificial intelligence use workshop has been carried out, the next stage is the implementation of the knowledge that has been given to the participants. Furthermore, assistance to improve the ability to use artificial intelligence in the implementation of deep learning was carried out intensively through the WA group which was attended by all participants. Materials or media that have been displayed in offline activities are distributed to the participants to be used as a guide for the use of artificial intelligence. One of the online mentoring is to facilitate and accelerate understanding and ability to utilize artificial intelligence-based applications in applying deep learning, especially in economics, without disrupting the schedule of activities of teachers who are actively active in school. In addition, online assistance through the WA group makes it easier and faster for the participant market in the question and answer process because the speakers are members of the group.

The implementation of the evaluation of pkm activities by the pkm team is carried out through the collection of participant response data at the beginning before the training activity and after the training activity is carried out. Pesertra is spread from various schools in Sidoarjo Regency, East Java which are members of the Sidoarjo Regency Economics Subject Teacher Conference (MGMP). The following is a descriptive description of the graph and the results of the questionnaire answered by the participants of the AI Implementation in Deep Learning training for MGMP Economics teachers in Sidoarjo Regency which can be used to complete the results analysis section.

The bar graph shown in figure 2 represents the distribution of the trainees' answers to each questionnaire question item in detail in Indonesian. Each questionnaire question, such as understanding AI concepts, the use of AI in

education, and the need for advanced training, is displayed along with the number of participants in each answer category, such as "Very Good", "Good", "Sufficient", "Very Understanding", "Very Useful", and so on.

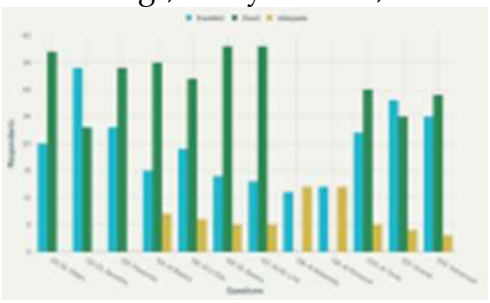

Figure 2. Practical Activity Assistance

In general, the graph shows that the majority of MGMP Economics Sidoarjo teachers already have a positive understanding and perception of training materials, resource persons, and the benefits of Artificial Intelligence (AI) and Deep Learning technology in education. Each bar on the graph shows a confirmative tendency, meaning that most participants choose the highest category in each assessment item. For example, for understanding the steps of Deep Learning implementation, the categories "Understand" and "Highly Understand" dominate. The majority of the benefits of training for teaching were also answered "Very Useful" or "Useful". The assessment of the resource persons is generally at the point of "Agree" to "Strongly Agree".

Table 1 is the result of data processing that shows the data processing of 13 questions (X1- X13) that have been filled in by artificial intelligence training participants in deep learning. Each question item is measured using a 4-point likert scale, this point indicates a higher value at a greater level of understanding, benefit or ability according to the respective question asked. The table shows that the average for all items is in the range of 2.98 to 3.60, which can be interpreted that participants respond to categories that are quite high to high. It is also shown that there are no items with a value below 2.5, so it can be interpreted that the participants have a good perception of the training that the participants participate in.

The minimum score ranged from 1 to 3, while the maximum score was consistent at a score of 4, indicating that the majority of participants gave their opinions on the positive category. The standard deviation value is in the range of 0.481 to 0.655, this shows that there is a variation in participants' responses at a moderate level, but this shows a tendency to vary perceptions from the teachers participating in the activity.

Table 1. Descriptives Statistic

N	Minimum	Maximum	Mean	Std.

						Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
X1	57	3	4	3,35	0,064	0,481
X2	57	3	4	3,60	0,066	0,495
X3	57	3	4	3,40	0,066	0,495
X4	57	2	4	3,14	0,081	0,611
X5	57	2	4	3,23	0,083	0,627
X6	57	2	4	3,16	0,074	0,560
X7	57	1	4	3,11	0,082	0,618
X8	57	2	4	3,37	0,085	0,645
X9	57	2	4	2,98	0,085	0,641
X10	57	2	4	3,00	0,087	0,655
X11	57	2	4	3,30	0,083	0,626
X12	57	2	4	3,42	0,083	0,625
X13	57	2	4	3,39	0,078	0,590

The descriptive analysis of the data obtained on 13 question items provides an overview of artificial intelligence (AI) and deep learning training for teachers who are members of the Sidoarjo Regency Economics MGMP has a significant positive impact. Furthermore, this can increase the understanding, perception of benefits, and also the initial ability of the participants of the activity in applying today's modern technology, namely artificial intelligence (AI) to economic learning in the classroom. In general, all mean scores are in the range of 2.98 – 3.60, this shows that teachers' assessments of the training followed are in the category of quite high. This assessment proves that the majority of participants give a positive response and have a strong perception of the effectiveness of artificial intelligence training and deep learning organized by the PKM team. According to research from Muzaffer Pınar Babanoğlu, Tuçe ÖUse the "Insert Citation" button to add citations to this document. ztürk Karataş (2025) proves that the digital readiness of teachers still needs to be improved through continuous practice and intensive mentoring, especially the mastery of artificial intelligence-based technology in learning.

The results of descriptive data processing identified that there was diversity in the answers of training participants. This diversity can be interpreted

as differences in the level of digital literacy, experience in using technology, and also the level of readiness per individual in understanding new knowledge. This was also found in the research of Johansen & Jeno (2023) which revealed that relevant activity materials have a direct effect on motivation and the application of technology in learning. Thus, the training held was able to provide a strong view for teachers regarding the urgency and potential implementation of AI in deep learning, especially in economics subjects.

However, on the other hand, the lowest average score was found in question 9 (2.98) and question 10 (3.00). Although it is still in the middle category, this data shows that there are several things in training, especially related to advanced understanding or deeper application, which are still felt to be less than optimal for some teacher participants. This is in line with the research submitted by Khalil & Alsenaidi (2024) that the readiness of digital mastery in teachers still needs to be strengthened through continuous practice and intensive mentoring, especially in the use of artificial intelligence technology.

The standard deviation value in the range of 0.481 to 0.655 indicates a moderate variation in the participants' answers to the questionnaire given. This diversity can be understood as there are differences in levels of digital mastery, experience in using technology, and also individual readiness to learn new knowledge. Research that supports this is from Caberos & Dioso (2025) which reveals that the diversity of teachers' ability to adopt digital technology is a common phenomenon, so follow-up mentoring activities need to be carried out. Overall, the results of the analysis of each item revealed that the training carried out not only improved the conceptual understanding of teachers, but also provided practical insights on the implementation of artificial intelligence in students' deep learning. Participants (teachers) argued that they were able to use AI to organize learning (item no. 7), gain new knowledge, namely the AI platform (X8), and in general they assessed that the training that had been carried out was useful (X9 and X12). Some of these things support the practice-based training model and mentoring delivered by the OECD (2025) which emphasizes the importance of a blended approach, namely face-to-face and online mentoring in teacher professional development programs.

Thus, the training that has been held can be categorized as successful and relevant in an effort to improve the digital competence and pedagogy of teachers who are members of the MGMP Economics organization, towards the use of artificial intelligence and deep learning. However, the existence of several question items with monetary value and diverse responses from activity participants is enough to indicate that teachers still need further training, especially training that is practical and project-based. [continuous support such as through WhatsApp Group is considered effective in maintaining learning consistency and providing quick solutions to the obstacles faced by teachers.

CONCLUSIONS AND RECOMMENDATIONS

The results of the data analysis that have been carried out can be taken several important things related to the training that has been carried out on the use of artificial intelligence and deep learning for MGMP Economics teachers, has run effectively and has a significant positive impact on improving the competence of

participants (teachers). All question items in the questionnaire show an average score (mean) in the category of quite high to high, which can be interpreted that participants receive positively and there is an increase in the participants' understanding of the material that has been presented in the training.

The training carried out is also considered to be able to improve understanding of the basic concepts of artificial intelligence and deep learning and provide real benefits to participants, especially in the relevance of the material to the needs of economic learning. In addition, the training held can build the initial ability of participants (teachers) to implement artificial intelligence-based technologies, such as learning settings and the use of educational AI platforms. It doesn't stop there, the training provides an overall beneficial training experience, for participants.

Although the training was well received by the participants, there is still a difference in the level of digital readiness between participants, this confirms the need for further mentoring programs and advanced training so that teachers can optimally apply AI and deep learning in learning activities.

ACKNOWLEDGMENT

The authors would like to express their sincere appreciation to all parties who contributed to the successful implementation of this community service activity, especially the institutional partners, participants, and organizing team whose cooperation and enthusiasm supported the integration of Artificial Intelligence (AI) in deep learning competency improvement; their active involvement and support were invaluable to the achievement of the program objectives and expected long-term impact on capacity development.

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