Empowering Asian Students Through Artificial Intelligence: A Workshop On Predicting Plant Growth To Support Smart Farming

Nurchim[1*], Nurmalitasari[2]

[1,2] Faculty of Computer Science, Universitas Duta Bangsa Surakarta, Indonesia
[*] Corresponding Author:
Email: nurchim@udb.ac.id

Abstract.

The integration of Artificial Intelligence (AI) in agriculture has revolutionized traditional farming practices, enhancing productivity, efficiency, and sustainability. This study highlights a workshop aimed at equipping students with practical AI skills, specifically focusing on linear regression techniques for crop growth prediction. The workshop, involved 55 students from nine Asian countries, fostering cross-cultural collaboration. Participants were introduced to theoretical concepts and engaged in hands-on training, covering data preprocessing, region of interest extraction, and model implementation using Python. The program emphasized the role of AI in addressing agricultural challenges such as resource optimization and food security.The workshop was conducted in five stages: preparation, implementation, evaluation, dissemination, and participant engagement. Pre and post-test evaluations revealed a significant improvement in participants' AI knowledge, with average scores increasing from 45% to 85%. Practical activities enabled students to connect theoretical knowledge with real-world applications, enhancing their ability to predict crop growth using AI techniques. Dissemination efforts included reports and publications to inspire similar global initiatives. The results demonstrated the workshop's effectiveness in bridging knowledge gaps, fostering sustainable agricultural practices, and preparing a skilled workforce capable of leveraging AI to address future challenges in smart farming.

Keywords: *Artificial Intelligence, Smart Farming, Linear Regression, and Prediction.*

I. INTRODUCTION

Integrating Artificial Intelligence (AI) in agriculture has revolutionized traditional farming practices, transitioning towards smart farming that enhances productivity, efficiency, and sustainability (Holzinger *et al.*, 2022; Yağ and Altan, 2022). Smart farming utilizes AI technologies to optimize decision-making processes by enabling precise monitoring and management of crops, water usage, and soil conditions (Sarma *et al.*, 2022). For instance, implementing AI-powered systems has significantly improved yield prediction, pest detection, and efficient resource allocation (Liu *et al.*, 2023). Such advancements have addressed several challenges in smart farming, including climate variability, limited arable land, and increasing food demand. However, despite the potential of AI in smart farming, its adoption remains uneven, primarily due to limited awareness, accessibility, and training opportunities in developing regions.Linear regression is a statistical method used in AI for modelling the relationship between a dependent variable and one or more independent variables (van Kooten *et al.*, 2022) widely perform well in explaining variance in phenotypic data, aiding efficient plant breeding programs in smart farming (John *et al.*, 2022). This method establishes relationships between dependent variables, such as plant growth rates, and independent variables, including temperature, humidity, and nutrient levels (Camacho *et al.*, 2023). Recent studies demonstrate the application of linear regression to accurately predict crop yields, assisting farmers in planning and optimizing their agricultural practices (Lahza *et al.*, 2023).

For example, research on regression models in agriculture has proven effective in analyzing the impact of environmental factors on wheat and rice productivity (Sidhu *et al.*, 2023). Linear regression provides a practical and reliable approach for informed decision-making in innovative farming systems by leveraging historical data and identifying growth trends (Nyéki and Neményi, 2022).Despite these advancements, several barriers hinder the widespread adoption of AI and data-driven approaches in agriculture. One of the critical challenges is the lack of technical expertise among farmers and agricultural practitioners, which limits their ability to utilize advanced tools effectively (Ahsan *et al.*, 2023). The digital divide between urban and rural areas also exacerbates this issue, as rural communities often have restricted access to technological infrastructures, human resources, and training programs (Agusta, 2023). Educational initiatives, such as workshops and training sessions, are crucial for addressing these challenges and fostering the adoption of AI in agriculture, especially among the younger generation (Williams *et al.*, 2023). The study highlights the need for early training and mentoring for students as the younger generation with skills to apply AI technologies in real-world scenarios, not just agriculture (Park and Kwon, 2024). Thus, training and mentoring students in applying artificial intelligence is necessary. This activity aims to provide practical training to students on AI applications with a case study of agriculture, focusing on linear regression techniques for crop growth prediction.

The workshop combined theoretical knowledge with hands-on exercises, enabling participants to understand the fundamental concepts of AI and their practical applications in smart farming. Students were introduced to data collection, preprocessing, and analysis by working with real-world datasets, ensuring they could apply these skills effectively in their future careers. Moreover, the workshop emphasized the importance of integrating AI in agriculture to address food security challenges and improve sustainability.This paper details the workshop's methodology, implementation, and outcomes, demonstrating its effectiveness in enhancing students' competencies in AI-based agricultural practices. The findings underscore the significance of educational interventions in bridging knowledge gaps and promoting the adoption of AI technologies in farming. Through initiatives like these, the agricultural sector can leverage the transformative potential of AI, ensuring efficient resource use, increased productivity, and sustainable farming practices. Such efforts contribute to technological advancements and building a workforce capable of addressing the future challenges of smart farming.

II. METHODS

The method consists of five primary stages: preparation, implementation, evaluation, dissemination, and participant engagement as shown in Figure 1.

Fig 1. Empowerment stages

a. Preparation

The preparatory phase identified 55 students from 9 Asian countries, including Indonesia, Japan, Madagascar, Thailand, Yemen, Palestine, Timor Leste, Vietnam, and Laos. A preliminary survey assessed their basic knowledge of AI and smart agriculture. Then, workshop modules will be created, including theoretical and practical AI materials. In addition, supporting devices such as computers, data sets, and Python software were needed. The workshop at the Teaching Factory of Duta Bangsa University Surakarta involved interactive and hands-on learning.

b. Implementation

The workshop was conducted over two days of theoretical and practical sessions in August 2024. Participants were introduced to smart farming, AI applications, and linear regression for plant growth prediction. Practical activities included data preprocessing, Region of Interest (ROI) extraction, applying linear regression models, and interpreting results using Python. Group work fostered collaboration, while facilitators provided real-time guidance to enhance learning.

c. Evaluation

The workshop's effectiveness was evaluated through pre- and post-tests, assessing participants' understanding of AI concepts and skills in implementing linear regression models. Feedback forms were used to evaluate the clarity of materials and facilitator performance. Participants presented their findings, allowing facilitators to assess their practical application of learned techniques.

d. Dissemination

The outcomes of the initiative were documented in reports and journal articles to share best practices and inspire the broader adoption of innovative approaches. Participants are encouraged to apply the knowledge gained in their respective countries, integrating it into their professional and personal lives. By sharing their experiences and success stories with peers, they contribute to a collaborative exchange of ideas. This effort fosters a global network of professionals committed to driving positive change and innovation in their fields.

e. Participant Engagement

Participants from diverse countries and academic backgrounds collaborated in an inclusive learning environment. The venue, Universitas Duta Bangsa Surakarta's Teaching Factory, provided well-equipped facility for effective hands-on training. This collaboration fostered cross-cultural exchanges and enriched the workshop experience.

III. RESULT AND DISCUSSION

3.1 Result

The empowering Asian students through artificial intelligence successfully equipped participants with essential knowledge and practical skills in AI applications for agriculture. The outcomes of the workshop are summarized as follows:

a. Participant Demographics

Fig 2. Participants from Asian students

A total of 55 Asian Students participated in the workshop (Figure 2), representing diverse academic disciplines. The participants were from Indonesia, Japan, Madagascar, Thailand, Yemen, Palestine, Timor Leste, Vietnam, and Laos, bringing unique perspectives and fostering a rich, multicultural environment. Their diverse backgrounds contributed to meaningful discussions on the role of AI in addressing agricultural or daily activities challenges across different regions.

b. Pre and Post-Test Results

Fig. 3. Pre-test process

The pre-test (Figure 3) results showed an average score of 45%, reflecting limited baseline knowledge of AI applications in agriculture. Following the workshop, the post-test scores increased significantly to an average of 85%, demonstrating substantial improvements in understanding AI concepts and implementing linear regression models. Figure 4 below illustrates the comparison of pre and post-test results, showing the percentage of participants scoring within different ranges before and after the workshop.

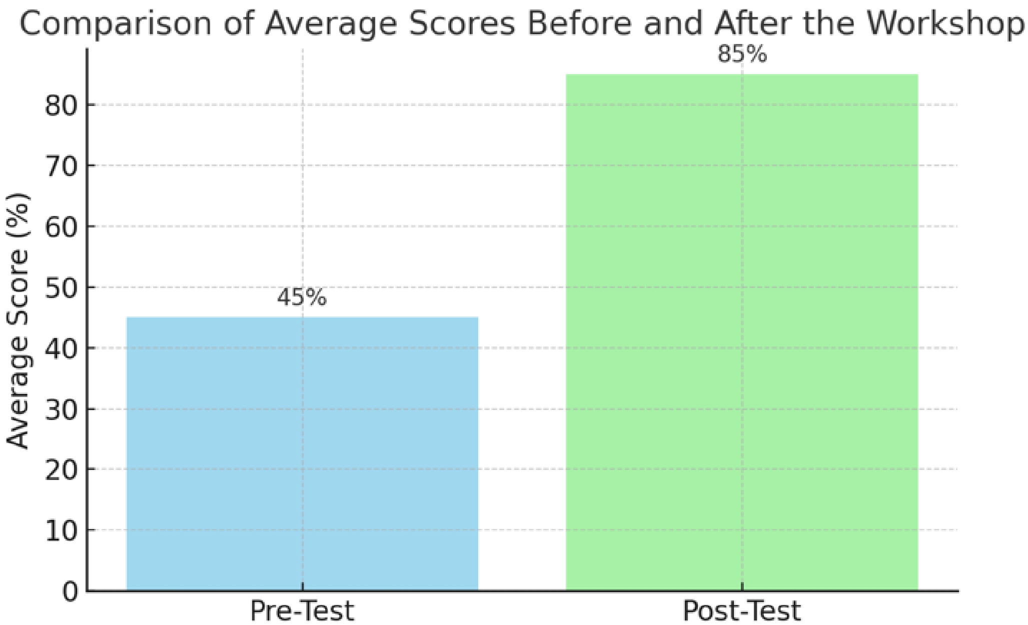

Fig 4. Pre and post-test results regarding AI comprehension

c. Hands-On Practice Outcomes

Fig 5. Training process

The workshop emphasized practical training (Figure 5), allowing participants to engage with real-world datasets and apply linear regression techniques effectively. Participants began by preprocessing data, where they successfully cleaned and normalized datasets to ensure readiness for analysis, gaining an understanding of how data quality impacts prediction reliability. Next, they performed Region of Interest (ROI) extraction to focus on specific data points, such as plant growth parameters, enabling them to concentrate on relevant features for modeling. Using Python language programming and Jupyter Notebook software (Figure 6), participants developed linear regression models to predict plant growth based on environmental variables, showcasing a high level of proficiency in coding and model interpretation by the session's end. The dynamic nature of Python, which allows for rapid development, poses challenges for automated test generation (Lukasczyk, Kroiß and Fraser, 2023). Finally, they analyzed model outputs, including slope, intercept, and prediction accuracy, to derive actionable insights, demonstrating their ability to connect theoretical concepts with practical applications to predict plant growth and interpret the results accurately in smart farming.

AI for Prediction Plant Growth using Linear Regression

August 5, 2024

[1]:
```
#import library
import numpy as np
import pandas as pd
import joblib as jb
from sklearn.linear_model import LinearRegression
```

[6]:
```
# load data
data = pd.read_excel("data1.xlsx")
```

[7]:
```
data
```

[7]:

	height	leaves
0	8.0	3
1	9.5	4
2	10.0	4
3	11.0	4
4	11.5	5
5	12.0	5
6	13.0	5
7	15.0	7
8	18.0	7
9	18.5	8
10	19.5	9
11	22.0	10
12	22.5	10
13	24.5	11
14	26.0	12

[8]:
```
#dataset
X = np.array(data[['height']])
Y = np.array(data[['leaves']])
```

[9]:
```
#create model regression
model = LinearRegression().fit(X,Y)
```

Fig 6. AI implementation practice module for crop growth prediction

3.2 Disccusion

The workshop's dissemination and application efforts highlight its potential to inspire global adoption of similar initiatives in AI and smart farming. Participants expressed their commitment to implementing the knowledge gained in their home countries, with outcomes documented in reports and articles that offer valuable insights for future programs. The dissemination materials are crafted to encourage institutions worldwide to organize comparable workshops, extending the reach and impact of AI advancements in agriculture. Notably, the significant improvement in post-test scores and the high completion rates for practical tasks underscore the effectiveness of the workshop in addressing knowledge gaps in AI applications for agriculture.

A combination of practical training, cultural diversity, and a focus on foundational AI techniques contributed to the workshop's success. The hands-on approach using real-world datasets enabled participants to link theoretical concepts with practical applications, reinforcing complex ideas through experiential learning. This method enabled students to grasp fundamental AI concepts while examining their significance in their own lives, encouraging a thoughtful perspective on AI's influence in society (Williams *et al.*, 2023). The multicultural composition of participants enriched discussions, fostering innovative solutions and broadening perspectives on agricultural challenges. Additionally, the emphasis on linear regression, a foundational AI technique, provided participants with tools to improve crop yield predictions. Linear regression in capturing complex relationships, suggesting that while it is foundational, more advanced methods can yield better predictive accuracy (Gomez-Cravioto *et al.*, 2022). Together, these elements demonstrate the workshop's comprehensive and impactful design.

IV. CONCLUSION

The workshop on empowering students through artificial intelligence successfully highlighted the transformative role of AI in agriculture. The initiative combined theoretical knowledge and hands-on training, allowing participants to explore the potential of AI techniques, such as linear regression, to address challenges in smart farming. By engaging participants in real-world data analysis, the workshop bridged the gap between conceptual understanding and practical application, enabling students to predict crop growth accurately. The diversity among participants fostered cross-cultural exchanges and enriched discussions on how AI can address region-specific agricultural challenges, enhancing the relevance and global applicability of the skills acquired.

The program's effectiveness was evident in the significant improvement in participants' comprehension of AI, as shown by the leap in post-test scores. This success underscores the value of structured, immersive training in fostering AI literacy. Furthermore, the dissemination of the workshop outcomes through reports and publications aimed to inspire similar global initiatives, ensuring a broader impact on sustainable agricultural practices. By equipping students with the tools to integrate AI into agriculture, the workshop not only advanced technological capabilities but also contributed to building a future-ready workforce poised to address pressing food security and sustainability challenges.

REFERENCES

[1] Agusta, Y. (2023) ‘Managing the Development of a Sustainable Digital Village’, *Sustainability (Switzerland)*, 15(9). doi: 10.3390/su15097575.

[2] Ahsan, M. B. *et al.* (2023) ‘Barriers, Challenges, and Requirements for ICT Usage among Sub-Assistant Agricultural Officers in Bangladesh: Toward Sustainability in Agriculture’, *Sustainability (Switzerland)*, 15(1). doi: 10.3390/su15010782.

[3] Camacho, J. *et al.* (2023) ‘Variable-selection ANOVA Simultaneous Component Analysis (VASCA)’, *Bioinformatics*, 39(1). doi: 10.1093/bioinformatics/btac795.

[4] Gomez-Cravioto, D. A. *et al.* (2022) ‘Supervised machine learning predictive analytics for alumni income’, ***Journal of Big Data***, 9(1). doi: 10.1186/s40537-022-00559-6.

[5] Holzinger, A. *et al.* (2022) ‘Needs Human-Centered AI : Challenges and Future Directions’, *Sensors*,22,pp.1–35.

[6] John, M. *et al.* (2022) ‘A comparison of classical and machine learning-based phenotype prediction methods on simulated data and three plant species’, *Frontiers in Plant Science*, 13(November), pp. 1–16.

[7] van Kooten, R. T. *et al.* (2022) 'Conventional regression analysis and machine learning in prediction of anastomotic leakage and pulmonary complications after esophagogastric cancer surgery', ***Journal of Surgical Oncology***, 126(3), pp. 490–501. doi: 10.1002/jso.26910.

[8] Lahza, H. *et al.* (2023) 'Optimization of Crop Recommendations Using Novel Machine Learning Techniques', *Sustainability (Switzerland)*, 15(11), pp. 1–18. doi: 10.3390/su15118836.

[9] Liu, Z. *et al.* (2023) 'Artificial Intelligence in Food Safety: A Decade Review and Bibliometric Analysis', *Foods*, 12(6). doi: 10.3390/foods12061242.

[10] Lukasczyk, S., Kroiß, F. and Fraser, G. (2023) *An empirical study of automated unit test generation for Python*, *Empirical Software Engineering*. Empirical Software Engineering. doi: 10.1007/s10664-022-10248-w.

[11] Nyéki, A. and Neményi, M. (2022) 'Crop Yield Prediction in Precision Agriculture', *Agronomy*, 12(10), pp. 10–13. doi: 10.3390/agronomy12102460.

[12] Park, W. and Kwon, H. (2024) 'Implementing artificial intelligence education for middle school technology education in Republic of Korea', ***International Journal of Technology and Design Education***, 34(1), pp. 109–135. doi: 10.1007/s10798-023-09812-2.

[13] Sarma, K. K. *et al.* (2022) 'Learning Aided System for Agriculture Monitoring Designed Using Image Processing and IoT-CNN', *IEEE Access*, 10, pp. 41525–41536. doi: 10.1109/ACCESS.2022.3167061.

[14] Sidhu, B. S. *et al.* (2023) 'How can machine learning help in understanding the impact of climate change on crop yields?', *Environmental Research Letters*, 18(2). doi: 10.1088/1748-9326/acb164.

[15] Williams, R. *et al.* (2023) *AI + Ethics Curricula for Middle School Youth: Lessons Learned from Three Project-Based Curricula*, ***International Journal of Artificial Intelligence in Education.*** Springer New York. doi: 10.1007/s40593-022-00298-y.

[16] Yağ, İ. and Altan, A. (2022) 'Artificial Intelligence-Based Robust Hybrid Algorithm Design and Implementation for Real-Time Detection of Plant Diseases in Agricultural Environments', *Biology*, 11(12). doi: 10.3390/biology11121732.