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Artificial Intelligence Education and Training Based on Machine Learning and Computer Vision to Improve Technological Literacy of Bina Satria Vocational School Students in Medan City

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Abstract

The development of Artificial Intelligence (AI) technology has had a significant impact on various sectors, including education. However, the level of technological literacy, particularly related to Machine Learning and Computer Vision, among students is still relatively low, so educational efforts are needed to improve students' understanding and skills in these technologies. This community service activity aims to improve the technological literacy of SMK Bina Satria Medan City students through practice-based education and training on the basic concepts of Artificial Intelligence, Machine Learning applications, and the implementation of Computer Vision using easily accessible software. The implementation method of this activity includes the stages of needs identification, material preparation, socialization, demonstration, direct practice using Google Colab, and evaluation through pre-tests and post-tests. The training materials include an introduction to Artificial Intelligence, types of Machine Learning, digital image processing, image classification using Convolutional Neural Networks (CNN), and a simple implementation of Computer Vision for object recognition. The results of the activity showed an increase in participants' knowledge and understanding of Artificial Intelligence concepts, as indicated by an increase in evaluation scores after the training. In addition, participants were able to independently implement a simple model for image classification using the Google Colab environment. This activity positively contributes to improving students' digital competencies while preparing them for technological advancements in the Industrial Revolution 4.0 and Society 5.0. It is hoped that similar activities can be implemented sustainably with broader coverage to support human resource development in the information technology sector.

Keywords: Artificial Intelligence, Machine Learning, Computer Vision, Tech Literacy, Google Colab

1. Introduction

The development of digital technology in the Industrial Revolution 4.0 era and the transformation towards Society 5.0 has encouraged the use of Artificial Intelligence (AI) as a technology that plays a vital role in various fields, including education, health, industry, agriculture, and public services. AI is no longer only used by researchers or the technology industry, but has become part of everyday life through various applications such as recommendation systems, chatbots, facial recognition, automatic translators, and autonomous vehicles. This condition demands the world of education to prepare students to have AI literacy so they are able to understand the basic concepts, how it works, benefits, limitations, and ethics of using this technology [1].

One of the main branches of Artificial Intelligence that is developing very rapidly is Machine Learning (ML). Machine Learning allows computers to learn patterns from data without having to be explicitly programmed so that they are able to make predictions, classifications, and automatic decision-making. The development of Machine Learning has also given birth to various Computer Vision applications, namely technology that allows computers to recognize, identify, and analyze objects from digital images and videos. Currently, Computer Vision has been used in security systems, manufacturing industries, smart agriculture, autonomous vehicles, medical diagnosis, and facial recognition-based attendance systems. Therefore, mastering the basic concepts of Machine Learning and Computer Vision is one of the important competencies that need to be introduced to students starting from vocational secondary education level [2].

Vocational High Schools (SMK) play a strategic role in producing graduates who are ready to enter the workforce or continue their education to a higher level.

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As industry demands a digitally competent workforce increase, the ability to understand Artificial Intelligence (AI) is becoming a highly sought-after skill. Various industrial sectors are beginning to implement AI-based automation systems to improve efficiency, accuracy, and productivity. This situation indicates that vocational high school graduates are not only required to master conventional technical skills but also need to understand the latest digital technologies to be able to compete in the era of digital transformation [3].

On the other hand, the implementation of Artificial Intelligence learning in schools still faces various challenges. Some of these include teachers' limited understanding of AI, the lack of easy-to-use learning media, the lack of practical activities, and students' low technological literacy regarding the concepts of Machine Learning and Computer Vision. Most students only know AI as applications such as ChatGPT or image-making media, without understanding the working principles of algorithms or their application in solving various real-world problems. This condition indicates the need for educational activities that are not only theoretical, but also provide direct practical experience to students [4], [5].

Artificial Intelligence Literacy is an individual's ability to understand the basic concepts of AI, use AI technology effectively, critically evaluate AI-generated results, and consider ethical aspects in its use. AI literacy not only focuses on the ability to use AI-based software, but also includes an understanding of data processing, model training, result interpretation, and its impact on society. With increasing AI literacy, students are expected to be able to become intelligent technology users and have the ability to develop AI-based solutions according to future needs [6].

One approach considered effective for improving AI literacy is through hands-on learning. In this approach, participants not only receive theoretical explanations but also conduct simple simulations and implementations using readily accessible software, such as Python, Google Colab, or Google Teachable Machine. Through hands-on practice, students can understand the process of training Machine Learning models, object recognition using Computer Vision, and how to evaluate model prediction results in a simple manner. Research shows that project-based and hands-on learning can improve understanding of AI concepts while increasing student learning motivation [7].

Bina Satria Vocational School in Medan City is a vocational school with significant potential to develop students' digital competencies. However, based on partner needs identification, material on Artificial Intelligence, specifically Machine Learning and Computer Vision, has not been a primary component of student training or skills development activities. Most students still have a limited understanding of AI concepts and have never had practical experience using AI learning platforms. Student literacy levels are very low in understanding AI. The number of students in this community service was 22 students, and the analysis of the results was conducted using pre- and post-tests. This situation, as evidenced by interviews, presents both opportunities and challenges for higher education institutions to implement community service activities that can bridge this need through systematic education and training programs.

This community service program is designed in the form of education and training that combines material delivery, demonstrations, hands-on practice, discussions, and learning evaluations. The material provided includes an introduction to Artificial Intelligence, the basics of Machine Learning, the concept of Computer Vision, digital image processing, and the implementation of image classification using simple models. In addition to improving technical skills, this activity also provides an understanding of the ethics of using AI, data security, and career opportunities in the field of artificial intelligence so that students have a more comprehensive insight into current technological developments [8].

Through the implementation of this activity, it is hoped that there will be an increase in technological literacy of SMK Bina Satria Medan City students, especially in understanding the basic concepts of Artificial Intelligence, Machine Learning, and Computer Vision [9], [10]. In addition, this activity is expected to be able to improve students' practical skills in utilizing AI-based software to solve simple problems and foster their interest in developing competencies in the field of information technology. Thus, SMK graduates are expected to be better prepared to face the challenges of the world of work and higher education in the era of increasingly developing digital transformation [11], [12].

2. Methods

The tools used in this community service activity are tailored to the needs of educational implementation and the application of artificial intelligence technology. The tools used include:

1. Laptop/Computer: Used as the primary device for Artificial Intelligence, Machine Learning, and Computer Vision concepts, processing image datasets, and presenting educational materials to participants.
2. Smartphone/Digital Camera: Used to capture live images of objects in the field. These images are then used as real-world examples in detection demonstrations.
3. Projectors and Presentation Screens are used to display materials, tutorial videos, detection processes, and Artificial Intelligence analysis

results to students during educational and training sessions.
4. An internet/Wi-Fi connection is required to download AI models, perform system updates, synchronize data, and support interactive demonstrations for students.
5. The Artificial Intelligence application serves as the primary software used to detect objects based on images. This system includes a visual interface, AI modules, and educational features.
6. Learning Modules and User Guides, in the form of teaching materials, brochures, or pocket books, provide explanations to improve participants' knowledge and understanding of the concepts of Artificial Intelligence, Machine Learning, and Computer Vision.
7. Field Samples: Used as practical materials and live demonstrations for students to observe actual detection.
8. Field Workbenches and Supporting Equipment: Such as baseboards, cutters, rulers, or writing utensils to support direct observation and sample collection.

The materials used in community service activities with the theme "Artificial Intelligence Education and Training Based on Machine Learning and Computer Vision to Improve Technological Literacy of Students of Bina Satria Vocational School, Medan City" include:

1. Artificial Intelligence Software: Python-based applications, Google Colab, and Matlab, consisting of computer vision, machine learning, and detection educational interfaces.
2. Object Dataset: Images of rice objects infected with diseases such as leaf blight, brown spot, and bacterial blight, used as educational materials and disease detection demonstrations.
3. Educational Material/Learning Module: includes slides, general material on Artificial Intelligence, types of Machine Learning, digital image processing, image classification using Convolutional Neural Networks (CNN), and a simple implementation of Computer Vision for object recognition.
4. Evaluation form: pre-test and post-test evaluation score improvement after training: Used to assess student understanding before and after the activity.

Participants in the community service activity carried out at SMK Bina Satria, Medan City, included 22 12th-grade or 3rd-grade students. The time and duration of this community service activity started at 09.00 to 12.00 WIB, with a duration of 3 hours. In this activity, students were given an introduction and in-depth understanding of Artificial Intelligence, types of Machine Learning, digital image processing, image classification using Convolutional Neural Networks (CNN), and a simple implementation of Computer Vision for object recognition.

Results and Discussions

The results and discussion of the educational material presented by the speaker to the students of SMK Bina Satria Medan City were very interesting and filled with students' curiosity about technological developments. This community service focused on objects in the students' surroundings, where they could understand directly. This community service also included knowledge of Artificial Intelligence-based technology, types of Machine Learning, digital image processing, image classification using Convolutional Neural Networks (CNN), which can be used to identify and classify objects.

Some of the educational materials provided at SMK Bina Satria, Medan City, are shown in Figure 1 below.

Figure 1. Opening greetings to students Source: Azrina Private Madrasah, Elementary School

Figure 1 above shows the opening and introductory greeting given by the presenter to the students. The students' high level of enthusiasm is clearly visible, with the hope of understanding the material on Artificial Intelligence.

The material will be presented live using an LCD projector and presentation screen, and students will be directly tested or practiced to understand and run AI, as shown in Figure 2 below.

Figure 2. Education for students regarding the development of Computer Vision Technology for rice diseases

Figure 2 above shows a warm interaction between the speaker and students of Bina Satria Vocational School, Medan City. The material presented relates to technological developments, about Artificial

Intelligence, types of Machine Learning, digital image processing, image classification using Convolutional Neural Network (CNN), and a simple implementation of Computer Vision for object recognition. Computer vision (CV) is a branch of science that focuses on digital images, meaning the data used is digital, including photos, videos, and other visual forms. Images are processed using several supporting methods, such as image segmentation. After this process is complete, the algorithm is implemented in the Python/colab programming language. The form of AI created and taught by the speaker to students is shown in Figure 3 below.

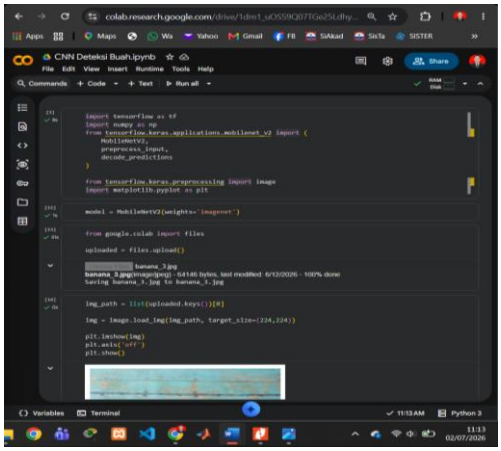

Figure 3. AI fruit detection algorithm implemented in colab

Figure 3 above shows the fruit object detection algorithm using Colab. The first step is to import TensorFlow as the model's import code. This is followed by the coding for uploading the object to be detected. The third section presents the coding for displaying the object uploaded in the previous step, as seen in Figure 4 below.

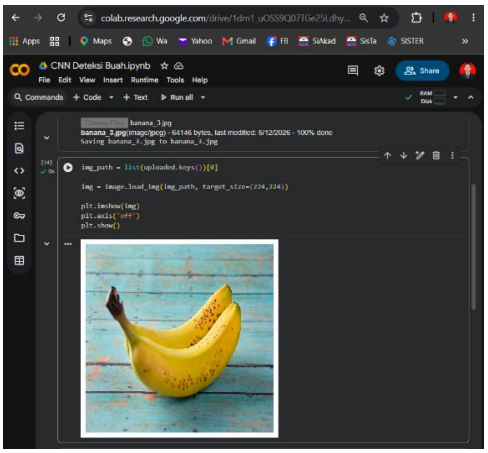

Figure 4. Upload view of the object to be detected

Based on Figure 4 above, we see a display of the object uploaded in the second stage. This object will first be identified as the system learns to recognize the object to be detected. The prediction results can be seen in Figure 5 below.

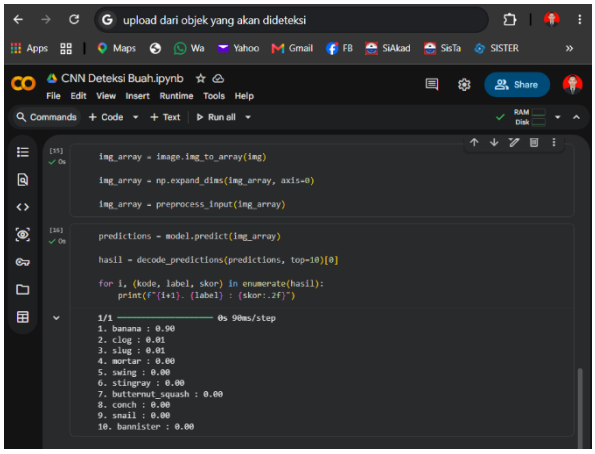

Figure 5. Display of object prediction results using Convolutional Neural Network (CNN)

Figure 5 above shows the results of a Convolutional Neural Network (CNN) model for detecting fruit objects using several object-based approaches. The prediction results are presented as a percentage, representing a threshold for the accuracy of the object detection. Based on the object prediction results, a 0.90% probability, or 90%, indicates that the object is a banana. The predictions demonstrated that the algorithm can accurately recognize and predict the object. Other algorithms presented by the presenter for understanding and training in Artificial Intelligence can be seen in Figure 6 below.

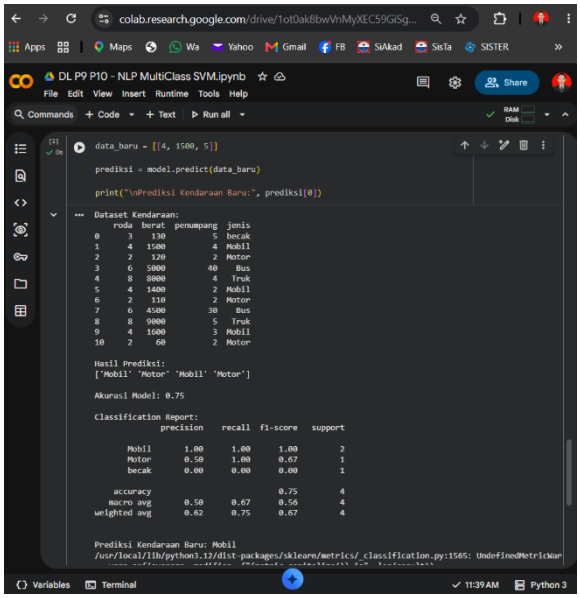

Figure 6. Vehicle detection using the SVM Multi-class classification model

Figure 6 above shows that the prediction uses SVM with multi-class classification to predict objects that have class characteristics so that they can be identified

as belonging to the appropriate class. Other material provided by the presenter to help students better understand is shown in Figure 7 below.

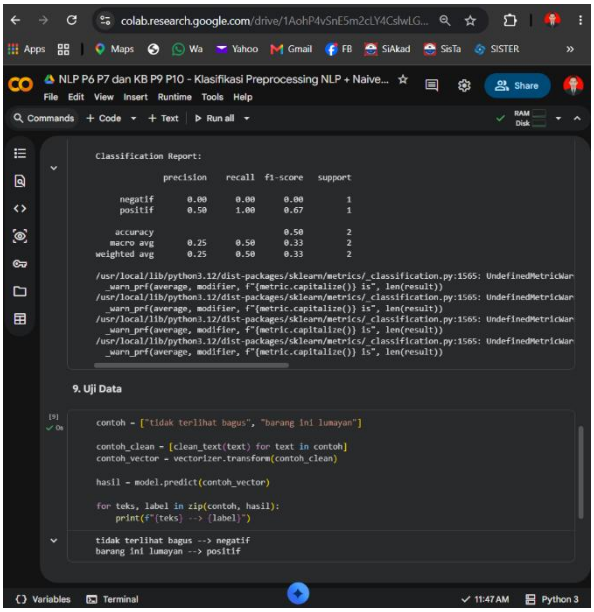

Figure 7. Predicting sentiment of words or sentences using Natural Language Processing (NLP) and Naive Bayes

Based on Figure 7 above, the presenter provides students with an understanding of detecting and predicting sentence sentiment, whether it is positive or negative, and demonstrates the accuracy of the percentage. Furthermore, the learning about computer vision can be seen in Figure 8 below.

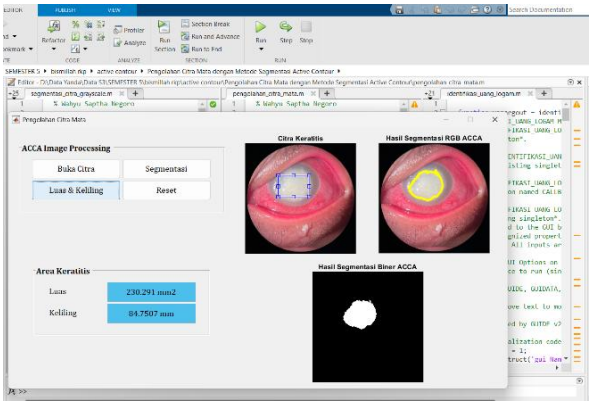

Figure 8. Computer Vision prediction of keratitis eye disease using Matlab 2022a programming

Based on Figure 8 above, the prediction using Matlab 2022a programming as a tool for creating a computer vision algorithm to predict keratitis eye disease. After the event concluded, the speakers closed with a group photo for documentation, as seen in Figure 9 below.

Figure 9. Closing of the Education Service and Artificial Intelligence Training at Bina Satria Vocational School, Medan City

Figure 9 above shows the community service session has been completed and continued with a group photo. However, based on the understanding obtained by the students of SMK Bina Satria, Medan City, the pretest by calculating the Average Score (Most Common) where there are 10 multiple-choice questions. Correct answer = 10 points Maximum score = 100. The percentage increase can be calculated by:

$$\text{Peningkatan} = \frac{\text{Post-test} - \text{Pre-test}}{\text{Pre-test}} \times 100\%$$

The following is a graph produced from the pre-test and post-test calculations for students of SMK Bina Satria, Medan City in Community Service, which can be seen in Figure 10 below.

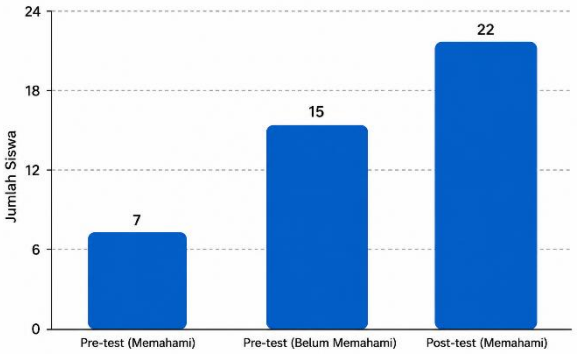

Figure 10. Graph of Pre-test and Post-test Results

Based on the evaluation results conducted through pre-test and post-test, it was found that before the training activities, only 7 out of 22 students (31.8%) had understood the basic concepts of Artificial Intelligence, Machine Learning, and Computer Vision, while 15 students (68.2%) still did not understand the material. After participating in educational and training activities that included material delivery, demonstrations, and direct practice using Google Colab and Python, the post-test results showed that all participants (22 students or 100%) had understood the material presented. Thus, there was an increase in the number of students who understood the material by 15 students, or an increase from 31.8% to 100%. These results indicate

that the practice-based training method (hands-on learning) applied in Community Service activities is effective in improving students' technological literacy, especially in the material of Artificial Intelligence, Machine Learning, and Computer Vision.

Information:

- Number of participants: 22 students
- Pre-test understanding: 7 students (31.8%)
- Pre-test did not understand: 15 students (68.2%)
- Post-test understanding: 22 students (100%)
- Increase in understanding: 68.2 percentage points (increase by 15 students).

3. Conclusions

The results of community service activities for students at SMK Bina Satria Medan City, showed high motivation and increased understanding. This service focuses on developing knowledge about understanding the basic concepts of Artificial Intelligence, Machine Learning, and Computer Vision. Calculating the Average Value (Most Common) carried out by the presenter to students after the community service program provided an increase in understanding: 68.2 percentage points (an increase of 15 students). This concludes that students have a good understanding of the material Artificial Intelligence Based on Machine Learning and Computer Vision.

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Author Contributions Statement

Contributor Role Taxonomy (CRediT) to recognize individual author contributions, the contributions made can be seen in the following table.

Name of Author	C	M	So	Va	Fo	I	R	D	W
Wahyu Saptha Negoro	✓	✓	✓	✓	✓	✓	✓	✓	✓
Asbon Hendra Azhar		✓			✓	✓	✓	✓	✓
Fhery Agustin	✓		✓	✓			✓		✓

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