

Implementation of *Gemini AI* in Practical Learning of Bacteria Material

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Abstract

This research aims to determine the implementation of Gemini AI in practical learning of Biology material, specifically bacteria, and the response of students to its application. The rapid development of Artificial Intelligence (AI), including Gemini AI developed by Google Deepmind, offers opportunities for a more effective learning environment, one of which is through the real-time analysis feature. The implementation of AI in the analysis of practical results, which was previously less integrated and often time-consuming, is expected to help students analyze practical results quickly and accurately. This descriptive qualitative research used a population of class X E4 students (36 participants) at SMAN 1 Taman Sidoarjo, with a purposive sampling technique. Primary data collection was carried out using a Google Form questionnaire and in-depth interviews. The results showed an overall positive response from students, where the majority felt helped, faster, and more practical using Gemini AI to analyze practical results compared to conventional methods. The information presented was judged to be complete and structured, and capable of increasing concept understanding.

Keywords: Gemini AI, Qualitative Research, Practical Results, Analysis

1. Introduction

The development of science and technology (IPTEK) is increasingly rapid and has a major impact on humans, one of which is artificial intelligence. Artificial Intelligence (AI) is a system that demonstrates intelligent behavior in achieving a certain goal, the application of which is in the form of a standalone computer program or embedded in a hardware device that has a specific purpose (Luckin & Holmes, 2016). Furthermore, the rapid advances in information and communication technology known as artificial intelligence (AI) have been very fast in recent years. In its use, AI has had a significant impact on all aspects of life, including the educational aspect, which allows personalized learning through data analysis and feedback.

In Biology learning, AI develops interactive applications, such as providing information and real-time analysis applications that offer immediate feedback to support independent learning (Luckin & Holmes, 2016). With the advancement of AI technology, there is an opportunity to explore the role of AI in creating a learning environment that is more effective, engaging, and tailored to the individual needs of students (Zawacki-Richter et al., 2019). The rapid development of technology has changed many aspects of life, including learning and teaching methods (Yusuf et al., 2024). In addition, AI also enables the development of adaptive learning solutions, which can adjust the material with a learning approach that suits the needs and individual abilities of students. With AI-based learning, students can deepen their knowledge in areas of interest and can develop new skills independently based on individual interests. This

not only increases students' learning experience but also encourages active motivation and involvement in the learning process (Anglia et al., 2025).

In reality, the implementation of AI in education in Indonesia still faces various challenges. The difference in digitalization awareness in each region, limited technological infrastructure, and the lack of ability of educators to implement technology are obstacles to optimizing AI in the education sector. Research conducted by Sabella et al (2023) showed that the introduction of AI technology as a learning medium for high school students in Palaihari District, Tanah Laut, is still unknown to teachers. The role of teachers as the "spearhead" in advancing the quality of education is crucial. Teachers must be able to adapt to the times by integrating AI technology into learning. With the increasingly rapid development and impact of Artificial Intelligence (AI), especially in the field of education, teachers and students are required to continue innovating in carrying out learning so that they must be technologically literate to always follow technological developments, one of which is in the Biology learning process.

Biology learning demands students to gain direct experience. This experience is obtained by connecting the subject matter directly with events or objects in the real world (Susanti, 2023). Students actively and independently work to solve problems based on predetermined goals (Susanti, 2023). This learning experience is structured and organized in learning stages, based on the actions of teachers and students during the learning process (Hindun, 2022). In Biology subjects, active and independent learning experiences can be obtained through a practicum-based learning method. As described by Gratchev, this method provides an opportunity for students to gain direct learning experience by applying the theories they have learned. This practicum approach can stimulate the development of interpersonal skills such as critical thinking, collaboration, communication, and creativity. Practicum is a learning activity aimed at giving students the opportunity to test and apply theories using laboratory facilities or outside the laboratory. Practicum in Biology learning is an effective method to achieve learning goals (Ali, M, 2024). According to Permendiknas no. 21 of 2016, some competencies that must be achieved by students in Biology lessons are applying the scientific work process and safety in the Biology laboratory in observations and experiments to understand biological problems in various objects, communicating the results of observations and experiments orally or in writing, and presenting data of various objects based on observations and experiments by applying scientific procedures.

In Biology learning, especially in the bacteria chapter, practicum activities are needed to observe and analyze the differences between bacteria and non-bacteria. The practicum was carried out at the Biology Laboratory of SMAN 1 Taman Sidoarjo. The practicum activity involved creating a bacterial growth medium in the form of Potato Dextrose Agar (PDA). The medium was then used by the students to capture and grow bacteria on it. The results of the bacterial capture were then analyzed. In the practicum learning process, the analysis process of the practical results is one of the key activities to determine the final result of the practicum implementation. The implementation of practical results analysis is an important process in determining the final outcome of the practicum, especially the bacteria practicum, and can improve students' analytical skills in the learning process.

However, the current analysis process of practical results is less integrated with Artificial Intelligence (AI). The use of Artificial Intelligence (AI) in Biology learning is more often used to help students prepare project activities rather than to help analyze practical results. In accordance with the research conducted by Rosi Ramadhani et al (2025), teachers and students utilize AI to prepare projects rather than assisting in the practicum process. This is also supported by the fact that teachers and students frequently performing manual analysis can affect the duration of the analysis implementation, making it quite long (Fitri W.A, et al, 2024). With the presence and implementation of Artificial Intelligence (AI), it can help teachers and students in carrying out the analysis process of these practical results. The current development of Artificial Intelligence (AI) can be utilized for the purpose of bacteria practicum analysis. One of the Artificial Intelligence (AI) used is Gemini AI. Gemini AI is an artificial intelligence platform from Google developed by Google Deepmind. Gemini AI is claimed to be more sophisticated than other similar platforms. One of the features offered by Gemini AI is the real-time analysis feature. The real-time analysis feature in Gemini is also an important element in the implementation of student practical results analysis. This application is capable of generating analysis from photos taken by students in real-time. Through this real-time analysis, students not only learn to read their analysis data but also produce more complete and real-time analysis results (Adminpintarharati, 2022). By utilizing Gemini AI through the real-time analysis feature, students are expected to be able to quickly and accurately analyze the practical results and can re-check the information generated through the application.

The objective of this research is to determine the implementation of Gemini AI in practical Biology learning, especially on bacteria material, and the response of students to the implementation of Gemini AI in the practicum. The focus of the research conducted is on the problems, namely how the implementation of Gemini AI is in the practical learning of biology material, and what the response of students is to the implementation of Gemini AI in the practical learning of bacteria. It is hoped that this research can produce accurate information that can be used as a reference in the context of using Gemini AI in the implementation of the practicum method of learning to analyze the results of student practicum. This research is also expected to find out the response of students when using Gemini AI in analyzing practical results in bacteria material learning.

2. Research Method

This research is a descriptive qualitative study. Descriptive research is a research method that aims to describe, explain, and answer issues systematically, factually, and accurately regarding the facts, properties, and relationships between the phenomena being investigated (Nugrahani, 2008). The method used in this research is the literature review method as a complementary source for obtaining data related to the research.

The population in this study were all students of class X SMAN 1 Taman Sidoarjo. The sample in this study was taken using the purposive sampling technique. Purposive sampling is a sample selection technique based on specific criteria that have been determined by the researcher (Sugiyono, 2017). The sample used in this study was class X E4, consisting of 36

students. The selection of class X E4 was based on the recommendation of the Biology teacher, who considered this class to have good academic ability and be very cooperative in the learning process, especially in practicum activities and using information technology (IT) in learning.

The data collection techniques used in this study consisted of Questionnaire (Google Form) A questionnaire was used as a primary data collection instrument. This questionnaire was designed using Google Form to obtain student responses related to the implementation of Gemini AI in the bacteria practicum. The questionnaire was structured using a Likert scale with statements covering the ease of use, practicality, time efficiency, completeness of information, and the influence of Gemini AI on understanding the material. Interviews were conducted to obtain deeper primary data, focusing on the perceptions and feelings of the students regarding the application of Gemini AI in the practical analysis process. The interviews were conducted with a small number of students selected from the research sample to explore in-depth reasons behind the questionnaire responses.

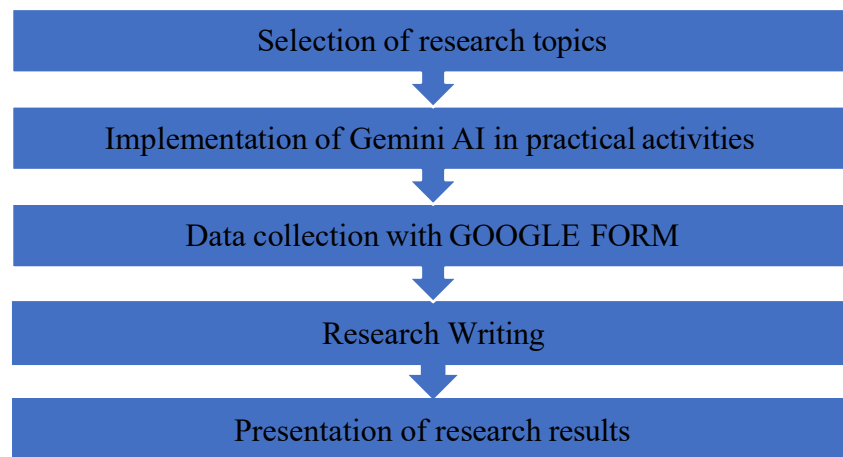


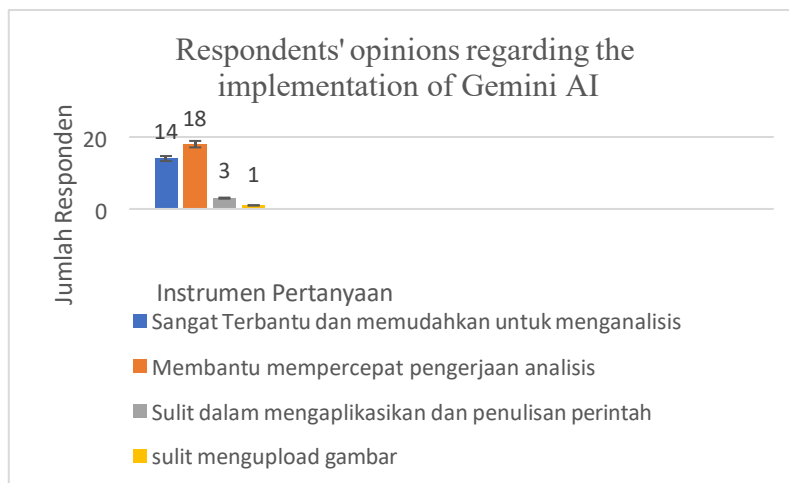
Diagram 1 Research Step

The data analysis technique used is data reduction. Data reduction is a process of selecting, focusing, simplifying, abstracting, and transforming rough data that appears in field notes (Miles et al, 2014). The data analysis steps in this research are Collecting all primary data obtained from the Google Form questionnaire and interviews. Reducing the data by selecting and focusing on important and relevant information, such as student responses (positive/negative) and their reasons for using Gemini AI in the practicum. Presenting the data that has been reduced in the form of descriptive text to facilitate the understanding of the research results. Drawing conclusions based on the data presentation to answer the research questions, namely the implementation and student response to the use of Gemini AI. The validity of the data was tested using the Triangulation of Methods technique, which involves comparing information obtained from the questionnaire and the results of the interviews (Fajri, 2023)

3. Result and Discussion

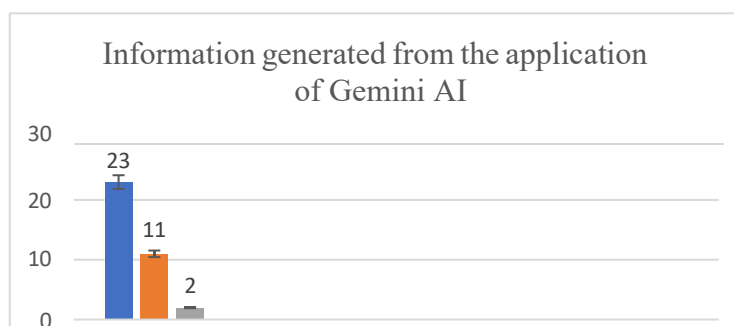
The implementation of Gemini AI in the practical learning of bacteria material was carried out in class X E4 at SMAN 1 Taman Sidoarjo, involving 36 students. The practical activity consisted of creating a bacterial growth medium (Potato Dextrose Agar/PDA), capturing bacteria, and then analyzing the growth results. The implementation stages of Gemini AI in the practical analysis were as follows:

Table 1. Respondents' opinions regarding the implementation of Gemini AI



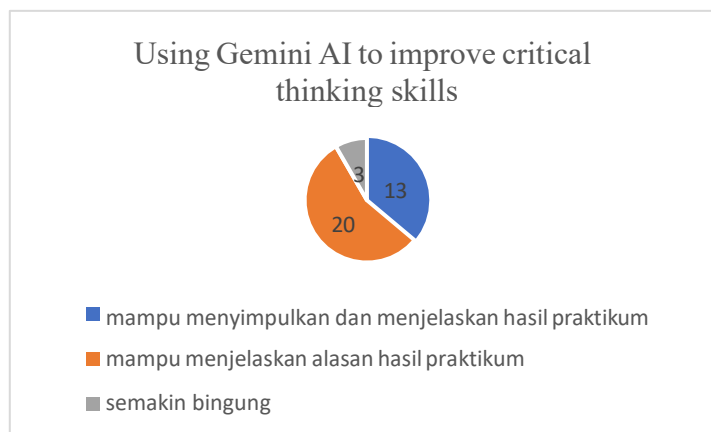
From table 1, it can be seen that 14 respondents or 38.9% of respondents answered that it was very helpful and made it easier to analyze, 18 respondents or 50.0% of respondents answered that it helped speed up the report processing, 3 respondents or 8.3% answered that it was difficult to apply and write commands (prompt), and 1 respondent or 2.8% answered that it was difficult to upload images for analysis. From table 1, it can be seen that most students were helped by the application of Gemini AI to help and speed up the analysis process, and a small number found it difficult to upload images and create prompts or commands on Gemini AI.

Table 2. Information generated from the application of Gemini AI



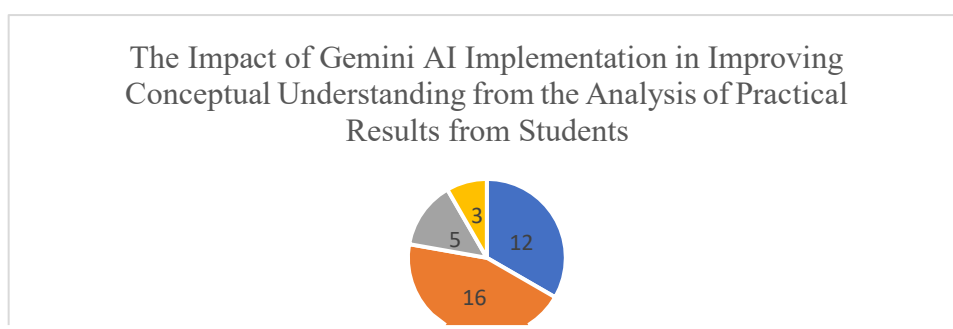
From table 2, it can be seen that 23 respondents or 63.9% of respondents answered that the information provided by Gemini AI was complete and structured, 11 respondents or 30.6% of respondents answered that the information provided by Gemini AI was easy to read and understand, and 2 respondents or 5.5% answered that the information presented was too long-winded. From table 2, it can be seen that most students can read the information provided by Gemini AI about the analysis of practicum results, and only a small portion considered that the information presented was too long-winded.

Table 3. Using Gemini AI to improve critical thinking skills



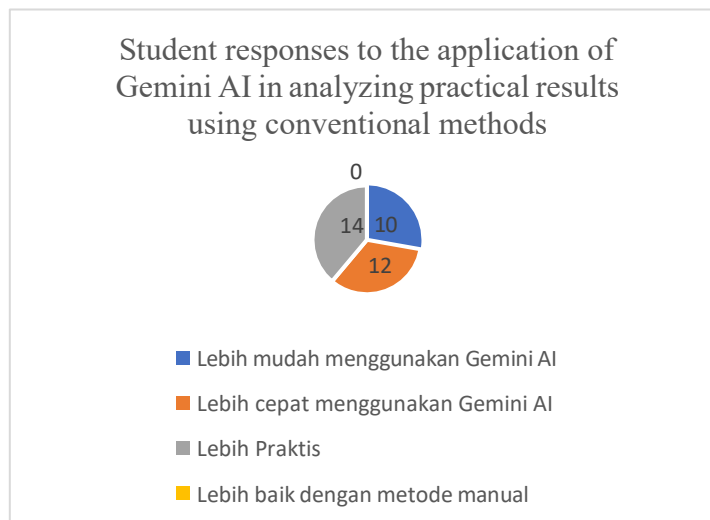
From Table 3, it can be seen that 20 respondents or 55.5% of respondents answered that they were able to conclude and explain the results of the practicum, 13 respondents or 36.2% of respondents answered that they were able to explain the reasons for the practicum results, and 3 respondents or 8.3% answered that they were increasingly confused. From Table 3, it can be seen that the majority of students were able to explain and conclude the phenomena arising from the results of the bacteria practicum, and a small portion of respondents became increasingly confused about the results of the practicum..

Table 4. The Impact of Gemini AI Implementation in Improving Conceptual Understanding from the Analysis of Practical Results from Students



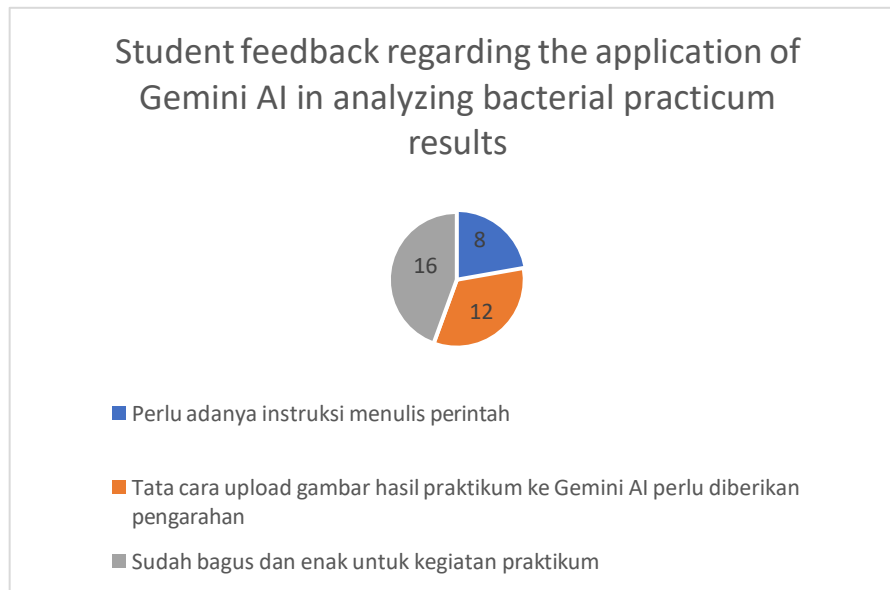
From table 4, it can be seen that 12 respondents or 33.3% of respondents answered that they increasingly understand the analysis of practicum results, 16 respondents or 44.4% of respondents answered that they understand the analysis of practicum results, 5 respondents or 13.9% answered that they do not understand, and 3 respondents or 8.3% of respondents answered that they do not understand the analysis of practicum results. From table 4, it can be seen that most students can understand the analysis of practicum results and a small number of students have little or no understanding of the analysis of practicum results presented by Gemini AI.

Table 5. Student responses to the application of Gemini AI in analyzing practical results using conventional methods



From table 5, it can be seen that 10 respondents or 27.8% of respondents answered that it was easier to analyze the results of the practicum using Gemini AI than with conventional methods, 12 respondents or 33.4% of respondents answered that it was faster to use Gemini AI to analyze the results of the practicum, 14 respondents or 38.8% answered that it was more practical to analyze the results of the practicum using Gemini AI, and 0 respondents or 0% of respondents answered that they used conventional methods. From table 5, it can be seen that most students find it faster, more practical, and easier to analyze the results of the practicum using Gemini AI than with conventional methods.

Table 6. Student feedback regarding the application of Gemini AI in analyzing bacterial practicum results



From table 6, it can be seen that as many as 8 respondents or 22.2% of respondents gave feedback with follow-up instructions on writing prompts, as many as 12 respondents or 33.4% of respondents gave feedback regarding the procedure for uploading lab images to Gemini AI, and as many as 16 respondents or 44.4% answered that it was good and pleasant to use Gemini AI for lab analysis activities. From table 6, it can be seen that most of the feedback from students regarding the application of Gemini AI in analyzing the results of bacterial labs was good and pleasant, while some provided feedback to add prompt writing commands and image upload procedures to Gemini AI.

Overall, student acceptance of Gemini AI's implementation in assisting the analysis of practicum results averaged over 70%. This suggests that students' positive response to Gemini AI's use of Gemini AI in analyzing bacteria practicum results is evident. This is demonstrated in Table 1, which demonstrates significant assistance in completing and analyzing practicum results. Furthermore, Table 5 demonstrates that Gemini AI is more helpful than conventional methods. Gemini AI offers a real-time analysis feature. The real-time analysis feature in Gemini AI is also crucial for analyzing practicum results. This application generates real-time analysis from photos taken by students. Through this real-time analysis, students not only learn to interpret their analysis data but also produce more comprehensive and real-time analysis results (Adminpintarharati, 2022).

In terms of student understanding of the information on bacterial lab results analysis using Gemini AI, the average understanding is dominated by very good and good students. This can be seen from the analysis results in Tables 3 and 4, which reveal that the implementation of Gemini AI in assisting students in analyzing bacterial lab results received a positive response. Furthermore, students' critical thinking skills resulting from reading the lab results analysis presented by Gemini AI produced good results. This is in line with biology learning which requires students to gain direct experience. The use of Gemini AI is achieved by directly

connecting subjects with events or objects in the real world (Susanti, 2023). Students actively and independently work to solve problems based on predetermined objectives (Susanti, 2023).

Meanwhile, the aspect of students' learning experience in obtaining information from the implementation of Gemini AI is dominated by students who understand and easily read the analysis results presented by Gemini AI as shown in tables 2 and 6. The direct learning experience in obtaining information and feedback from the experiences gained by students makes the application of Gemini AI in analyzing the results of bacterial practicums receive a positive response. This is supported by research conducted by Harmilawati (2024) that several key findings include the ease provided by Gemini AI in accessing various learning resources widely and quickly, helping students expand their knowledge and understanding of various topics. By using data analysis, Gemini AI can recommend learning materials that suit the individual needs of students, enabling a more effective and relevant learning experience.

4. Conclusion

4.1 Conclusion

The **implementation of Gemini AI in the practical learning of bacteria material in class X E4 at SMAN 1 Taman Sidoarjo was carried out through the use of the real-time analysis feature. This** implementation successfully integrated AI technology to perform rapid analysis of bacterial colony growth results in petri dishes. The process involves image capture, instant analysis generation, and subsequent comparison with manual observations, effectively shifting the learning focus to analysis and interpretation rather than slow data collection.

The response of students to the implementation of Gemini AI in practical analysis was **highly positive**. A total of 100% of students agreed/strongly agreed that the use of Gemini AI made the practical analysis process **easier, faster, and more efficient in terms of time**. Students also perceived the information provided by the AI as **complete and structured**, thereby **increasing their conceptual understanding** of bacteria material and raising their motivation for practicum activities. The students strongly preferred the use of AI compared to conventional analysis methods.

4.2 Suggestion:

It is recommended that educational institutions and teachers consider integrating Artificial Intelligence, such as Gemini AI, as an effective analysis tool in practicum-based learning to improve efficiency, analytical ability, and student motivation. Further research is needed to explore the long-term impact of using AI on students' critical thinking and problem-solving skills in Biology subjects.

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