

## **The Perceptions of the Pre-service and In-service Biology Teachers on Artificial Intelligence in Biology Learning**

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### Abstract

This study aimed to determine the perceptions of pre-service biology teachers and in-service biology teachers on artificial intelligence in Biology learning. AI has recently become a new trend and has changed many aspects of life. Artificial intelligence allows machines to learn from experience, adapt to new inputs, and perform human-like tasks like ChatGPT, launched in Q4 of 2022. The survey method used in this study. We used a questionnaire from 42 respondents of in-service teachers and pre-service teachers, respectively. Selected teachers were senior high school biology teachers who have used the independent curriculum in their schools. This study showed that the pre-service biology teachers (69%) had higher perceptions than in-service biology teachers (40.5%). This result followed by AI usage; 28.6% of pre-service biology teachers and 7.1% of in-service biology teachers used AI daily. However, the pre-service and in-service biology teachers believed that AI could be implemented in the new curriculum to increase student achievement on biology subject. This study concluded that the perceptions of to use AI is still low. So, AI must be introduced to the pre-service and in-service biology teachers.

Keywords: Artificial Intelligence, Independent Curriculum, Pre-service Biology Teachers, In-service Biology Teachers

### INTRODUCTION

Independent Curriculum is a new curriculum launched in 2022. This curriculum is an innovation in Indonesian education that aims to provide learning freedom to students. The concept of "learning freedom" is the main foundation of this curriculum. Students are accommodated to determine their learning path. Independent Curriculum emphasizes improving the quality of education, developing student character, and improving the quality of student competence by providing essential materials. (Ministry of Education, Culture, Research and Technology, 2022b)

In the Independent Curriculum, teachers have the main task of helping, guiding, and freeing children physically and mentally in learning. Teachers must carry out their duties comprehensively in educating, teaching, and guiding students. Thus, the Independent Curriculum not only gives students freedom of learning, but also provides new challenges for teachers to improve the quality of learning (Dewi et al., 2022; Ministry of Education, Culture, Research, and Technology, 2022a).

A distinctive feature of the Independent Curriculum is the emergence of a two-principle called personal nature and period policy. Personal potential refers to the learning potential of

each student who carries genetic potential from birth and the influence of growth in the family environment. Meanwhile, the period policy relates to the demands of the technologies that students live in (Ministry of Education, Culture, Research, and Technology, 2022b).

On the other hand, teachers need a breakthrough in formatting the learning that relies on these two policies. Personal potential policies allowed many methods to synergize student potential in the classroom with a differentiated learning approach. Teachers accommodate students' learning needs during teaching and learning activities by facilitating learning according to their needs. Students have different characteristics and potential, so they are given other treatments. However, to respond to the nature of the times, learning must equip students with skills according to their age so that they can live, work and adapt themselves. In the current learning context, students need to be equipped with 21<sup>st</sup>-century skills currently dominated by artificial intelligence (AI), biotechnology, robotics, and the Internet of Things (IoT). Schools must not be left behind in responding to this challenge (Dewi & Alam, 2022; Kurdiati, 2022; Muarifin, 2022).

Artificial Intelligence (AI) is a human intelligence simulation modeled in a machine and programmed to think like a human. AI systems can act like humans, although they do not yet have the perfect abilities that humans generally have. Artificial intelligence allows machines to learn from experience, adapt to new inputs, and perform human-like tasks. Human intelligence is the starting point in the development of artificial intelligence. The story of AI is divided into four stages; the first wave starts from the development of theory that marks the emergence of the idea of providing machine knowledge, the second wave is when machines begin to process inputted data, and the third wave is when the internet has been invented, the fourth wave is characterized by the development of robots, such as driverless cars, or the emergence of generative AI, such as ChatGPT technology, that emerged in Q4 2022 (Arif et al., 2023; Cooper, 2023; Sallam, 2023).

As one of the emerging technology trends, AI can be used in schools to teach and learn biology. Activities that AI can support include processing information obtained by students in learning activities and processing exam results or attendance. By analyzing this information, teachers can master the class and students in totality and familiarize biology learning that suits the needs of students. AI can be considered a virtual mentor, voice assistant, innovative content, or presentation translator (Hassoun et al., 2021).

However, there is still no study on the extent of Indonesian biology teachers' perceptions of artificial intelligence. AI must be implemented in the new curriculum as the latest technology

trend. Therefore, this study aimed to determine the pre-service biology teachers and in-service biology teachers' perceptions on artificial intelligence (AI) in Biology learning.

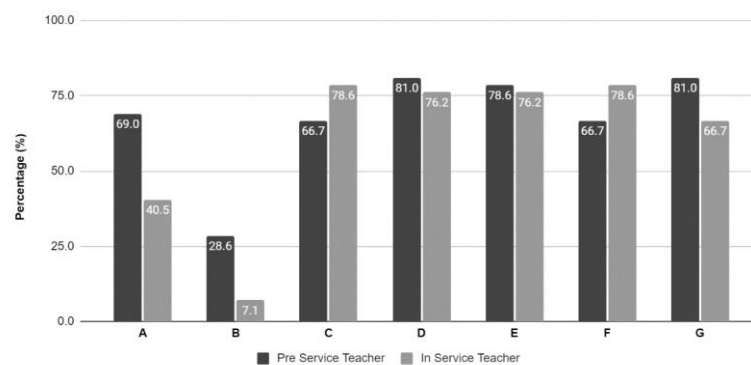
## METHOD

The research was conducted in Java island as a barometer of education in Indonesia. The determination of participants was carried out using a purposive sampling technique. The criteria for participants were prospective teachers studying at colleges of education and teachers who taught in schools implementing the independent curriculum. The respondents comprised 42 teachers, including in-service biology teachers (IST) and pre-service biology teachers (PST). The selected teachers are senior high school biology teachers who have used the Independent curriculum in their schools. The study was conducted in the even semester of the 2022/2023 academic year by distributing a set of closed-type questionnaire questions.

Based on the objectives and form of the conceptual research framework, this type of research is qualitative with descriptive data. Data collection used primary data directly from data sources. The data to be expressed is in the form of perceptions on AI in Biology learning.

## RESULTS AND DISCUSSION

The results showed a significant difference between the perceptions of PSTs and ISTs in Figure 1. There is a substantial difference in AI understanding, 69% for PSTs and 40.5% for ISTs. Among those who knew AI, only 7.1% of ISTs and 28.6% of PSTs had used it. However, when asked about the potential for AI to be applied in Biology learning, both data sources answered relatively high, 66.7% (PST) and 78.6% (IST), respectively. Furthermore, 81% of PSTs and 76.2% of ISTs believe that AI can improve the understanding of Biology.



**Figure 1.** The Perceptions of Pre-service Teacher and In Service Teacher of Biology on AI Description

- A : Do you know AI?
- B : Do you use AI?
- C : Can AI be applied to Biology Learning?
- D : Can AI improve understanding?
- E : Does AI support Merdeka Curriculum
- F : Does AI support Differentiated Learning
- G : Is AI appropriate for the specialization Biology Major?

Regarding implementing the Independent Curriculum, ISTs and PSTs responded similarly; 78.6% of PSTs and 76.2% of ISTs believed that AI could support the new curriculum. In line with this data, 78.6% of IST thought AI also supported differentiated learning, while 66.7% of PST were confident that it could help this approach to education. However, for specialization majors, i.e., other majors taking Biology, 66.7% of ISTs and 81% of PSTs stated that AI supports Biology learning for students in different majors.

Further tracking of perceptions of AI in Table 1 below revealed that 73.3% of ISTs and 75.6% of PSTs understood AI to refer to software design to mimic human abilities. Interestingly, the answers varied when asked how AI is used in Biology. 63.3% of ISTs and 63.4 PSTs agreed on the response to replacing human work. However, some thought AI was used to discover new medicines, alter human DNA, and even create new life. These answers affected how AI can be used in Biology learning, where 93.3% of ISTs and 100% of PSTs answered as an aid to understanding complex Biology concepts. Only a few ISTs answered to replace teachers and remove practical learning. Regarding a tool, 46.7% of ISTs and 44.0% of PSTs answered that AI could increase students' interest in Biology. In addition, respondents said that AI can improve students' cognitive abilities, although other respondents answered that AI could reduce students' critical thinking skills and the quality of biology education.

Table 1. Advanced Perception on AI Implementation (n=42)

Description	IST (%)	PST (%)
AI refers to the design of software to mimic human capabilities.	73.3	75.6
AI replaces human jobs	63.3	63.4
AI as a tool for understanding complex Biology concepts	93.3	100.0
AI can increase students' interest in Biology	46.7	44.0
AI is more appropriate in class in groups	73.3	65.9
AI helps the research and development process	90.0	78.0
AI replaces humans in Biology research	45.0	48.9

As a new technology among educators, AI implementation is also considered the place where it is implemented. 73.3% of ISTs and 65.9% of PSTs responded that AI should be implemented in the classroom in groups. However, some suggested it should be done independently, at home, or in groups at the school.

Learning activities are about teaching, learning interactions, and micro-research. When asked about the benefits of AI in Biology research, 90.0% of ISTs and 78.0% of PSTs stated that it helps the research and development process. Very few answered that AI enhances creativity in producing products, improves skills, or affects the intelligence of researchers. So, when asked further about the chances of AI replacing human roles in Biology research, 45.0%

of ISTs and 48.9% of PSTs stated that only some roles could be substituted. In contrast, other answers AI applied to some types of research only.

Regarding the benefits gained by learning AI in Biology learning, both ISTs and PSTs were unanimous in their opinion that it increases students' interest in Biology learning, improves students' technological skills, and increases students' understanding of the use of AI in research in a similar percentage of answers. Alongside the benefits, respondents also expressed the challenges that teachers and students face when implementing AI. ISTs and PSTs predominantly answered limited understanding of AI, limited access to AI technology, and lack of human resources trained to operate AI.

The understanding and application of AI are still primarily implemented in the industry. AI is not yet widely used in authentic classroom learning. Ideas and views on AI are still being explored. Indeed, only 69% of PSTs are familiar with it, even only 40.5% of ISTs. Their introduction to AI is still primarily limited to media information and has not yet reached an absolute understanding of the sundries of AI. The lower the school level (University, High School, Junior High School), the smaller the demand for AI usage, and the lower their knowledge of AI (Douali et al., 2022; Lindner & Romeike, 2019)

The knowledge of AI, which is known through mass media and social media, has given optimism for IST and PST to recommend AI to be applied in Biology learning. As a science based on living things, Biology has high dynamics in the times, following the dynamics of natural changes. Thus, updated information is needed to keep up with the speed of change, so a device that can also be updated quickly and responsively is required. This increases student understanding in learning (Sangapu, 2019).

Concerning the response to the new curriculum change, namely the Independent Belajar Curriculum, 76.7% of IST and 75.6% of PST each think that AI can support it. These three aspects require AI-like tools that can rationalize and take actions with the best chance of achieving specific goals. Moreover, AI works with programming algorithms on computer systems during its creation process. Its systems will process by combining large amounts of data with repetitive, fast and sophisticated processing (Access, 2022; Attwood et al., 2020).

AI is not limited to learning in one subject area but can be accommodated across subject areas. According to the survey results, 75.0% of ISTs and 65.9 PSTs stated that AI supports Biology learning for students of different majors. In this program, students with non-biology backgrounds will learn about the world of Biology, which may help them gain knowledge of other fields. AI media can be a bridge to synchronize Biology with these different fields (Douali et al., 2022; Garg & Sharma, 2020; Yun & Kim, 2022). Thus, there is a strong synergy between

Biology and Non-Biology, which can produce useful work products. This statement also supports that AI can be applied in differentiated learning based on differences in the interests and learning styles of each student. 68.3% of ISTs and 78.0% of PSTs believe that students' different typologies in learning can be synergized with the AI bridge.

The characteristics of biology include: a) the object of study is concrete and can be captured by the five senses b) it developed based on practical experience and c) has systematic steps. In point A, it was mentioned that AI can be applied in Biology learning, so in the following statement, AI can be used as a tool to understand complex Biology concepts (IST 93.3% and PST 100.0%). Both types of respondents strongly support this opinion because it is supported by the understanding of AI as software mimicking human abilities (IST 73.3% and PST 75.5%). While it is not an absolute percentage that answered AI as a substitute for humans, the reality is that this machine can provide many semi-dynamic answers and solutions. Therefore, not all respondents are convinced of the role of human substitution because the machine element has weaknesses and limitations. Only 63% of both types of respondents believe AI can replace human work. AI's inadequacies include being unable to learn or think out of the box. Although AI can learn over time with inputted data and experience through digital footprints by inputting, it isn't easy to think creatively in its approach (Garg & Sharma, 2020).

However, AI has the potential to increase students' interest in Biology. AI can be an intelligent assistant for students to satisfy all the curiosity that they want to uncover. Although this statement was less believed by IST (46.7%) and PST (44.0%). This is supported by the idea that there are limitations to understanding AI, including access to AI technology and a lack of trained human resources. Therefore, the following opinion is that AI is more appropriate to be conducted in groups in the classroom (IST 73.3% and PST 65.9%).

The other side of learning is research, which teachers are required to do through Classroom Action Research or another mini-research. Many ISTs (90.0%) and PSTs (78.0%) thought that AI could help the research process and its development. Just like AI in other fields, for research, AI can help find real problems that need to be addressed by researchers. AI can also provide alternative solutions to be implemented directly. However, the limitations of machines that do not have a feel for a problem and are limited in understanding context cause 45.0% of ISTs and 48.9% to believe that AI can replace the role of humans in research. However, machines have weaknesses that need to be considered for control and advantages that humans do not have physically (Shin, 2021).

## **CONCLUSION**

This study examined how pre-service biology teachers (PSTs) and in-service biology teachers (ISTs) perceived artificial intelligence (AI) in biology learning. The results showed that the two groups' comprehension and use of AI differed significantly. Although PSTs (69%) were more knowledgeable about AI than ISTs (40.5%), both groups acknowledged that AI may improve biology instruction. Even though fewer people were using AI, over 76% of PSTs and ISTs agreed that it might help students grasp the Independent Curriculum and boost their comprehension of it.

Artificial Intelligence (AI) is a technology with human-like intelligence that can be a medium for biology learning. As a dynamic and progressive study of the science of living things, AI is very supportive of following the learning styles of teachers and students in schools, including linear with the development of the new curriculum, namely the Independent Curriculum, which is based on the nature of nature and the nature of the times with a differentiated learning approach. In addition, AI also supports Biology research needs, both classroom action research studies and pure studies in the field.

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