

Readiness for implementing deep learning in biology learning based on students' information processing abilities and habits of mind

Muhammad Syaipul Hayat ^{(1)*}, Endah Rita Sulistya Dewi ⁽¹⁾, Siti Patonah ⁽¹⁾, Fibria Kaswinarni ⁽²⁾, Waewdao Dathong ⁽³⁾, Azizul Ghofar Candra Wicaksono ⁽²⁾, Dina Alfiyana ⁽²⁾, Mellisa Putri Adelianna ⁽⁴⁾

⁽¹⁾ Master's Program in Science Education, Postgraduate Program, Universitas PGRI Semarang, Semarang City, Central Java, Indonesia

⁽²⁾ Department of Biology Education, Faculty of Mathematics, Science and Information Technology Education, Universitas PGRI Semarang, Semarang City, Central Java, Indonesia

⁽³⁾ Department of Science Education, Faculty of Science and Technology, Nakhon Ratchasima Rajabhat University, Mueang District, Nakhon Ratchasima, Thailand

⁽⁴⁾ Department of Elementary School Teacher Education, Faculty of Education, Universitas PGRI Semarang, Semarang City, Central Java, Indonesia

* Corresponding Author Email: m.syaipulhayat@upgris.ac.id

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Abstract

The Ministry of Primary and Secondary Education plans to implement a deep learning approach into the curriculum. One prerequisite for its success is student readiness supported by habits of mind and effective information processing. However, studies on deep learning readiness from the perspective of these two aspects are still limited, especially in high school biology learning. This study aims to determine the condition of students' habits of mind and information processing as supporting aspects of deep learning. The study used a descriptive quantitative-qualitative method on 134 grade X students of SMA N 1 Semarang and SMA Islam Sultan Agung 1 Semarang on environmental change material. Data were collected through questionnaires and observations, then analyzed using descriptive statistics (average, percentage, and achievement categories) and independent sample t-test. The results showed that the ability of habits of mind scored 81 (very good) in SMA N 1 Semarang and a score of 76 (good) in SMA Islam Sultan Agung 1 Semarang. Meanwhile, the results of student information processing obtained a score of 83 (very good) in SMA N 1 Semarang and a score of 81 (very good) in SMA Islam Sultan Agung 1 Semarang. Therefore, the research results indicate that students are well-prepared to support the implementation of deep learning, although critical thinking, creative thinking, and information synthesis skills still need to be strengthened. This study provides initial empirical evidence regarding students' cognitive readiness for the implementation of deep learning in biology.

Abstrak. Kementerian Pendidikan Dasar dan Menengah berencana mengimplementasikan pendekatan deep learning ke dalam kurikulum. Salah satu prasyarat keberhasilannya adalah kesiapan siswa yang ditunjang oleh habits of mind dan pemrosesan informasi yang efektif. Namun, kajian mengenai kesiapan deep learning dari perspektif kedua aspek tersebut masih terbatas, khususnya dalam pembelajaran biologi SMA. Penelitian ini bertujuan mengetahui kondisi habits of mind dan pemrosesan informasi siswa sebagai aspek pendukung deep learning. Penelitian menggunakan metode deskriptif kuantitatif-kualitatif terhadap 134 siswa kelas X SMA N 1 Semarang dan SMA Islam Sultan Agung 1 Semarang pada materi perubahan lingkungan. Data dikumpulkan melalui kuesioner dan observasi, kemudian dianalisis menggunakan statistik deskriptif (rata-rata, persentase, dan kategori capaian) serta independent sample t-test. Hasil penelitian menunjukkan kemampuan habits of mind skor 81 (sangat baik) di SMA N 1 Semarang dan skor 76 (baik) di SMA Islam Sultan Agung 1 Semarang. Sementara pada hasil pemrosesan informasi siswa diperoleh skor 83 (sangat baik) di SMA N 1 Semarang dan skor 81 (sangat baik) di SMA Islam Sultan Agung 1 Semarang. Oleh karena itu, hasil penelitian mengindikasikan bahwa siswa memiliki kesiapan yang baik untuk mendukung implementasi deep learning, meskipun kemampuan berpikir kritis, berpikir kreatif, dan sintesis informasi masih perlu diperkuat. Penelitian ini memberikan bukti empiris awal mengenai kesiapan kognitif siswa dalam menghadapi implementasi deep learning pada pembelajaran biologi.

A. Introduction

Twenty-first century education requires students not only to master knowledge, but also to be able to think critically, creatively, solve problems, and adapt to various changes that occur in their surrounding environment (Bara et al., 2025; Harapan & Purwanto, 2024). In an ideal learning process, learning is not simply oriented toward mastering material, but also toward building knowledge and solving problems that can develop into productive thinking habits. Through the right learning process, students' thinking habits will be developed well and become essential assets in facing the increasingly complex challenges of life and learning (Hasibuan et al., 2019).

In line with these demands, deep learning will become a hot topic in 2024, following the Ministry of Primary and Secondary Education's plan to incorporate this approach into the curriculum. In this study, deep learning refers to a pedagogical approach that emphasizes meaningful understanding, critical reflection, knowledge integration, and contextual problem-solving, rather than AI-based in-depth learning. Conceptually, deep learning encourages students to not only comprehend information but also connect it more deeply, leading to a more holistic understanding (Feriyanto & Anjariyah, 2024; Weng et al., 2023). Through this approach, students are encouraged to conduct critical analysis, connect new information with previous learning experiences, and apply knowledge in various real situations.

However, the success of deep learning implementation is determined not only by the teaching strategies used by teachers, but also by students' cognitive readiness to participate in the learning process. Deep learning requires students to be able to reflect on their thinking processes, manage their learning independently, and process information effectively to construct and apply knowledge meaningfully (Faza & Lestari, 2025; Graaf, 2022). Therefore, thinking skills and information processing skills are important foundations that students need to have before in-depth learning can be applied optimally.

One of the skills that support deep learning readiness is habits of mind. Marzano et al. (1993) divide habits of mind into three categories: critical thinking, creative thinking, and self-regulated thinking. According to Ennis (1993), critical thinking skills are the appropriateness of reflective thinking focused on deciding something that is beneficial for students both now and in the future. Creative thinking skills include participating intensely in tasks even when the answer or solution is not yet clear; maximizing knowledge and abilities; and generating new ways of viewing situations outside the boundaries of common habits (Ridzal et al., 2024). In addition, the Self-Regulation category includes making plans effectively; recognizing and using necessary resources; and being sensitive to feedback (Faza & Lestari, 2025).

Information processing skills also play a crucial role in supporting in-depth learning. A student's understanding of the material is considered good if it reaches a sufficient level of information reception, measured by their ability to analyze the information presented in the learning materials. High information reception and processing skills mean students have sufficient working memory to process the information (Fitriana et al., 2026; Jamaludin & Jamaludin, 2022). The use of the information processing dimension in Marzano et al. (1993) framework measures the thought processes associated with receiving and processing acquired information. Marzano et al. (1993) identified one of the fundamental ideas supporting educators' understanding of cognition and learning: assessment should focus on students' use of complex knowledge and reasoning rather than their recall of low-level information.

The importance of habits of mind and information processing is becoming increasingly relevant in biology learning, particularly in environmental change. This material requires students not only to understand theoretical concepts but also to develop habits of mind and integrated information processing skills. Environmental change material related to real-life issues such as pollution, ecosystem damage, and climate change encourages students to think critically in analyzing cause and effect, think creatively in designing solutions, and manage their learning process independently through self-regulation. This aligns with findings that developing habits of mind in biology learning contributes to improved cognitive abilities and student learning outcomes (Bariroh et al., 2024; Isfiani & Ekanara, 2022). On the other hand, the complexity of the information in this material requires students to have good information-processing skills, from receiving, organizing, to interpreting various sources of scientific data. Research also shows that integrating environmental literacy into biology learning can enhance students' understanding of environmental issues in a deeper and more contextual way (Mercan et al., 2024; Putri, 2024).

Although extensive research has been conducted on habits of mind, information processing, and deep learning, most studies still focus on the influence of each variable on student learning outcomes, critical thinking skills, or academic achievement. Yet, these two aspects are crucial foundations for student success in building meaningful understanding in line with the characteristics of deep learning (Fitriani et al., 2025; Sinon et al., 2021). In this study, there is a novelty in the integration of thinking habits and information processing dimensions as indicators of student readiness for the implementation of deep learning in the context of biology learning, this study specifically examines cognitive readiness as a fundamental requirement for deep learning pedagogy.

Based on these considerations, research is needed to analyze the potential readiness for implementing deep learning in high school biology from the perspective of habits of mind and information processing. Therefore, this study aims to determine the condition of students' habits of mind and information processing as aspects that support the implementation of deep learning. The urgency of this research, designed based on the written problem background, is the need to take strategic steps by analyzing students' thinking habits in the form of real-life actions and information processing in biology learning in high school. The results of this study are expected to provide an overview of students' cognitive readiness and serve as a basis for developing biology learning strategies that support the implementation of deep learning in schools.

B. Material and method

The research was conducted using a qualitative-quantitative descriptive method, namely data collection by looking at the results of student questionnaires supported by the results of observations during the learning process. The subjects in the study were taken by purposive sampling, namely grade X students who received biology subjects on environmental change at SMA Negeri 1 Semarang as a sample of public schools and SMA Islam Sultan Agung 1 Semarang as a sample of private schools in Semarang City. The research was conducted in March - September 2025. The research instrument was prepared based on the framework of thinking adapted from the instrument developed by (Hayat, 2020). The instrument has been tested for validity and reliability including questionnaires on habits of mind and information processing in the form of closed statements using a Likert scale so that a scale of 4 is the most ideal answer and a scale of 1 answer that need to be followed up. In addition, there is an observation sheet instrument on habits of mind, information processing to strengthen the data obtained using the questionnaire by photographing the entire learning process. The data collection technique was carried out by providing questionnaires on habits of mind and information processing to be filled out by students. In addition, the data is backed up by observations made by researchers on students' habits of mind and information processing.

Data were analyzed using a mixed method, meaning both quantitative and qualitative data were collected. Quantitative data were collected using descriptive statistics and independent sample t-tests based on questionnaire results. Quantitative data were analyzed by compiling all student responses and scoring criteria using the Formula 1.

$$\text{Final score results: } \frac{\text{total score}}{\text{highest score}} \times 100 \dots \text{Formula (1)}$$

Meanwhile, qualitative data was analyzed descriptively based on field notes from teacher

observations of students' habits of mind and information processing during learning.

The quantitative data obtained from the research were systematically classified according to the respondents' achievement levels. The score interpretation criteria according to Arikunto (2010) are in Table 1.

Table 1 Research result score classification criteria

Average	Level
81-100	Very good
61-80	Good
41-60	Enough
21-40	Poor
0-20	Very poor

C. Results and discussion

The results of the study on habits of mind and information processing abilities to determine students' readiness for the application of deep learning in biology learning for grade 10 students are presented in a diagram depicting student achievement. These three aspects demonstrate a close relationship in supporting students' learning process, starting from the ability to manage themselves in learning, process information from various sources, to construct meaningful understanding through learning experiences in the classroom. Through the material on environmental changes, students are not only required to understand the concept, but also be able to relate it to real problems, so that learning becomes more contextual and supports the formation of higher order thinking skills.

Habits of mind

Questionnaire

The results of the Habits of Mind Questionnaire at SMA Negeri 1 Semarang are illustrated in the data diagram in Figure 1. The results of the Habits of Mind questionnaire for 10th-grade students at SMA N 1 Semarang showed an average score of very good. High achievement in the self-regulation aspect indicates that students can make effective plans, identify necessary resources, and are sensitive to work evaluations in biology learning. The critical thinking aspect indicates that students have been able to control themselves so as not to rush into making decisions and are sensitive to the feelings and level of knowledge of others, even those they know closely. These abilities are an important foundation in biology learning, which requires students to understand natural phenomena scientifically and based on evidence. Meanwhile, the creative thinking aspect showed lower achievement, indicating that students tend to work on assignments at their own pace, achieve significant understanding, and produce alternative learning methods, although the results are not significantly different. These findings indicate that students tend to be able to complete assignments and

find alternative learning methods but have not yet fully demonstrated flexibility in generating diverse ideas or solutions. This condition may be influenced by the characteristics of learning, which has so far emphasized mastery of concepts and accuracy of answers rather than open exploration of ideas (Robin et al., 2024). The results of this study are in line with

previous research which shows that aspects of self-regulation and critical thinking tend to develop better because they are more frequently facilitated in daily learning activities, while creative thinking requires a learning environment that provides more space for students to explore and innovate (Haka et al., 2022; Hayat et al., 2019; Hidayati & Idris, 2020).

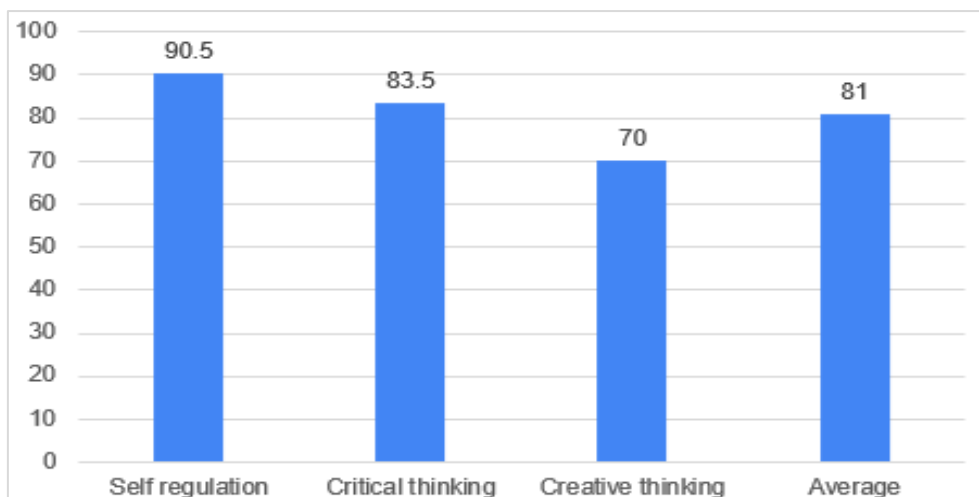


Figure 1 Results of the habits of mind questionnaire at SMA Negeri 1 Semarang

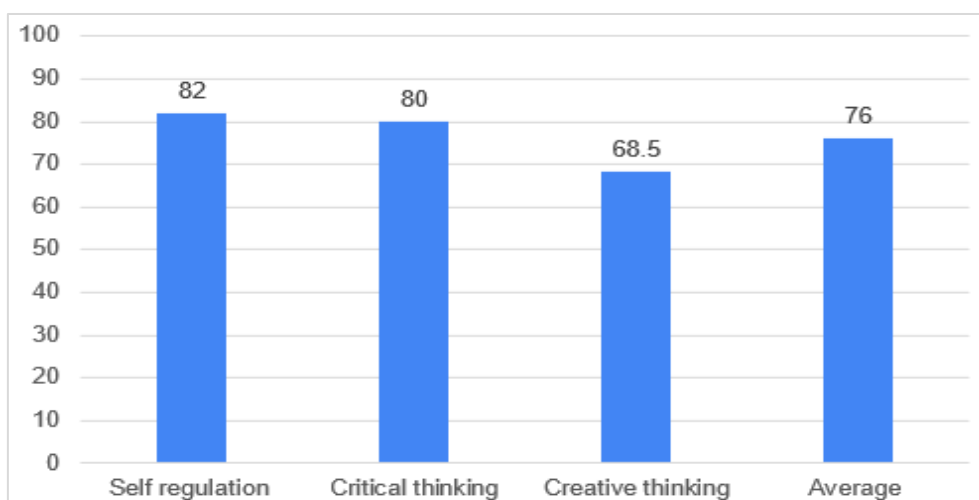


Figure 2 Results of the habits of mind questionnaire at Sultan Agung 1 Islamic High School, Semarang

Table 2 Independent sample T-test results of the habits of mind questionnaire

Independent Samples Test									
		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Habits of mind	Equal variances assumed	6.633	.012	1.550	60	.126	.17419	.11239	Lower Upper
	Equal variances not assumed			1.550	52.585	.127	.17419	.11239	Lower Upper

The results of the Habits of Mind Questionnaire at Sultan Agung 1 Islamic High School, Semarang are

illustrated in the data diagram in Figure 2. The results of the Habits of Mind questionnaire at Sultan Agung 1

Islamic High School in Semarang were in the good category across all measured aspects. Excellent achievement in the self-regulation aspect indicates that students are able to plan learning activities effectively, identify learning needs, and utilize available resources to achieve learning objectives. In the critical thinking aspect, the research results indicate that students are able to consider information rationally, control themselves in decision-making, and demonstrate awareness of the various consequences that may arise from their decisions. Data on the creative thinking aspect indicates that students tend to be able to understand concepts and complete assignments well, but the ability to generate various alternative ideas or solutions still needs to be developed. The research results indicate that creative thinking skills have not developed as optimally as self-regulation and critical thinking skills. This condition may be influenced by learning experiences that often emphasize conceptual understanding, structured task completion, and finding the right answer rather than exploring various possible solutions (Ghbari & Harahsheh, 2024). In line with previous research findings which show that students' habits of mind generally have aspects of self-regulation and critical thinking which are more dominant in supporting the ability to plan, control themselves, and evaluate learning, while the development of creative thinking is still influenced by the learning experiences and strategies used by students (Ariyati et al., 2024; Ramadani et al., 2025; Suryawati et al., 2024).

The results of the habits of mind questionnaire were analyzed using a comparative test between SMA Negeri 1 Semarang and SMA Islam Sultan Agung 1 Semarang using the independent sample t-test in Table 2. The results of the independent samples t-test showed a significance value of 0.127 ($p > 0.05$). This means there is no significant difference in habits of mind abilities between students of SMA N 1 Semarang and SMA Islam Sultan Agung 1 Semarang. Although there is a difference in the average of 0.17419, where the average of SMA N 1 Semarang is higher (3.2677) than SMA Islam Sultan Agung 1 Semarang (3.0935), the difference is not statistically significant. This shows that the characteristics of students' habits of mind in both schools tend to develop at a relatively similar rate. Influencing factors include students' increasingly equitable access to digital and non-digital learning resources, so that opportunities to develop habits of mind are not solely determined by the status of public or private schools. The results of this study are in line with the view that habits of mind are thinking habits that develop through continuous learning experiences, a supportive learning environment, and opportunities for reflection and active problem-solving (Bariroh et al., 2024; Hidayati & Idris, 2020).

Observation

The results of the Habits of Mind Observation at SMA Negeri 1 Semarang are illustrated in the data diagram in Figure 3.

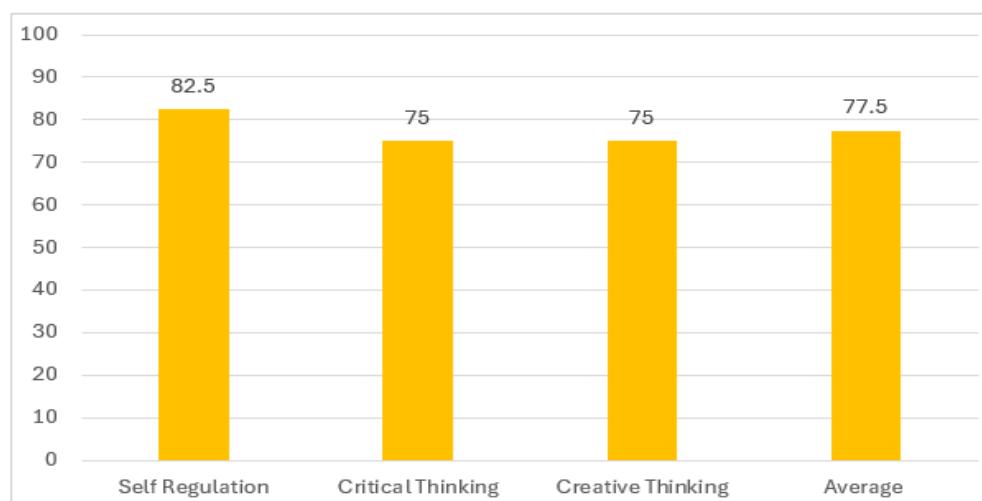


Figure 3 Results of observations on habits of mind at SMA Negeri 1 Semarang

Based on the results of observations of habits of mind, class X students who received material on environmental changes in biology learning at SMA N 1 Semarang showed average results with good achievements. Students demonstrated the self-regulation aspect of being able to plan learning activities effectively, identify necessary resources, and evaluate the learning process and outcomes obtained. In the critical thinking aspect, students were able to

consider information and make rational decisions based on the situation at hand, although they did not always ask for advice. Meanwhile, in the creative thinking aspect, students were able to find solutions to problems and generate ideas in the learning process, although its development could still be optimized.

The results of this study indicate that biology learning needs to be designed with activities that encourage students to actively think, reflect on the

learning process, and engage in problem-solving related to real-life phenomena as essential prerequisites for deep learning. Thus, the observation results provide a more contextual picture of the implementation of habits of mind in the classroom, while the questionnaire results reflect students' confidence in their abilities. Nevertheless, both results indicate that students already have a strong foundation of habits of mind to support their readiness for deep learning, especially in the aspect of self-regulation. In biology learning, habits of mind, with the aspect of self-

regulation, tends to be higher because it plays a role in planning and evaluating learning, followed by critical thinking and creative thinking that develop through problem-solving activities, although not yet optimal (Sun, 2022; Supriwardi et al., 2025). Self-regulation also plays a key role in improving critical and creative thinking in technology-based science learning in accordance with 21st century learning developments (Bariroh et al., 2024; Neiroukh, 2025; Suryawati et al., 2024).

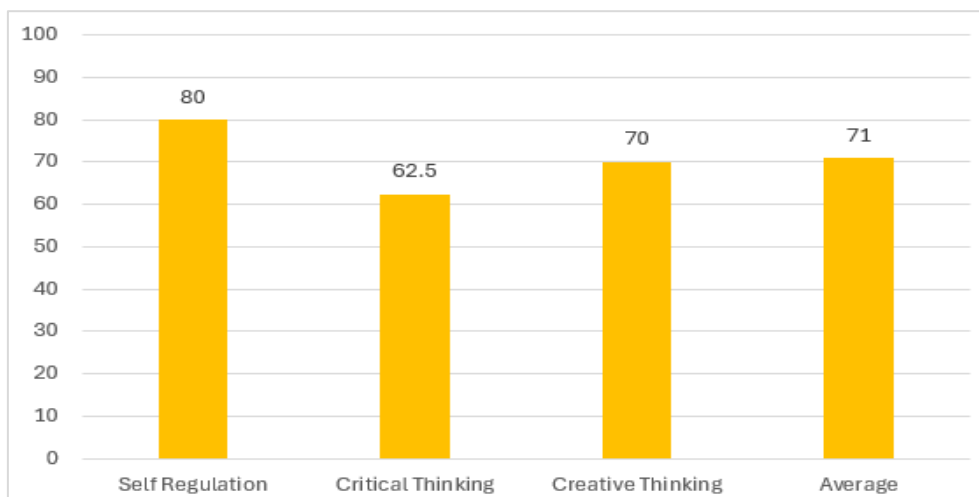


Figure 4 Results of observations on habits of mind at Sultan Agung 1 Islamic High School, Semarang

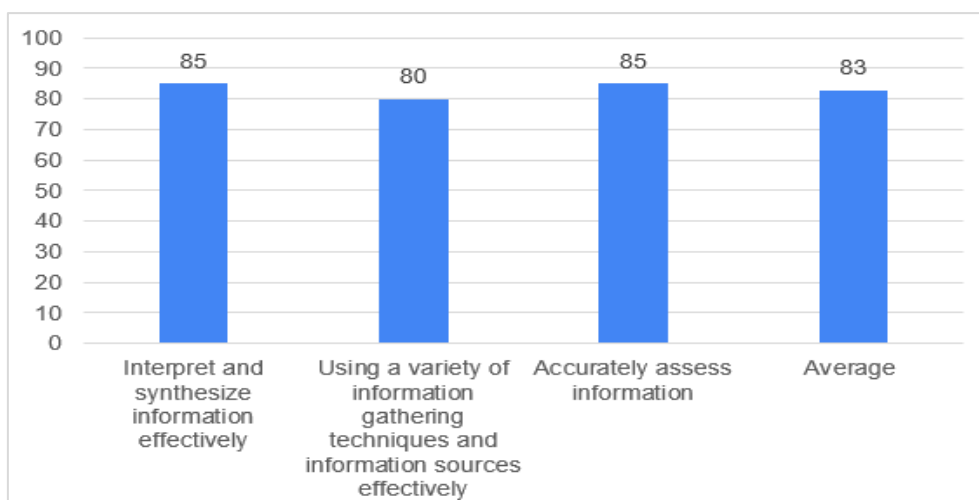


Figure 5 Results of the information processing questionnaire at SMA Negeri 1 Semarang

The results of the Habits of Mind Observation at Sultan Agung 1 Islamic High School, Semarang are illustrated in the data diagram in Figure 4. Based on the results of observations on habits of mind in grade 10 at SMA Islam Sultan Agung 1 Semarang, the results were categorized as good. The self-regulation aspect showed that students were able to make effective plans, identify necessary alternative resources, and were sensitive to evaluation, even though they did not seek advice from knowledgeable sources. The results

obtained from the critical thinking aspect with good scores indicated that students were less careful in making decisions and their sensitivity to the feelings and level of knowledge of others was evident, although some did not yet respect the opinions of others. Meanwhile, the creative thinking aspect showed that students appeared tenacious and able to produce creative solutions, although some still relied on practical methods such as the use of digital media. The similarity of findings from both instruments indicated

that students had developed the ability to manage learning, reflect on thought processes, and consider information rationally. These conditions indicate that students are quite well prepared to participate in in-depth learning, because these abilities are an important foundation for building meaningful understanding, connecting knowledge to real contexts, and solving problems reflectively and contextually (Braad et al., 2022). This finding strengthens the results of previous studies which revealed that in science learning, students' self-regulation abilities tend to develop better than critical thinking, which is still influenced by accuracy in decision-making and an attitude of respecting opinions, while students' creative thinking has been able to produce alternative solutions even though it still utilizes practical methods or technological support (Mahrufah & Rijanto, 2024; Panadero, 2017; Susilowati et al., 2018).

Information processing

Questionnaire

The results of the Information Processing Questionnaire at SMA Negeri 1 Semarang are illustrated in the data diagram in Figure 5. Based on the results of the information processing questionnaire, class X students at SMA N 1 Semarang obtained an average achievement of very good. In the aspect of interpreting and synthesizing information effectively, it shows that students are able to understand the material and connect it with existing knowledge but

are not yet able to link information sources to form complete conclusions. Meanwhile, in the aspect of using various information gathering techniques and sources effectively, it shows that students tend to seek learning resources on digital platforms, discussions, asking friends and teachers. Meanwhile, in the aspect of accessing information, the achievement was very good, indicating that students check the accuracy of the material provided by the teacher by digging for information through various sources, but tending more towards digital media. Overall, the achievement of very good information processing indicates that students are well prepared to participate in in-depth learning, which is supported by the ability to access various learning sources, interpret information, and evaluate the accuracy of information independently. However, the ability to integrate various information sources still needs to be improved so that knowledge construction can take place more deeply and meaningfully (Reynders et al., 2020). In biology learning, these findings can be translated into learning strategies by facilitating case analysis activities, data-based discussions, and concept mapping to help students organize and synthesize the information they receive. The ability to interpret and evaluate information effectively and utilize various learning resources, especially digital media, despite the integration of information into coherent conclusions, is still not optimal (Noskova, 2021; Sulistiyarini & Sabirin, 2020; Trixa & Kaspar, 2024).

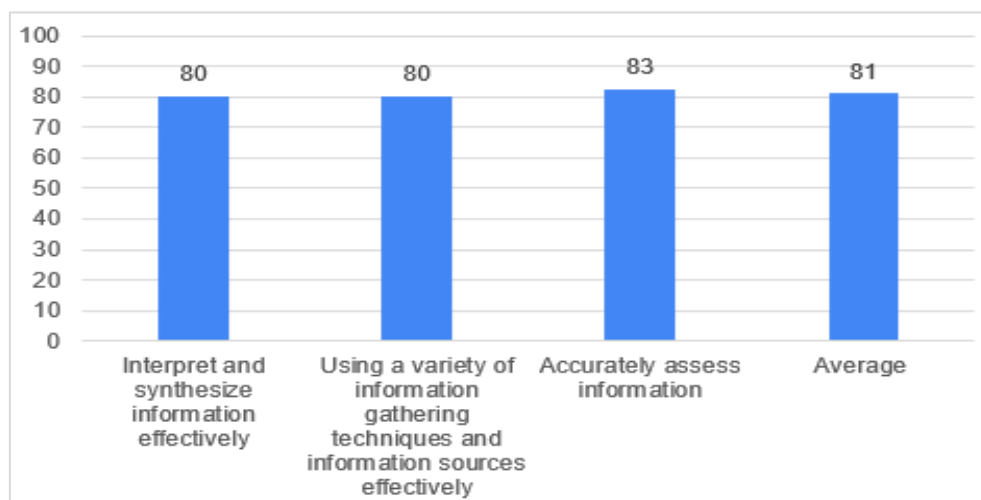


Figure 6 Results of the information processing questionnaire at Sultan Agung 1 Islamic High School, Semarang

The results of the Information Processing Questionnaire at Sultan Agung 1 Islamic High School Semarang are illustrated in the data diagram in Figure 6. The results of the information processing questionnaire for 10th grade students at Sultan Agung 1 Islamic High School in Semarang were categorized as very good. This is demonstrated in the aspect of interpreting and synthesizing information effectively, with achievements categorized as good. Students were able to understand the material despite having

difficulty connecting it with prior knowledge to become important points of conclusion. In terms of using various information gathering techniques and sources effectively, students found sources of material relying on digital and non-digital platforms independently, although they did not take notes on important points from the teacher's material. In terms of accurately accessing information, students demonstrated the ability to check the material provided by the teacher correctly by exploring

material information (LKS, reading modules, and biology books), although they tended to be more proficient using digital media only. The results of the study indicate that the skill of accessing information is not always followed by the ability to process and synthesize information in depth. One factor that can influence this condition is the habit of students who focus more on information search than the process of reflection, organization, and linking information from various sources (Claes, 2021). This tendency is also

reinforced by various studies that reveal that students' information processing abilities have developed well in terms of accessing and evaluating various learning sources, but there are still obstacles in integrating information with prior knowledge to form complete conclusions, as well as the dominance of the use of digital sources compared to in-depth information processing (Ansoriah et al., 2025; Hryhorieva et al., 2023; Lidiastuti et al., 2025).

Table 3 Independent sample T-test results of the information processing questionnaire

		Independent Samples Test							
		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Habits of mind	Equal variances assumed	1.521	.225	-.152	40	.880	.01905	.12569	Lower: -.27308 Upper: .23498
	Equal variances not assumed			-.152	37.669	.880	.0195	.12569	Lower: -.27357 Upper: .23547

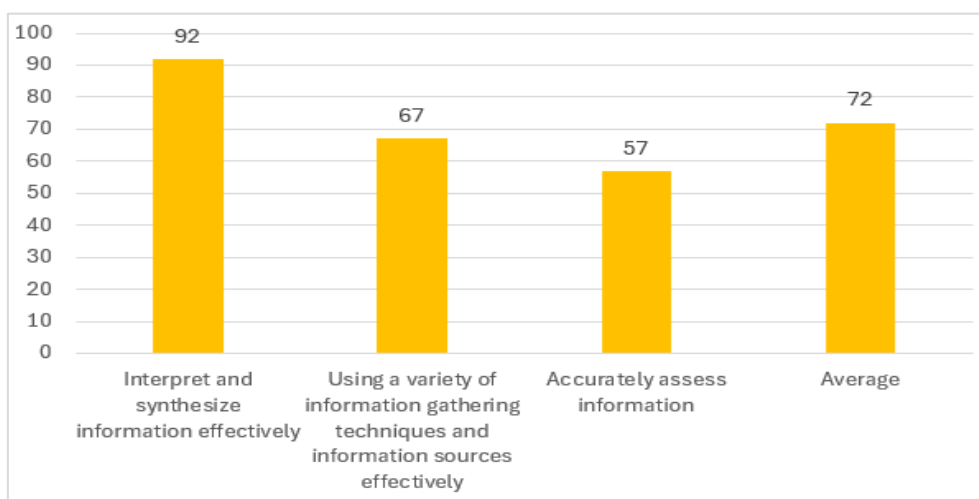


Figure 7 Results of observations on information processing at SMA N 1 Semarang

The results of the information processing questionnaire were analyzed using a comparative test between SMA Negeri 1 Semarang and SMA Islam Sultan Agung 1 Semarang using the independent sample t-test in Table 3. The results of the independent samples t-test showed a significance value of 0.880 ($p > 0.05$). This means there is no significant difference in information processing ability between students of SMA N 1 Semarang and SMA Islam Sultan Agung 1 Semarang. Although there is a difference in the average, namely 3.3524 and 3.3714, the difference is not statistically significant. The absence of a significant difference may be caused by several factors such as the similarity of curriculum implementation, access to learning resources and technology, and the relatively homogeneous academic characteristics of students in both schools. In addition, information processing ability is likely more influenced by individual factors,

such as learning motivation, cognitive abilities, learning strategies, and family environmental support, rather than by the school's status as a public or private school (Kagan, 2023; Kikas et al., 2024). Therefore, these findings suggest that school type is not a major factor differentiating students' information processing abilities.

Observation

The results of the Information Processing Observation at SMA Negeri 1 Semarang are illustrated in the data diagram in Figure 7. Observations on information processing in class X at SMA N 1 Semarang showed that the average achievement was in the good category. This was demonstrated in the aspect of interpreting and synthesizing information effectively, showing that students were able to understand the material and could connect it with existing knowledge, although not

linked to information sources to form conclusions. In the aspect of using various information gathering techniques and sources effectively, students sought material sources through non-digital platforms (LKS, reading modules, biology books), but students were active in discussions with teachers and friends even though they did not take notes on material points from the teacher. As for the aspect of accurately accessing information, the results showed that students took notes but did not explore the accuracy of the information provided by the teacher, only asking questions to the teacher and friends despite being proficient in learning using digital media. The observation results showed a difference from the questionnaire data in that students' perceived information processing abilities were not yet optimally

apparent in learning activities. In the observation results, students were seen actively seeking information and discussing, but were not yet accustomed to synthesizing information from various sources into complete conclusions and had not consistently verified the accuracy of the information obtained. This picture indicates a pattern that is also found in various recent studies, namely that students' information processing abilities are relatively good at the stage of understanding and interpreting material, but tend to be lower at the stage of evaluating the accuracy and integration of information due to limitations in verifying sources and processing information in depth (Dwyer et al., 2023; Kurniawana & Sarah, 2023; Reynders et al., 2020).

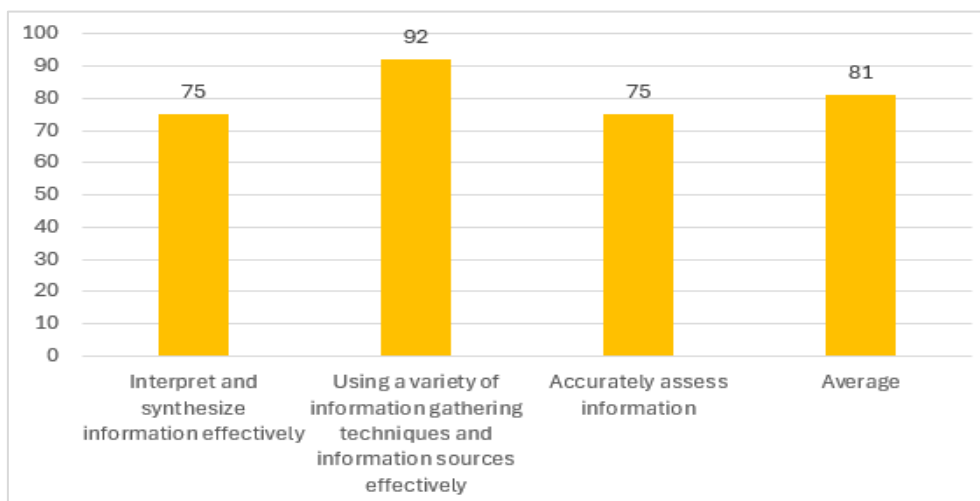


Figure 8 Results of Observations on Information Processing at Sultan Agung 1 Islamic High School, Semarang

The results of the Information Processing Observation at Sultan Agung 1 Islamic High School, Semarang are illustrated in the data diagram in Figure 8. Observations on information processing for class X at SMA Islam Sultan Agung 1 Semarang showed very good results. This was demonstrated in the aspect of effectively interpreting and synthesizing information, indicating that students were able to understand the material but had difficulty connecting it with existing knowledge by linking the information into key points and conclusions. In terms of effectively using various information gathering techniques and sources, students demonstrated persistence in seeking learning resources from digital and non-digital media, although they did not take notes on key points from the teacher. In terms of accurately accessing information, students were able to record information obtained but did not explore the accuracy of the material provided by the teacher despite being proficient in using both digital and non-digital media. The results of the study indicate that students' ability to access information has developed better than their ability to process that information into an integrated understanding. This condition may be influenced by learning habits that

emphasize searching and gathering information rather than analyzing, reflecting, and synthesizing information from various sources. Therefore, although students have demonstrated good readiness through their ability to access various learning sources, strengthening their ability to synthesize and evaluate information is still necessary so that the learning process does not stop at collecting information, but develops into a deep, contextual, and meaningful understanding (Ardyawin, 2024). In biology learning, teachers can implement strategies that encourage students to synthesize information through activities such as creating concept maps, summarizing based on multiple sources, and reflective discussions after learning. Students have high abilities in accessing and collecting information from various sources, both digital and non-digital, but still face challenges in linking information to prior knowledge and evaluating the accuracy of information in depth, so that the understanding formed is not fully integrated (Brod, 2021; Rifqi, 2025; Wang et al., 2019).

The habits of mind and information processing profile data obtained from questionnaires and observations indicate good readiness for deep learning

implementation, although there are still areas for optimization. This underpins habits of mind and information processing as the primary foundation for implementing deep learning-based learning, as both play a role in shaping students' abilities to manage learning, process information deeply, and construct knowledge meaningfully (Ariyati et al., 2024; Panadero, 2017; Zebua, 2025). The research data indicate that students' "habits of mind" are very strong and their information processing skills are strong, with self-regulation and the ability to assess and evaluate information being more developed than critical thinking, creative thinking, and the ability to synthesize information, all of which still need improvement. This suggests that both public and private schools demonstrate a high level of readiness to implement deep learning based on students' "habits of mind" and information processing skills.

D. Conclusion

Based on the research conducted, it can be concluded that students demonstrate good readiness to support the implementation of deep learning from the perspective of habits of mind and information processing. This readiness is primarily demonstrated by the development of self-regulation skills, which are better than the critical thinking and creative thinking aspects, which are still less than optimal. In the information processing aspect, students have demonstrated good abilities in accessing, interpreting, and evaluating information from various sources, but still experience difficulties in synthesizing various information into a complete and meaningful understanding. The results of this study provide implications for biology teachers to design more student-centered learning through case analysis activities, argumentative discussions, scientific investigations, learning reflections, and contextual problem solving. This study has limitations because it only involved two schools in Semarang City with a limited sample size and used a questionnaire instrument that could potentially be influenced by the respondents' subjective perceptions. Therefore, further research is recommended to involve a wider and more diverse range of schools and develop and test deep learning-based biology learning interventions to directly evaluate their effects on the development of students' habits of mind and information processing abilities.

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