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Analysis of the Occurrence of Critical Thinking in Biology Teaching Modules on Enzymes Class XII High School in Surakarta

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ABSTRACT

Critical thinking skills are very important in learning biology which emphasizes on providing direct learning experiences by developing thinking skills. The study of biology requires problem solving skills through critical thinking. The purpose of this study was to analyze the emergence of critical thinking in the biology teaching module of high school enzyme material in Surakarta. The type of research included descriptive qualitative. The population in this study were all biology teachers in Surakarta. The sample was 15 high school biology teachers in Surakarta, one teacher each per school (Public, Private, Muhammadiyah). Sampling was done purposively with each school analyzed 5 teaching modules. Data collection techniques by means of documentation and interviews and then the data were analyzed descriptively. The results showed that the emergence of critical thinking in each indicator was different for State, Private and Muhammadiyah schools. Thus, the conclusion that can be put forward is that the highest occurrence of critical thinking is in private school teaching modules (35.37%), with the most frequently appearing indicator being giving simple explanations (45.33%) and the least frequently appearing tactical strategies (2.67%). These findings can provide information to high school biology teachers regarding critical thinking strategy and tactics indicators.

1. INTRODUCTION

To face various challenges in the 21st century, every student needs to have a number of skills, namely critical thinking, collaboration, communication, creativity, culture, and connectivity, known as the 6Cs (Anugerahwati, 2019). Biology learning is important to implement the 21st century and follow the principles of 21st century learning (Wijaya *et al*., 2022).

Biology as a scientific discipline related to nature, includes various facts and phenomena that require various skills to support the learning process (Wulandari *et al*., 2021). Biology learning in reality is still considered a difficult lesson by students (Erpiyana *et al*., 2022) so that it is one of the obstacles faced by teachers. Teachers make various innovations in the learning process, in order to change the paradigm that biology lessons are interesting and fun lessons, so that students can master the skills and abilities to achieve the desired learning objectives (Jayawardana *et al*., 2020). One of the abilities that students must have in learning biology is the ability to think critically. Biology learning is one part of the science process that contains facts and principles as a result of scientific processes that require problem solving through critical thinking skills (Gulo & harefa, 2024).

According to (Ennis, 2015), ideal critical thinkers seek and provide clear reasons, use credible sources, and are open-minded. This is in line with the view of (Erwanto, 2020), which states that critical thinking involves a deep understanding of a problem, maintaining open-mindedness to various approaches, and not easily believing information from various sources. Dewi *et al*., (2020) assert that critical thinking means consciously choosing actions by focusing on personal thinking.

(Kusumawati *et al*., 2022), added that critical thinking skills involve the ability to recognize assumptions and integrate previously learned knowledge, so that students can analyze mathematical situations in depth, including in problem solving, calculating possibilities, making decisions, and drawing conclusions. Critical thinking skills are very important in learning biology, which e mphasizes hands-on learning experiences to develop thinking skills Apriyani *et al*. (2017). Maknun (2020) added that critical thinking allows students to learn through discovery, so they are responsible for their learning process. This is in line with the opinion of (Amin *et al*., 2020) which states that critical thinking plays an important role in academic success, because students can identify goals and points of view, assess the reasoning behind the content, and evaluate the reasoning behind the content.

Critical thinking skills can be measured through several aspects, such as listening, reading carefully, identifying basic assumptions, and believing in actions based on relevant knowledge (Nuraini, 2017). Mohamed Nor & Sihes (2021), state that students can develop critical thinking skills if teachers apply higher-order thinking methods, such as dealing with real-world situations and supporting inquiry-based activities. Nugraha *et al*., (2022) identify five major groups of critical thinking skills, including providing simple explanations, building basic skills, drawing conclusions, providing further explanations, and applying strategies and tactics. However, in reality, students' critical thinking skills remain low, due to teaching methods that are predominantly lecture-based, a focus on teacher-centered learning, and techniques that rely heavily on memorization, which tend to make students passive Nur *et al.*, (2023). Fitria *et al*. (2023), also add that the challenges in critical thinking learning are caused by a learning process that remains teacher-centered and relies solely on memory techniques, without considering ideas related to the material.

From previous studies, it was found that critical thinking skills at SMAN 1 Singorojo Kendal were good (Kusuma Dewi & Rahayu Utami, 2016). The same thing was found at SMA PGRI 4 Jakarta which was also good (Endang *et al*., 2021). However, research at SMA Negeri 1 Lahewa Timur, North Sumatra is still relatively low (Gulo & Harefa, 2024). Similarly, SMAN 4 Surakarta is still classified as low and needs to be improved (Perdani *et al*., 2019).On the other hand, at MAN Surakarta it is very poor Hariyatmi *et al*., (2019). According to Herdawati (2022), the biology learning process at Jeneponto High School, South Sulawesi has not fully implemented critical thinking skills due to teacher limitations in implementing these skills in the learning process. This shows that the learning process in schools lacks critical thinking skills. In line with this finding, research by (Wijayanti, 2022) reported that the low critical thinking skills of students in class XII MIPA 8 at SMAN 6 Semarang were caused by the selection of learning models and methods from teachers that were not in accordance with the character of students who were less active and critical. Thus, these two studies highlight the challenges faced in developing students' critical thinking skills in various schools.

In Surakarta, there are still few studies that analyze the extent to which the teaching module reflects critical thinking elements, especially on complex enzyme material (Deratama *et al*., 2020). Teachers are expected to design and plan learning to meet expectations, which are outlined in the teaching module (Rahimah, 2022).. This ability depends on the teacher's pedagogical competence (Sahidin, 2023). Salsabilla (2023), emphasized the importance of developing pedagogical competence in the preparation of teaching modules so that teaching techniques are more efficient, effective, and in accordance with achievement indicators.

Teaching modules are learning media that contain lesson plans to direct the learning process in order to achieve learning outcomes (Novi *et al*., 2023). The preparation of teaching modules must be systematic and complete so that learning becomes interactive, fun, efficient, and can increase student motivation to actively participate. The module also provides space for students to develop their creativity as well as their physical and psychological aspects (Nisa *et al*., 2023). Thus, teaching modules play an important role in developing students' abilities and achieving the expected competencies (Alfiyah *et al*., 2024).

One topic in biology that is often considered difficult is enzymes. The concept of enzymes is often considered abstract, so students need to use the right logic to understand correctly (Puspitasari, 2020). In the biology curriculum for class XII SMA, there is a discussion about enzymes. This topic is included in the learning outcomes of the biology understanding element at the end of phase F, where students are expected to understand the function of enzymes and recognize the metabolic processes that take place in the body. This material is considered difficult due to its abstract nature, broad scope, and is usually delivered through lectures with a teacher-focused approach. As a result, students have difficulty in mastering the material as well as acquiring the necessary facts, concepts, and knowledge (Adibah *et al*., 2024).

Research by A. R. Nasution *et al*. (2020), showed that the PCK profile of Biology teachers at SMA Negeri 11 Medan Tembung was classified as good. Research conducted by (Amelia et al., 2023) also showed similar findings, where the TPACK of Biology teachers at SMA Dabo Singkep Riau was also in the good category. On the other hand, Unaida & Fakhrah, (2022) reported that the TPACK ability in SM/MA in Dewantara Aceh District was quite good. Meanwhile, Indriyani & Hariyatmi, (2023) stated that PCK skills in Sragen Regency were in the moderate category. (Anggie Iim Setyoningsih & Hariyatmi, 2024) added that teachers' PCK skills were very good.

The importance of preparing teaching modules for learning, the analysis of the emergence of critical thinking in the Biology teaching module of high school enzyme material in Surakarta even semester Academic Year 2024/2025, so as to provide benefits to add insight and knowledge about the emergence of critical thinking skills in biology teaching modules carried out by high school teachers, assist schools in providing information about the emergence of critical thinking skills in teaching modules as a lesson plan to continue to be implemented in the learning process, and provide inspiration for further researchers.

2. METHODS

2.1. Type of Research

The type of research used is descriptive qualitative research, the data is described objectively, as it is regarding the emergence of critical thinking in the teaching module of high school biology in Surakarta in the 2024/2025 school year. The collection of high school biology teaching module documents in Surakarta in the form of softfile, hardfile is complemented by interviews with teachers.

2.2. Population, Sample, and Sampling

The population in this study were biology teachers of class XII in Surakarta, with a sample of 15 high school biology teachers in Surakarta from each school of one teacher including State, Private, Muhammadiyah schools (SMAN, SMAS, SMAM). Sampling was done by purposive sampling, namely selecting samples that have certain characteristics or criteria relevant to the research (State, private, and Muhammadiyah groups that are close to the campus), teaching modules from each teacher analyzed amounted to 5 teaching modules.

2.3. Research Prosedure

After the pilot test, testing the research instruments that have been made to identify critical thinking that appears in teaching modules from peers, made by PPG teachers, and downloaded from the internet.

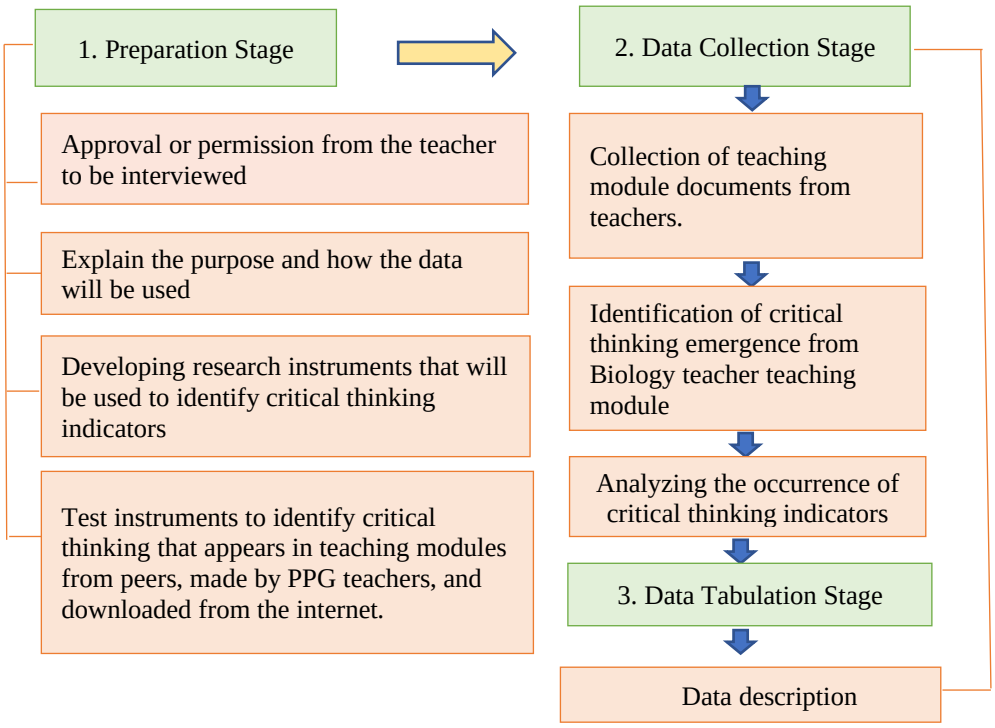


Fig 1. Flowchart of Research Procedure

The data collection stage by identifying the emergence of critical thinking from the teaching module of high school Biology teachers in Surakarta. Teaching modules were analyzed for critical thinking skills which included five indicators, namely providing simple explanations, building basic skills, conclusions, making further explanations and tactical strategies. Data tabulation is done by grouping various data in a table that has been made simpler with the intention that data on the critical thinking skills of high school students in Surakarta are easier to analyze and describe. The data analyzed is the frequency of how many teachers bring up critical thinking (Fig 1).

3. RESULTS AND DISCUSSION

The data from the study on the emergence of critical thinking in the biology teaching module on Enzymes for Grade XII high school students in Surakarta in the 2024/2025 academic year is presented in Table 1. The results of the study displayed in Table 1 show that the most frequent critical thinking indicator that appears overall in the teaching module of Biology Enzymes material of high schools in Surakarta is the indicator of giving a simple explanation (45.93%). When viewed based on the State, Private, and Muhammadiyah groups, the average indicator of giving simple explanations is highest in the State group (50%), while the lowest is in the Muhammadiyah group (42.47%). On the other hand, the indicator that appeared least frequently (2.32%) was the strategy and tactics indicator, the highest in the Muhammadiyah group (2.74%), and the lowest in the State group (1.63%).

Table 1. Recapitulation of Average Data (%) of Critical Thinking Occurrence of Biology Teaching Modules on Enzymes in High School in Surakarta.

	Critical Thinking	SMAN	SMAS	SMAM	$\bar{x}$
1.	Giving Simple Explanation	**50**	**45,33**	**42,47**	**45,93**
2.	Building Basic Skills	29,69	29,33	27,40	28,81
3.	Conclusion	17,19	13,33	21,92	17,48
4.	Making Further Explanation	1,63	9,33	5,48	5,46
5.	Strategy and Tactics	**1,63**	**2,67**	**2,74**	**2,32**
	Total	100	100	100	100

Figure 2 is a comparison of the emergence of critical thinking (SMAN, SMAS, SMAM)

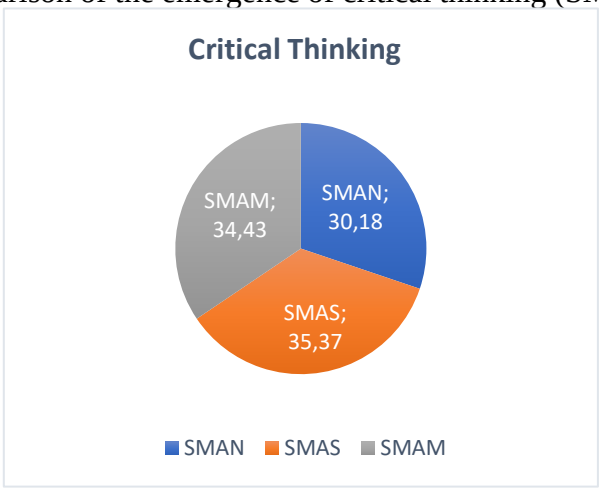


Fig 2. Comparison Diagram of Critical Thinking Emergence (%)

The analysis of the occurrence of critical thinking in the teaching module (Fig. 2) shows that among the three school groups (State, Private, and Muhammadiyah), the Private group most often displays critical thinking (35.37%). Meanwhile, the State group (30.18%) was among those who rarely displayed critical thinking in the teaching module (Fig 2).

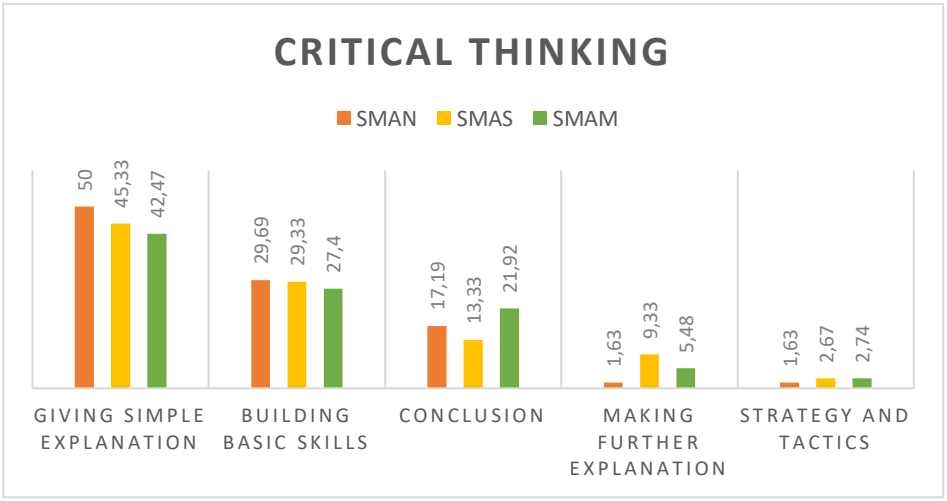


Fig 3. Comparison Chart (%) of Critical Thinking Indicator Occurrence (SMAN, SMAS, and SMAM)

After looking at Figure 3, it can be seen that the school group that most often raises the critical thinking indicator of giving simple explanations is the State group (50%), while the Muhammadiyah group raises this indicator the least (42.47%). For the indicator of building basic skills, the State group also dominated (29.69%), while the Muhammadiyah group recorded the lowest percentage (27.4%). In the conclusion indicator, the Muhammadiyah group appeared most often (21.92%), while the private group appeared least often (13.33%). The indicator of making further explanations, the private group showed the highest frequency (9.33%), while the State group was the lowest (1.63%). As for the strategy and tactics indicator, the Muhammadiyah group appeared most often, (2.74%), while the State group appeared least often (1.63%).

The emergence of critical thinking in the teaching modules of biology teachers in three groups of schools (Public, Private, and Muhammadiyah) in Surakarta, based on (Ennis, 2015) identification indicators, includes providing simple explanations, building basic skills, conclusions, making further explanations, and tactical strategies. This study shows that students

in public schools are rarely encouraged to think critically. Thus, the role of teachers is crucial in helping students develop critical thinking skills.

3.1. Providing Simple Explanations

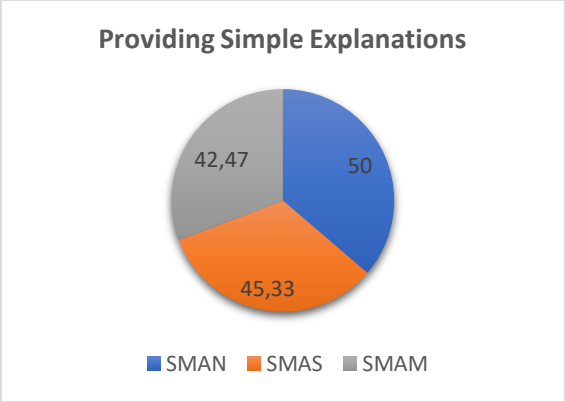


Fig 4. Comparison Diagram of Occurrence (%) of Indicator of Providing Simple Explanation (SMAN, SMAS, SMAM)

Based on Fig. 3, it can be seen that of all the indicators, the most frequently appearing indicator is the indicator of giving simple explanations (45.93%) and Fig. 4, shows that the indicator of giving simple explanations is most prevalent in the State/SMAN group (50%).

The figure below shows the analysis of the occurrence of the indicator of providing simple explanations in public, private and Muhammadiyah schools.

Inti: 1. Guru meminta peserta didik untuk membaca bagian pendahuluan tentang respirasi aerob. Lalu, mintalah peserta didik mendeskripsikan reaksi kimia respirasi, tujuan respirasi, struktur ATP, dan 4 tahapan respirasi. — Konstruksi Pengetahuan 1) Berpikir Kritis (Memberikan penjelasan sintaks 1 sederhana) SMAN	Providing simple explanations Students were given the opportunity to read an introduction to the material on enzymes in respiration, then describe the results. This shows that teachers train students to express their knowledge about respiration.
2. Kegiatan Inti (115 menit) Langkah 1. Merumuskan masalah a. Guru bertanya tentang apa saja faktor-faktor yang memengaruhi kerja enzim? (1) Berpikir Kritis (Memberikan Penjelasan sederhana) b. Guru menyajikan grafik pengaruh suhu, pH, konsentrasi enzim dan substrat terhadap kerja enzim. c. Peserta didik diminta untuk mengajukan sebanyak mungkin pertanyaan yang berkaitan dengan faktor-faktor yang memengaruhi kerja enzim. (1) Berpikir Kritis (Memberikan Penjelasan sederhana) SMAS	Providing simple explanations Students are given the opportunity to ask as many questions as possible related to the factors that affect enzymes. This means that teachers train students to express their questions, so that students become accustomed to thinking critically.
Kegiatan Inti (70 Menit) Tahapan Kegiatan pembelajaran menggunakan model Problem Based Learning — *Fase 1 : Orientasi Murid pada Masalah* 1. Menayangkan video enzim. 2. Guru memberikan pertanyaan ' Apa yang kalian ketahui tentang enzim? 1) Berpikir Kritis (Memberikan penjelasan sederhana) SMAM	Providing simple explanations, the teacher asks students questions about what they know about enzymes, thereby training them to express their understanding of enzymes.

Fig. 5. Example of the Appearance of Indicators Providing Simple Explanations in the Biology Teaching Module on Enzymes at Surakarta High School.

Based on interviews with public school biology teachers, it was found that during lessons, students are usually active in asking questions about the material to be studied. Public school teachers also added that students play an active role in answering basic questions asked by teachers. This aligns with research (Suharyani *et al*., 2023),which reported that the highest contribution to critical thinking skills at SMAN 2 Mranggen was observed in the indicator of providing simple explanations, as students were already able to formulate problems by constructing at least three questions related to the text stimulus, identifying and addressing relevance and irrelevance, and responding to an explanation or challenge with their reasons. On the other hand, in the teaching modules of private and Muhammadiyah schools, there are fewer basic questions or opportunities to respond to an explanation.

Based on interviews with private and Muhammadiyah biology teachers, it was found that students are accustomed to answering questions based on problems. Teachers also added that the approach often used is PBL, where PBL aims to train students in problem solving. This is in line with (Masrinah *et al*., 2019), which states that critical thinking skills can be improved through Problem-Based Learning (PBL), with this approach students are involved in real situations and are not only required to understand the problem, but also must collaborate to solve it. From this explanation, it can be concluded that public high schools in Surakarta still heavily involve students in critical thinking during learning, particularly in the indicator of providing simple explanations. This indicator falls into the low category because it still focuses on basic understanding rather than in-depth analysis (Khoirunnisa & Sabekti, 2020).

3.2. Building Basic Skills

From Figure 6, the highest percentage of indicators for building basic skills is in the Negeri group (29.69%), as illustrated in the diagram below (Fig. 6). The results of this study are similar to those of (Khoirunnisa & Sabekti, 2020),who reported that in high schools in Tanjung Pinang City, indicators for building basic skills are still classified as low. As explained by (Khoirunnisa & Sabekti, 2020),the activities in the teaching module are more focused on mastering basic knowledge and understanding, rather than on in-depth analysis, evaluation, or the creation of new ideas. According to (Novita & Patonah, 2025), developing basic skills highlights the importance of strengthening feedback to students. This feedback is essential for students to be more effective in collecting and analyzing information, which is a crucial aspect in enhancing critical thinking skills.

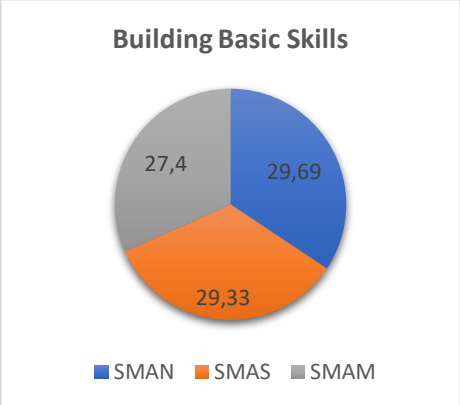


Fig 6. Comparison Diagram of the Appearance of Indicators for Building Basic Skills (%) in Surakarta High Schools

The figure below shows an analysis of the emergence of indicators for building basic skills in public, private, and Muhammadiyah schools.

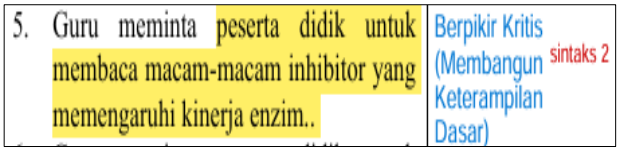
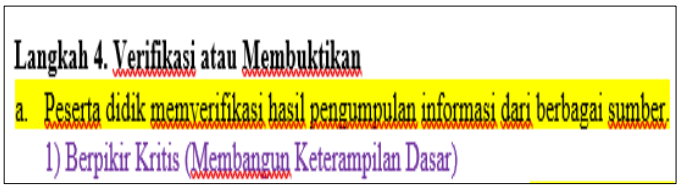
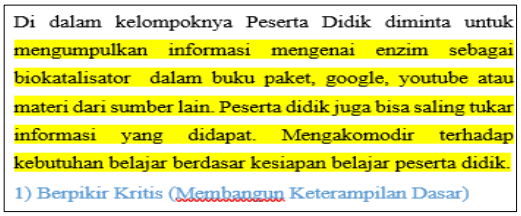
 SMAN	Building basic skills is demonstrated by giving students the opportunity to explore information more deeply by reading material related to enzymes. In this way, teachers teach students to obtain more information and train them to adapt the sources they have obtained.
 SMAS	To build basic skills, students are asked to verify the results of information gathering from various sources they have read. In this way, teachers train students to gather information from various sources and be able to provide reasons based on the information obtained.
 SMAM	Building basic skills, students are allowed to search for information from various sources such as YouTube, Google, or other sources, and then given the opportunity to exchange information with classmates. This shows that teachers train students to access information from various sources and exchange information with group members, so that they can identify weaknesses in the sources obtained.

Fig. 7. Example of the Appearance of Indicators for Building Basic Skills in the Biology Teaching Module on Enzymes at Surakarta High School.

Among the three groups of schools, there were no significant differences, as each school had already introduced this indicator but needed to develop it further. From the interviews conducted with biology teachers from public, private, and Muhammadiyah schools, it was found that teachers provide students with opportunities to explore information from various sources beyond textbooks, such as Google, journals, YouTube, or other relevant sources related to the material being studied, thereby enriching students' knowledge. In line with (Fujika *et al*., 2016), who state that a key characteristic of critical thinking is the ability to utilize information in formulating solutions to problems or making decisions, and if necessary, seeking additional relevant information.

3.3. Conclusion

Based on Figure 8, the Muhammadiyah group showed the highest frequency in applying the conclusion indicator (21.92%), more than the public group (17.19%) and private group (13.33%). Based on the results of interviews with Muhammadiyah biology teachers, it was found that students in the classroom were accustomed to being asked to summarize the learning material that had been taught. Teachers also added that by summarizing, students become more skilled at remembering the knowledge they have acquired during the learning process. In line with Irmayadi *et al*., (2020), the ability to draw conclusions helps students assess the new knowledge they have acquired.

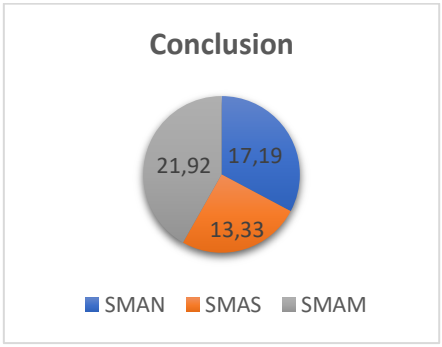


Fig. 8. Comparison Diagram of the Appearance of Conclusion Indicators (%) (SMAN, SMAS, SMAM)

The figure below shows an analysis of the emergence of conclusion indicators in public, private, and Muhammadiyah schools.

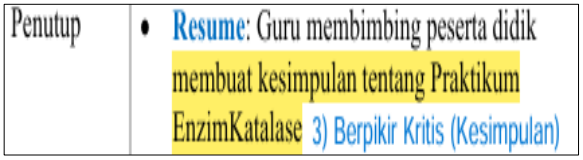
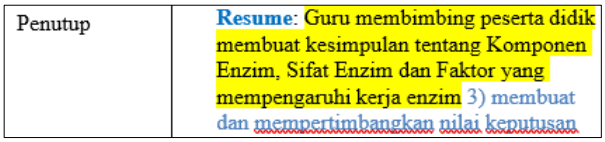
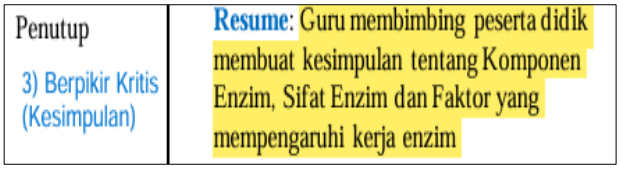
 SMAN	Conclusions are demonstrated by giving students the opportunity to summarize the results of the enzyme experiment. This shows that teachers train students to draw conclusions based on the facts they have learned.
 SMAS	Conclusions are drawn by asking students to summarize the components of enzymes, the properties of enzymes, and the factors that affect enzymes. Students are asked to draw conclusions based on their existing understanding. This shows that teachers train students to express their knowledge based on existing evidence.
 SMAM	Conclusions are demonstrated by students being asked to summarize their understanding of enzyme components, enzyme properties, and factors that affect enzymes. Compared to the private school group, this assignment is similar. This shows that teachers train students to summarize the facts they have learned.

Fig. 9. Example of the Appearance of Conclusion Indicators in the Biology Teaching Module on Enzymes at Surakarta High School.

A person can also be said to have the ability to draw conclusions if they understand three indicators, including being able to draw conclusions from specific to general, draw conclusions from general to specific, and be able to make a decision that will later be considered based on the results of that decision (Supriyati *et al*., 2018). However, in reality, the ability to draw conclusions in teaching modules in the three school groups is still rarely highlighted, which indirectly fails to adequately train students to learn how to make decisions. This aligns with Muhakim, A., (2021), who states that low ability to draw conclusions is caused by various factors, one of which is the inappropriate use of teaching strategies.

3.4. Providing Further Explanation

The indicator of providing further explanation is rarely found in biology teaching modules. After observing Figure 10, it can be seen that the indicator that appears most frequently is in the

private school group (9.33%). The indicator of providing further explanation is classified as a high-level indicator because it involves in-depth analysis, evaluation, and argument development. This aligns with (Fujika *et al*., 2016), who state that the indicator of providing further explanation falls under the high-level category because critical thinkers can utilize information to find solutions or make decisions, as well as seek additional relevant information if needed. It can be said that the Private group is more likely to apply high-level critical thinking indicators compared to the Public (1.63%) and Muhammadiyah (5.48%) groups.

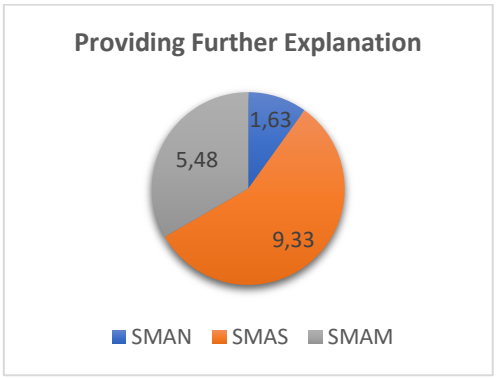


Fig. 10. Comparison Diagram of Indicator Appearance Making Further Explanations (%) (SMAN, SMAS, SMAM)

The figure below shows an analysis of the emergence of indicators that provide further explanation in public, private, and Muhammadiyah schools.

1. Guru menanyakan kepada peserta didik tentang penerapan faktor pH dan suhu dalam proses pembuatan tempe sehingga enzim yang dihasilkan jamur *Rhizophus* sp. tidak rusak dan fermentasi dapat berlangsung secara normal.. | Aplikasi Konsep 4) Berpikir Kritis (Membuat Penjelasan lebih lanjut) sintaks 3 SMAN	Further explanation is shown by the teacher asking students questions about the application of pH and temperature factors in the tempeh-making process. This shows that the teacher trains students to express assumptions based on existing facts.
1. Guru menanyakan kepada peserta didik tentang pemanfaatan enzim dalam praktik kehidupan sehari-hari. 4) Berpikir Kritis (Membuat penjelasan lebih lanjut) sintaks 4 | Aplikasi Konsep SMAS	Further explanation is provided by the teacher asking students questions about the use of enzymes in everyday life. This can train students to explain their understanding of the use of enzymes in daily activities.
Fase 4. Mengembangkan dan Menyajikan Hasil Karya Peserta didik diminta untuk Membandingkan masing-masing soal yang telah di bagikan mengenai enzim sebagai biokatalisator. Penyajian hasil belajar berdasar minat peserta didik **(KSE: Manajemen diri)** 4) Berpikir Kritis (Membuat penjelasan lebih lanjut) SMAM	Further explanation is provided by asking students to compare each question related to enzymes as biocatalysts. This trains students to express the reasons that arise from comparing the questions that have been given..

Fig. 11. Example of the Appearance of Indicators Providing Further Explanation in the Biology Teaching Module on Enzymes at Surakarta High School.

After reviewing Figure 11, it can be concluded that all three school groups have shown this indicator, although it needs to be developed further. The low occurrence of this indicator requires further explanation, as learning still uses simple methods, meaning that students are not often encouraged to think critically at a high level. This aligns with the statement by (Novantoro, 2019),

who noted that the ability to think critically in the context of providing further explanations falls into the category of moderately high. This indicates that not all students are yet capable of providing further explanations. Handoko *et al*. (2019), also added that the indicator for providing further explanations needs to be developed in line with the objective of enabling students to identify terms.

3.5. Strategy and Tactics

Strategy and tactic indicators rarely appear in biology teacher teaching modules. These indicators are classified as high-level because they involve students in analyzing, evaluating, and providing solutions to problems encountered (Indriana *et al*., 2022). Among the three school groups, strategy and tactic indicators appear most frequently in Muhammadiyah schools (2.74%). This indicates that the Muhammadiyah group more frequently applies strategy and tactic indicators compared to the public (1.63%) and private (2.67%) groups.

Fig. 12. Comparison Diagram of the Appearance of Strategy and Tactics Indicators (%) (SMAN, SMAS, SMAM)

The figure below shows an analysis of the emergence of strategy and tactic indicators in public, private, and Muhammadiyah schools.

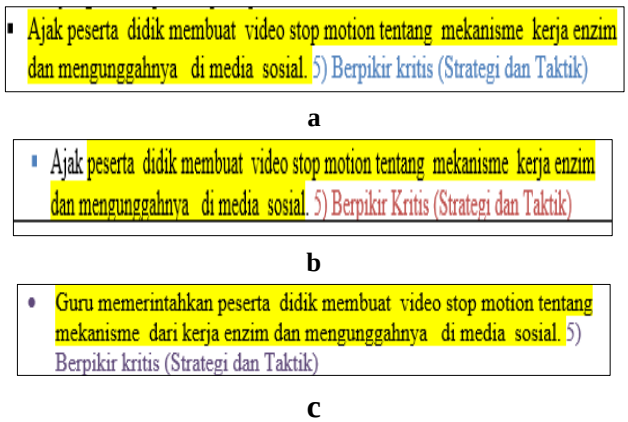


Fig. 13. abc is an example of one of the Strategy and Tactics Indicators that Appears in the Biology Teaching Module on Enzymes for the third year of High School (Public, Private, Muhammadiyah).

Based on Figure 13, it can be seen that in the biology teaching modules in the three school groups (Public, Private, and Muhammadiyah), students were given similar assignments by teachers, namely to make stop motion videos and upload them on social media, without any other innovative assignments. This indicates that teachers are training students to define facts about the

mechanism of enzyme function presented in the form of stop-motion videos, in order to facilitate understanding of the material.

Interviews with biology teachers at public schools revealed that students are still relatively passive in contributing to problem solving and taking action. Students need to be given stimuli from teachers first in order to be active in determining the steps to take in solving a problem. Teachers at private and Muhammadiyah schools also noted that some students are already very active in contributing without needing stimulation, while others remain passive and tend to be quiet. This aligns with research (Suharyani *et al*., 2023), which states that the lowest contribution is observed in the strategy and tactics indicators, where students are unable to determine actions based on the problem.

4. CONCLUSIONS

Based on the research conducted, it can be concluded that the highest level of critical thinking occurs in teaching modules in private schools (35.37%), with the most frequently occurring indicator being providing simple explanations (45.33%) and the least frequently occurring indicator being strategies and tactics (2.67%). These findings can provide information to high school biology teachers regarding indicators of critical thinking, particularly in relation to strategies and tactics.

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