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Characteristics of the Metacognitive Skill Evaluation Instrument in Merdeka Curriculum Biology Learning

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Abstract

Metacognitive will encourage students manage cognitive activities which be controlled. This research aims to develop instruments that can measure students' metacognition as an implementation of the Merdeka Curriculum. This research according to the ADDIE model. The research was conducted on students who had studied Environmental Change material in class X, with a small-scale trial on 10 students, and a large-scale trial on 50 students. Qualitative data analysis is in the form of descriptive validator comments. Quantitative data analysis includes validity, reliability, differentiated, question difficulty, and product effectiveness tests. Based on the development study, this product consists of 4 indicators, that is knowledge, regulation, awareness, and responsiveness. The instrument can effectively measure students' metacognition, with the proportion of achievement of metacognitive integrated questions is 68%, and metacognitive questionnaires is 72%. The percentage of metacognitive integrated questions is 73.362%, with a KMO value is 0.875, and the fit category as a measurement instrument is 48%. The percentage of metacognitive questionnaire measurability is 82.123, with a KMO value is 0.578, and a fit category as a measurement instrument is 20%.

How to Cite

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INTRODUCTION

Education in Indonesian year after year continues to change, which is now entering the 21st Century Learning marked by the integration of knowledge, skills, attitudes, and abilities in mastering technology. Metacognitive skills as one of the special skills that need to be empowered in 21st Century Learning century learning (Febrina & Mukhidin, 2019). This good metacognitive skills is a provision to face global challenges (Sunanto & Nur, 2018). Metacognitive skills support the increasing ability to think high level of students (Budhiman et al, 2021)

Students' metacognitive abilities will drive how they manage their cognitive activities in themselves that basically need to be controlled. Students should be aware of how they manage their own cognition. These are called metacognitive skills. Fitria et al., (2020) also explained that good metacognitive skills lead students to become independent students, that is, they will be able to recognize the way they think or process their cognitive processes, with each of these students will act as a manager for themselves. These abilities are aligned with the idea of Merdeka Curriculum, which leads students to gain the freedom to think independently and manage their cognitive abilities.

These metacognitive skills also determine students to learning success . A good understanding of metacognitive can be a provision for students in improving their learning outcomes. Increasing metacognitive skills improves learning outcomes including affective, cognitive, and psychomotor (Asaidah et al., 2022). Previous research that has been conducted on students in Biology subjects that is a positive relationship between metacognitive skills and learning outcomes. If the level of metacognitive skills experience an increase, so the learning outcomes will also increase (Usman et al., 2017).

The empowerment of metacognitive skills in Indonesian still has obstacles. These barriers arise because the paradigm of students with the role of receiving knowledge from the teacher, and the teacher as a source of knowledge. The assessment also emphasizes to test the cognitive abilities of students (Sari & Ria, 2020). S everal previous studies stated that the metacognitive skill of high school were classified as not really dan at risk (Agati et al., 2019). This condition causes students to find it difficult to regulate their thought process.

This phenomenon of biology learning not being carried out consciously to empower metacognitive skills was discovered in Indonesia. Biology learning that has been applied has been a lot of innovation and tends to be rare with lecture methods, but teachers there still have not implemented learning that can empower their students metacognitive. Students are still not accustomed to cultivate the ability to think independently. This is influenced by the application of learning models presented by biology teachers have not been able to empower students metacognitive. Evaluation questions made by biology teachers are also classified as summative questions that have not directed metacognition.

The results of interviews with students, found that students who have never heard the term metacognitive. Students certainly don't know much about metacognition themselves so it has not been measured. This is because biology teachers still have not performed metacognitive empowerment in biology learning, and not availability of metacognitive empowerment tools. This fact is a sign that metakognitive skills in a planned and conscious manner by biology teachers have not been implemented in biology learning. Biology learning students to gain direct experience as a form of application of facts, concepts, principles, and findings related to the problems around us. Biology learning diri trains individual students to study about themselves and the environment. Siregar (2019) explained that biology learning is very related to the students metacognitive skills, because it is useful in solving a problem, so that existing learning problems can be solved more easily.

Environmental Change is a biological material closely related to everyday life. Many things that are often encountered in daily activities are part of material concept of Environmental Change. Students must understand the concept of Environmental Change correctly and be able to consciously relate the material taught to everyday life. Learning this metacognitive integrated Environmental Change material will avoid refraction in concepts. Students when studying Environmental Change material need to study entirety.

Starting from the learning facts that have been described, it is necessary to develop instruments to measure metacognitive skills that are in accordance with the idea of the Merdeka Curriculum. The results of the instrument analysis will describe the characteristics of the instrument in measuring the metacognition of students. Hopefully, if it is known that the students metacognition is still low, then a teacher needs to find solutions to improve the metacognition of students. Therefore, there needs to be changes that are

more directed towards to empower metacognitive skills. It is hoped that the development of this metacognitive instrument will be a way to get used to empowering students' metacognition, especially those whose schools have implemented the Merdeka Curriculum. The results of metacognitive analysis are important for the development of students' self-potential (Majid, 2022).

Seeing the importance of metacognition in students as something that can be taken into account in achieving success in the learning process, it is necessary for teachers and even students themselves to know about the development of metacognition in themselves. To be able to obtain metacognitive information from students, a tool is needed to measure students' metacognition in Biology learning as an implementation of the Merdeka Curriculum. This information will then become a reference for teachers to progress further in empowering students' metacognition. Students will also be more open and aware of their own cognitive processes or ways of thinking, and if it turns out that students' metacognition has not yet developed, they will always improve their metacognitive processes.

METHOD

This research is a Research and Development that is oriented towards developing a product, and testing the effectiveness of the product being developed (Sugiyono, 2019). The product to be developed is a metacognitive instrument.

The research procedure according to the ADDIE model flow chart by Rayanto & Sugianti (2020).

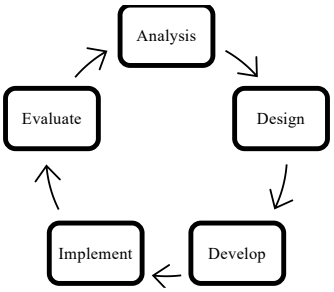

Figure 1. ADDIE Model

1) Analysis, consists of two stages, namely performance analysis and needs analysis. Performance analysis is intended to analyze the curriculum, learning models, and assessments that have been carried out in schools. Needs analysis aims to identify problems that occur in schools related to the empowerment of student metacognition. The purpose of this needs analysis is to determine the product in the form of a metacognitive instrument. 2) Design, the design stage is formulating objectives and designing product grids, which consist of Metacognitive Skill Evaluation instruments that include essay questions according to metacognitive knowledge indicators and learning outcomes in the Merdeka Curriculum, and metacognitive questionnaires adapted from SEMLI-S (Thomas et al., 2008), and AILI (Meijer et al., 2013) which are guided by MAI (Schraw & Dennison, 1994). 3) Development, the stage of developing metacognitive instruments based on the draft instrument grid that has been prepared. The next stage is to review the Metacognitive Skill Evaluation instrument in the form of an integrated metacognitive test instrument, and the metacognitive questionnaire by validating the instrument design by a team of experts. If the instrument has been revised based on validation and suggestions from the expert team and has been declared feasible, then a limited trial (small-scale trial) is carried out. 4) Implementation, namely implementing metacognitive instruments in learning activities at school, by testing the instrument on a large scale. Students were given instructions to work on the metacognitive integrated essay question instrument, and continued by filling out the metacognitive questionnaire. 5) Evaluation, The results of the analysis of this group trial will then be revised again as the final product of the Metacognitive Skill Evaluation instrument. The final product is implemented to measuring metacognition.

This research was conducted at SMA Islam Al-Mizan and SMAN 1 Jatiwangi, namely schools at the high school level in Indonesian. The subjects of this research consisted of a team of experts who validated the product, subjects for product trials, namely students who had participated in learning Environmental Change, and biology teachers of SMA Islam Al-Mizan and SMAN 1 Jatiwangi. Small-scale trials were applied to 5 students, while large-scale trials were applied to 25 students.

Data analysis will be conducted after the data search process in the study. Data analysis is adjusted to the type of data to be processed, that is quantitatively or qualitatively. Qualitative data processing includes product validation results in the form of validator suggestions and comments in descriptive form. Quantitative data testing metacognitive instruments includes validity, reliability, discrimination, and difficulty level tests on the Metacognitive Skill Evaluation instrument, and to test the effectiveness of the instrument.

The instrument must be declared effective

to measure students metacognition. The criteria for an instrument to be declared effective are used if it meets the proportion of students' achievement and is able to analyze students' metacognition. The proportion of students' achievement is calculated by comparing the total score obtained by students with the maximum score of students in one class for each statement item. The proportion of item achievement is said to be good if students are able to achieve 60% of the 50% of existing statement items.

$$K = \frac{\sum ni}{N} \times 100\%$$

K : Percentage of a achievement obtained
$\sum ni$: Total score obtained by students
N : The maximum number of scores

Calculating the instrument's ability to measure using the IBM SPSS Statistics. If percentage is above 60%, so the instrument is said to have the ability to measure metacognition aspects well.

Analysis of metacognitive integrated question instruments was carried out based onscoring obtained by students. The higher the value obtained, the better the metacognition. The rubric for assessing integrated metacognitive questions is determined based on the rubric that has been formulated, namely adopted from the MAD Rubric which consists of 7 scales (0-7) and as a reference for checking the answers to each test item. This MAD Rubric will be adjusted to the metacognition criteria of students.

The score is converted into a value using the following formula:

$$NP = \frac{R}{SM} \times 100\%$$

NP : Percentage value sought or expected
R : Raw score obtained by students
SM : Ideal maximum score of the relevant-ability test

The metacognitive questionnaire scoring was analyzed in the following way:

1 Calculating the overall score
2 Determine the criteria for measuring students' metacognitive abilities in the following way:
- Maximum score is obtained from highest weight x number of statement items.
= 4 x 35 = 140
3 3.Determine the interval value. There are 4 intervals required, namely metacognition is very well developed, metacognition is well developed, metacognition is beginning to develop, and metacognition is not developed.
4 Interval Length: The interval length is obtained by dividing the maximum score by the interval value, namely 140:4 = 35.

Criteria for students metacognition are presented in Table 1.

Table 1. Student Metacognition Criteria

Score	Category
$106 < x \leq 140$	Metacognition is very well developed
$71 < x \leq 105$	Metacognition is well developed
$36 < x \leq 70$	Metacognition begins to develop
$0 < x \leq 35$	Metacognition is not developed

The validity of the developed product is known by conducting a validity test by a team of experts and a reliability test. The validation results from the expert team will then be analyzed quantitatively and qualitatively referring to the item validity coefficient according to Arikunto (2013).

Table 2. Item Validity Coefficient

Reliability	Criteria
0.81-1.00	Very high
0.61-0.80	Tall
0.41-0.60	Enough
0.21-0.40	Low
0.00-0.20	Very Low

Quantitative validity analysis was carried out using the Aiken's V technique, then tested again with a validity test using the SPSS program based on the results of a small trial.

Table 3. Validity of Aiken's V Metacognitive Questions

Item	Assessor					V	Note
	I	II	III	IV	V		
Items 1-14	56	52	55	50	50	0.919	Tall

Based on Table 3, it shows that the value of V = 0.919. Referring to Aiken's V criteria for items assessed by 5 raters with 4 scale options with an error rate of 0.05, which is 0.87, the metacognitive integrated questions have high validity.

Table 4. Validity of Aikens'V Metacognitive Questionnaire

Item	Assessor					V	Note
	I	II	III	IV	V		
Items 1-16	62	60	62	58	58	0.917	Tall

Based on Table 4, it shows that the V value = 0.917. Referring to Aiken's V criteria for items assessed by 5 raters with 4 scale options with an error rate of 0.05, which is 0.87, the metacognitive questionnaire has high validity. The product was then tested on a small scale with the help of the SPSS program.

Table 5. Validity of Metacognitive Questions

Criteria	Question Item Number
Valid	1,2,4,5,7,8,9,10,11,12
Invalid	3,6

The analysis of item validity in the results of the small trial showed that 10 questions were valid and 2 questions were invalid, so the question items that had invalid criteria would not be used in the large trial.

Table 6. Validity of Metacognitive Questionnaire

Criteria	Question Item Number
Valid	1,4,5,7,9,10,11,12,13,14,15,16,17 , 18,19,20, 21,22,23,24,25, 26,27, 28,29,30,33,34,35,36, 37,39,40, 43, 44
Invalid	2,3,6,8,31,32,38,41,42

The validity of metacognitive questionnaire items in the results of the small trial showed that 35 items were declared valid and 9 questions were declared invalid, so the metacognitive questionnaire items that had invalid criteria would not be used in the large trial.

The formula used in the instrument reliability test process is the Cronbach Alpha coefficient, then analyzed by referring to the Reliability criteria according to Sugiyono (2019).

Table 7. Reliability Criteria

Reliability	Criteria
0.81-1.00	Very high
0.71-0.80	Tall
0.41-0.70	Currently
0.21-0.40	Low
0.00-0.20	Very Low

Based on the analysis of the reliability test of the integrated metacognitive questions, it produces a reliability value of 0.946, so the product is declared to have very high reliability criteria. The results of the metacognitive questionnaire reliability test produce a reliability value of 0.984, so the product has very high reliability criteria. This means that the components of the Metacognitive Skill Evaluation instrument based on the results of the small trial have very high reliability, and are worthy of being implemented on a larger scale. The results of the differential power test analysis can be seen in the Table 8.

Table 8. Differential Power Metacognitive Questions

Criteria	F	%
Question rejected	2	16.7
Question fixed	0	0.0
Question accepted but corrected	1	8.3
Questions are well received	9	75.0
Amount	12	100.0

Based on Table 8, of the 12 metacognitive integrated questions developed, 10 questions will be used in large-scale trials, consisting of 9 questions that were well accepted and 1 question that was accepted but needed improvement, while the other 2 questions were rejected or not used in large-scale trials. The level of difficulty of the questions can be seen in the Table 9.

Table 9. Difficulty Level of Metacognitive Questions

Criteria	F	%
Difficult category questions	2	16.7
Medium category questions	7	58.3
Easy category questions	3	25.0
Amount	12	100.0

Based on Table 9, it shows that 2 questions are classified as difficult (16.7%), 7 questions are classified as medium (58.3%), and 3 questions are classified as easy (25.0%). The questions that will be used during implementation in large-scale trials based on the level of difficulty of the questions are only medium and easy category questions.

RESULT AND DISCUSSION

Characteristics of the Metacognitive Skill Evaluation (MSE) Instrument on Environmental Change Material

The Metacognitive Skill Evaluation (MSE) instrument product is described based on the indicators of Figure 2.

Knowledge	Self
	Task
	Strategy
Regulation	Learning Strategy Planning
	Implementation of Learning Strategies
	Building Information Connections
	Monitoring and Evaluation
Awareness	Understanding Potential
	Learning Independence
Responsiveness	Metacognitive Experience
	Providing Feedback

Figure 2. Instrument Indicators Metacognitive Skill Evaluation (MSE)

Metacognitive indicators in metacognitive integrated questions include strategic knowledge; cognitive task knowledge (including conditional knowledge, contextual knowledge); and self-knowledge. The composition of the final product of metacognitive integrated questions developed based on the Metacognitive Skill Evaluation (MSE) knowledge indicators is described in the Table 10.

Table 10. Final Product Composition of Metacognitive Questions Based on Knowledge Indicators

Indicator MSE	Number of Questions
Self	4
Strategy	4
Task	2
Amount	10

The metacognitive questionnaire was compiled with several indicators adopted from previous metacognitive questionnaires, and its purpose was to perfect the existing metacognitive questionnaires. Patmawati et al., (2022) explains that students' metacognition can be known from students' metacognitive activities which are arranged into statements in a questionnaire. Metacognitive activities include organizing information, experiences, goals, and strategies in solving problems (Setyawati & Nur, 2022). Practice of problem-based learning strategies in class can increase student metacognition (Herlanti, et al., 2017). Learning activities have also empowered metacognition through the active role of students planning, monitoring, and evaluating the teaching and learning process (Nasrudin & Azizah, 2020).

The composition of the final product of the metacognitive questionnaire developed based on the Metacognitive Skill Evaluation (MSE) indicators is depicted in the Table 11.

Table 11. Final Product Composition of the Metacognitive Questionnaire

Indicator MSE	Number of Questions
Knowledge	8
Regulation	16
Awareness	6
Responsiveness	5
Amount	35

Metacognitive indicators of self-knowledge, meaning the extent to which students are aware of the knowledge they have, knowledge that is well understood, able to understand important things, even things that are still considered difficult for them. Knowledge of tasks, meaning students need to have a broad understanding of what is currently their task, for example by having initial knowledge or having broad knowledge so that they will be able to further analyze the tasks they are facing.

Knowledge of the task can also mean knowing about the effective time for him to study, how to study according to the material he will study, what he does after studying a material, even how he has understood that his concentration on a task depends on the difficulty of the task. Task knowledge leads individuals to remember how he responds to the task at hand.

Strategic knowledge means that students in the learning process have certain strategies so that they can solve the problems being faced by students. This strategic knowledge describes how they can understand the most effective steps or strategies in completing a task. This knowledge will also assess whether the individual understands the steps needed for him to do a task, in addition this knowledge will be able to know the reasons for each individual in completing the task. Strategic knowledge also describes how a person will remember what they know about a task.

Learning strategy planning is students in making a plan when completing a task. Improving student metacognition requires the right learning strategy (Parlan, 2024). This planning is in the form of preparing everything before starting a task, designing the purpose of using a particular strategy that will be applied, re-applying things that have been successfully done in completing a task, and making several plans when completing the task. Ijirana & Supriadi (2018) based on their research stated that metacogniti-

ve activities that appear at the planning stage are setting goals and choosing the right strategy. The selection of this strategy shows that students have understood what is needed to solve problems. Several aspects that can underlie self-regulation in students include metacognition, motivation, and positive actions (Widiastuty, et al., 2022).

The implementation indicator of learning strategies describes the learner in carrying out the planning that has been prepared when completing a task. The implementation in question is that someone really understands the strategy that students uses when completing a task. The person really carries out the strategy according to what he has planned from the beginning, in addition, when carrying out the task, the students is orderly in reading the instructions/instructions as part of a plan, even understands what other people expect to understand when completing a task or following a learning.

Building information connections describes himself when building various information he has, in the form of how he will try to remember the material that has been learned when starting new material, understanding the difficulties in themself to build information connections, and connecting the knowledge they has with what will be learned, and really understanding the relationship between what is learned and everyday life. Students recall past learning experiences and relate them to the solving techniques that have been learned including at the regulation stage (Wider & Walton 2023). According to Palennari (2016) empowering students' metacognition in class contributes to their cognitive improvement, because metacognition plays an important role in cognitive activities, including memory in this case related to mastery of concepts that he has within a certain period of time.

Monitoring and evaluation describe the process of evaluating and monitoring what students have done. The statement is related to the success of achieving goals, the ability to manage time, the ability to know achievements when doing a task, and even a person's habit of monitoring. Wider & Walton (2023) explain that in this evaluation stage, students will consider whether the answers given in completing a task are accurate and logical. Monitoring and evaluating the thinking process are very important to help students become independent and more effective students in understanding and applying biological concepts (Majid, et al., 2024).

Understanding potential describes the extent to which a person understands their own potential. When a person understands their potential, they will know their strengths and weaknesses, be able to use knowledge to overcome difficulties or weaknesses, know and understand things that are considered difficult, and be able to predict possible obstacles or problems. Palennari (2016) also stated that if students are aware of what they are thinking, then the ability to remember the information received will last longer, which is then related to their cognitive retention.

The sub-indicator of learning independence brings out the independent traits that exist in a person, which are related to a person's habit of making notes about important information, making summaries of things that have been learned, describing something as a tool to understand something or making it into a diagram, and the individual's ability to motivate themselves.

Responsiveness in the form of metacognitive experiences regarding several things that have been experienced by a person related to the metacognitive process in him, including regarding a person's thinking process when facing a task, as well as alternatives to complete it, a person's ability to understand what has been conveyed, and be confident in the efforts he has made. According to Parlan (2024), if a student is faced with a certain phenomenon, he will activate the components of his metacognitive knowledge, so that they will be able to construct a scientific explanation properly. Active learning based on the initial knowledge that students already have will link the initial concepts they have with real life in students, then provide a fairly large opportunity for more meaningful biology learning (Tegeh, et al., 2021).

Feedback describes the process of giving feedback on something, including how he gives feedback to himself through others, changes certain strategies when he fails with what has been done, rechecks, even his attitude that shows he does not care about what he has tried. Radulovic, et al., (2024) explains that by providing feedback, students will be involved in reflective activities, such as reflecting on the learning strategies they use, the goals they have set, and the achievements they have achieved, and students will become more aware of their strengths and areas that need improvement. Giving feedback is also said to be a form of response to the metacognition process during learning (Susantini, et al., 2019).

Effectiveness Metacognitive Skill Evaluation (MSE) Instrument to Measure Students' Metacognition

Based on the large-scale trials that have been conducted, the following are the results of

the integrated metacognitive test scores obtained by students, depicted in the Figure 3.

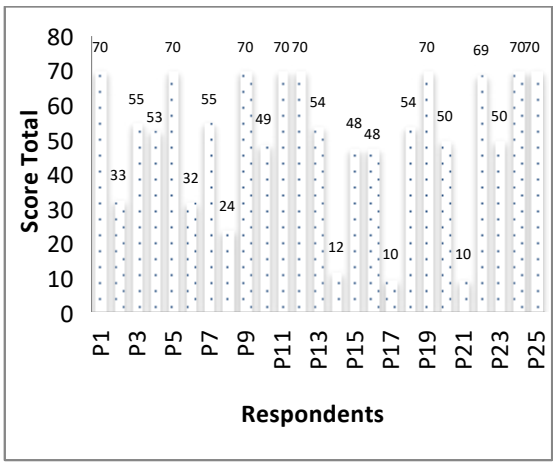

Figure 3.Integrated Metacognitive Question Scoring at SMAN 1 Jatiwangi

The highest score was obtained by respondents P1, P5, P9, P11, P12, P19, P24, and P25, namely with a total score of 70, which means getting a score of 100. Students who get the highest score are able to understand the questions well, and integrate the knowledge they have to answer all the questions presented, so that students can answer all the questions correctly. The lowest score is 10 obtained by P17 and P21, which means getting a score of 14. Students are unable to understand what needs to be included when answering questions, and do not even understand the direction of the question in question. Students also tend to solve questions without a specific strategy.

Based on this scoring, it can be clearly seen that each student has a different way of thinking in solving a problem. Students who get a score in the medium category are P13 and P18 with a score of 54, meaning getting a score of 77. Students in this category tend to be able to re-explain the answers that have been written on the previous metacognitive integrated questions calmly. Students read carefully when answering questions to remember the material that has been taught. Students create strategies to answer questions.

The scores obtained by students in filling out the integrated metacognition questions are a picture of the level of metacognition in each student. Students who get high learning outcomes show that their metacognition is also well developed, conversely students who get low test scores have not developed well. The score then becomes a guideline for teachers to be able to create learning that can empower students' metacognition, while improving learning outcomes. Thus, it is known that student learning outcomes describe the metacognition process that occurs or develops in students. According to Fariah et al (2024) when metacognitive awareness in students is good, it turns out that their learning outcomes are also in the high category. Therefore, there is a correlation between metacognitive awareness and learning outcomes.

The results of the integrated metacognitive test scoring obtained by students in the large trial at SMA Islam Al-Mizan shown in Figure 4.

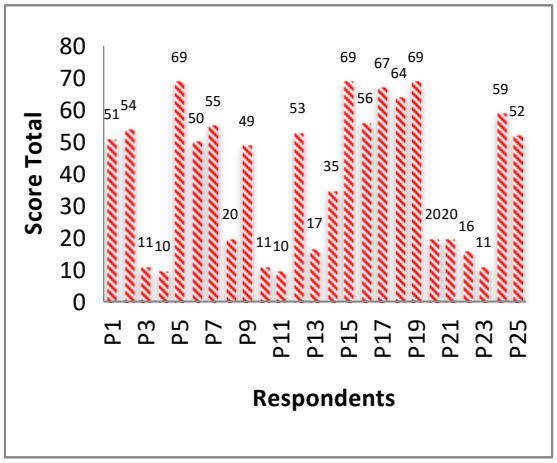

Figure 4. Scoring of Integrated Metacognitive Questions at SMA Islam Al-Mizan

The highest scores were obtained by respondents P15, P15, and P19, with a total score of 69, which means getting a score of 99. Students who get the highest score are able to provide an explanation of the answers given. Students are able to describe the problems in the questions, and understand the knowledge they have related to the questions presented, so they can solve the problems faced. Students are able to build good information connections between the knowledge that has been taught and the problems being faced, by reading the questions repeatedly, and recalling the knowledge they have previously had. Students are also aware of their shortcomings, for example realizing that the question that is difficult for them is question number 1, and students are unsure of the answer given for question number 1.

The lowest score obtained by students is 10 obtained by P4, and P11, which means getting a score of 14. Students tend not to understand the questions well, so the answers given are not on target. Students are unable to provide an explanation of the method they use when solving questions, meaning that participants in this cate-

gory are still not aware of how to think or even manage their thinking skills. Students who scored in the medium category, namely P1 with a score of 51, meaning getting a score of 73, and P6 with a score of 50 meaning getting a score of 71. Students are able to explain their answers by giving reasons for their explanations. Students provide an explanation of the answer to question number 10, namely how to manage plastic waste by recycling waste. These students are aware of the answer given with the reason that if plastic waste is managed by burning it will cause other problems, for example it can cause shortness of breath. These students are sure of the steps taken to solve the problem. Student boredom in answering questions, the form of questions, and supervision when students work on questions affect the results of working on metacognitive integrated questions (Najmah, et al., 2024).

The results of the analysis of students' metacognition levels based on the metacognitive questionnaire scoring are presented in Figure 5.

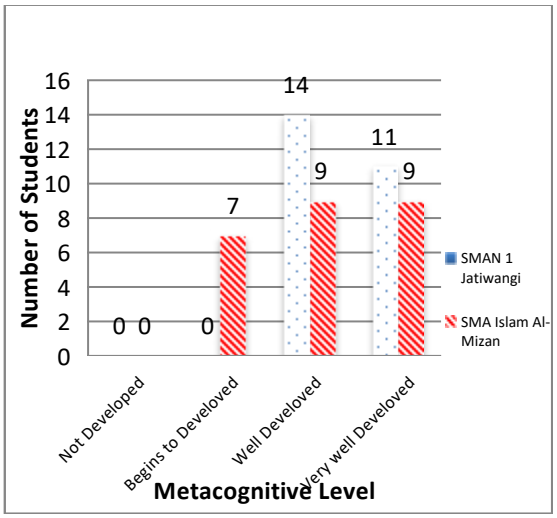

Figure 5. Metacognition Level Based on Metacognitive Questionnaire Scoring

The analysis of the metacognitive questionnaire score refers to Figure 5, it can be seen that students with a metacognition level are said to be well developed because students have been able to understand the biology material that is important to learn well, and then students will carry out the learning process well. Students will think about various things when faced with questions, and understand the best steps to answer questions. The metacognitive level category of this metacognitive questionnaire scoring is in line with the scoring results on the metacognitive integrated questions. Students with a very well developed metacognition level also get high scores on the metacognitive integrated question test. At SMAN 1 Jatiwangi, there are 11 students classified as very well developed metacognition, while at SMA Islam Al-Mizan it is known that there are 9 students classified as very well developed metacognition. There are 14 students classified as well developed metacognition at SMAN 1 Jatiwangi, and 9 students at SMA Islam Al-Mizan.

Several students at SMA Islam Al-Mizan were found to be able to remember what they knew and had learned when answering questions, but did not know for sure the strategy used during the learning process. Students learn well if they already know the biology material that will be taught. Students read the instructions before starting the assignment, and tend to recheck the answers to the test questions they are working on. This indication indicates that students' metacognition is said to be starting to develop, found in 7 students at SMA Islam Al-Mizan. The results of the analysis of students' metacognition levels based on metacognitive questionnaire scoring show that most students have mastered metacognition in themselves. Several ways that can be done to activate students' metacognitive abilities are through metacognitive empowerment in daily learning. This method will accustom students to processing their metacognitive abilities, so that they are increasingly honed. External factors that influence students' metacognitive abilities include the family environment, school, community, and socio-economic conditions (Najmah, et al., 2024).

Proportion of Student Achievement

The proportion metacognitive questionnaire achievement in large-scale trials is in the Table 14.

Table 14. Proportion of Student Achievement

School	Achievement Proportion	
	Metacognitive Integrated Questions (%)	Metacognitive Questionnaire (%)
SMAN 1 Jatiwangi	72	80
SMA Islam Al Mizan	63	64
Average	68	72

Based on Table 14 on the proportion of student achievement, it is known that at SMAN 1 Jatiwangi, 72% of the metacognitive integrated questions were able to be completed by students, while at SMA Islam Al-Mizan, 63% of the me-

tacognitive integrated questions were able to be completed. These data illustrate that most students have managed their cognitive abilities to complete the existing questions. Students know their level of achievement during the biology learning process, and will remember what has been learned. Students are aware of connecting the knowledge they have with everyday life. These results are in line with the achievement proportion of the metacognitive questionnaire, namely 80% of the achievement proportion at SMAN 1 Jatiwangi, and 64% of the achievement proportion at SMA Islam Al-Mizan. Students are accustomed to motivating themselves to be active in studying biology, and some of the students make summaries of the material that has been studied. Based on the achievement proportion, the product developed has met the requirements for the achievement of a product.

Knowledge Indicator Achievement

The achievement of knowledge indicators as part of metacognitive indicators carried out in large-scale trials can be seen in Figure 6.

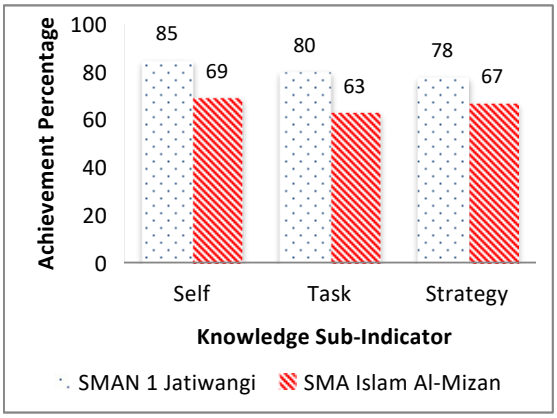

Figure 6. Achievement of Knowledge Indicators

Based on the Figure 6, the self-sub-indicator at SMAN 1 Jatiwangi has an achievement of 85%, the task sub-indicator has an achievement of 80%, and the strategy sub-indicator has an achievement of 78%. SMA Islam Al-Mizan has an achievement of 69% in the self-sub-indicator, the achievement of the task sub-indicator is 63%, and the achievement of the strategy sub-indicator is 67%. The self-sub-indicator is the highest achievement in both schools compared to other knowledge sub-indicators with the highest achievement of 85%. The lowest achievement based on the overall data is in task sub-indicator.

Achievement of Regulatory Indicators

The achievement of regulatory indicators as part of metacognitive indicators carried out in large-scale trials can be seen in Figure 7.

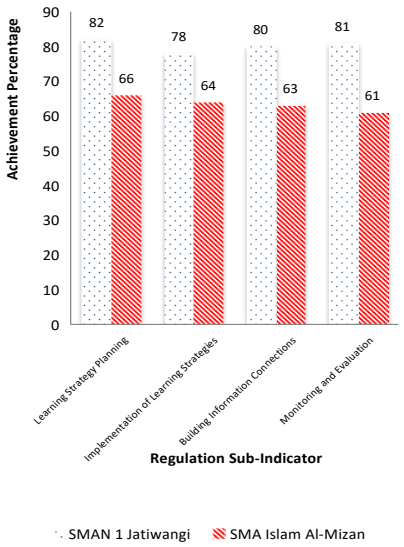

Figure 7. Achievement of Regulatory Indicators

Based on the Figure 7, it can be seen that the sub-indicator of learning strategy planning at SMAN 1 Jatiwangi has an achievement of 82%, the sub-indicator of learning strategy implementation has an achievement of 78%, the sub-indicator of building information connections has an achievement of 80%, and the sub-indicator of monitoring and evaluation has an achievement of 81%. According to Feyzioglu, et al.,(2018) that not only new knowledge but metacognitive monitoring allows to improve prior knowledge. If students can make decisions about whether prior knowledge is wrong or right, then the individual will be able to realize certain mistakes that have been made. Therefore, in this monitoring and evaluation indicator, knowing students after completing the activity whether they recognize that there are errors in prior knowledge.

SMA Islam Al-Mizan has an achievement of 66% in the sub-indicator of learning strategy planning, achievement of the sub-indicator of learning strategy implementation 64%, achievement of the sub-indicator of building information connections 63%, and achievement of the sub-indicator of monitoring and evaluation 61%. The sub-indicator of learning strategy planning is the highest achievement in both schools compared to other regulatory sub-indicators with the highest achievement of 82%, and the lowest achievement based on overall data is in the sub-indicator of monitoring and evaluation. Students who are able to plan learning strategies and make learning adjustments according to their needs are basically

classified as having good metacognitive abilities. (Najmah, et al., 2024). They will be aware of how they learn, monitor their learning progress, and regulate their cognitive activities (Azevedo, 2020).

Achievement of Awareness Indicators

The achievement of awareness indicators as part of metacognitive indicators carried out in large-scale trials can be seen in Figure 8.

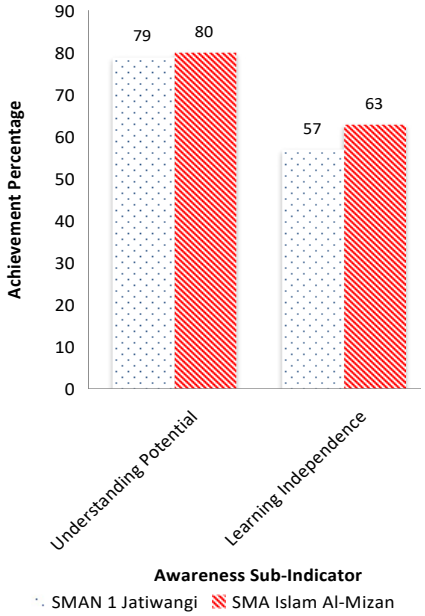

Figure 8. Achievement of Awareness Indicators

Based on the Figure 8, it can be seen that the potential understanding sub-indicator at SMAN 1 Jatiwangi has an achievement of 79%, and the learning independence sub-indicator has an achievement of 57%. SMA Islam Al-Mizan has an achievement of 80% in the potential understanding sub-indicator, and the achievement of the learning independence sub-indicator is 63%. The potential understanding sub-indicator is the highest achievement in both schools compared to other awareness sub-indicators with the highest percentage of 80%, and the lowest achievement is the learning independence sub-indicator in both schools with the lowest percentage of 57%. Awareness of metacognition contributes to increasing student self-efficacy (Bouknify, 2023).

Achievement of Responsiveness Indicators

The achievement of the responsiveness indicator as part of the metacognitive indicators carried out in large-scale trials can be seen in Figure 9.

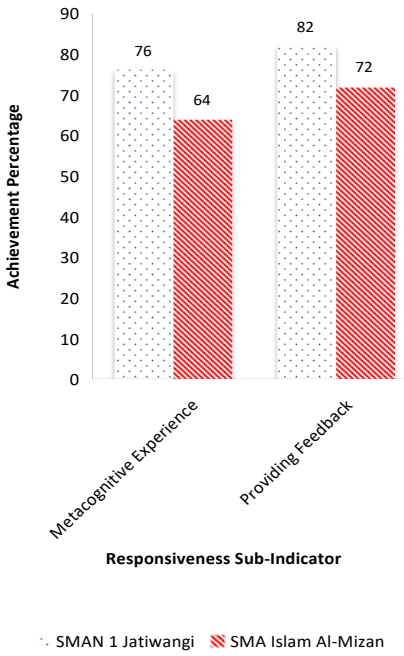

Figure 9. Achievement of Responsiveness Indicators

Based on the Figure 9, it can be seen that the sub-indicator of cognitive experience is SMAN 1 Jatiwangi has an achievement of 76%, and the feedback sub-indicator has an achievement of 82%. SMA Islam Al-Mizan has an achievement of 64% in the cognitive experience sub-indicator, and an achievement of 72% in the feedback sub-indicator. The potential understanding sub-indicator is the highest achievement in both schools compared to other awareness sub-indicators with the highest percentage of 80%, and the lowest achievement is the learning independence sub-indicator in both schools with the lowest percentage of 57%.

The improvement of students' metacognitive knowledge must be considered by teachers in order to obtain more optimal learning outcomes (Januarti, et al., 2022). Metacognition has the potential to improve learning significantly, especially the intellectual abilities of students (Jamaluddin, et al., 2023) Metacognition is part of the main contributors for the academic achievement of students (Sukarelawan, et al., 2021).

Teachers must be able to create a learning process that leads their students to organize their own learning process, be able to identify their respective learning needs, so that students will be encouraged to make positive changes with the independent learning process activities carried out (Azmi, 2016). Another opinion states that the higher the learning outcomes obtained by students, the better their metacognitive level will

be. Students will be more competent in terms of metacognition abilities when their value increases (Fauzi & Sa'diyah, 2019). According to Syahmani et al., (2023) this metacognitive is very important in increasing conceptual understanding.

Level of Instrument Ability in Measuring Metacognition

The purpose of developing a measurement instrument is certainly expected to be able to be used well in the process of measuring the metacognitive aspects of students in the Environmental Change material. To find out how much the instrument's ability is in measuring students' metacognition, it is analyzed using the IBM SPSS Version 26 program through factor analysis, the Total Variance Explained (dimension factors that can be formed) can be known so that the percentage of the instrument's ability can measure the specified aspects. Total Variance Explained is said to be good if its value is more than 60%. The results of the Total Variance Explained analysis shown in Table 14.

Table 14. Total Variance Explained Analysis

MSE Instruments	Total Variance Explained	
	Measurability (%)	KMO
Integrated Questions Metacognitive	73.362	0.875
Metacognitive Questionnaire	82.123	0.578

The developed metacognitive integrated question instrument can measure metacognitive aspects because it has a measurable percentage of up to 73.362% and has a KMO of 0.875. If the KMO value is more than 0.5, then the variables and samples used allow for further analysis. A good KMO limit is > 0.5. The developed metacognitive questionnaire instrument also has high measurable percentage and KMO results. The measurable percentage of the metacognitive questionnaire is up to 82.123% and has a KMO of 0.578, so it can be concluded that the developed metacognitive questionnaire instrument also has very good ability in measuring the expected metacognitive aspects.

The data was also analyzed to determine the Reproduced Correlations which show the value of the instrument fit of the developed instrument product. The results of the Reproduced Correlations of the instrument fit must be below 50%. The results of the Reproduced Correlations on the metacognitive integrated question instrument developed have a value of 48%, and the metacognitive questionnaire has a value of 20%, so it can be concluded that the developed instrument has entered the fit category.

So, MSE instrument can be used to measure metacognition in studentts. Abdullah, et al., (2021) stated that the development of this metacognitive turned out to be effective in supporting the 21st century learning paradigm. Similar to the results of research from Fauzi & Sa'diyah (2019) Metacognitive empowerment in science learning is one of the success factors in 21st century learning.

CONCLUSION

Based on the results on the development of Metacognitive Skill Evaluation instruments in biology learning Merdeka Curriculum, it can be concluded that the Metacognitive Skill Evaluation (MSE) instrument product consists of 4 indicators, namely knowledge, regulation, awareness, and responsiveness, which include metacognitive integrated questions and metacognitive questionnaires. The instrument also effectively measure students' metacognition, with proportion of metacognitive integrated question achievement is 68%, and the proportion of a metacognitive questionnaire instrument achievement is72%. The percentage of metacognitive integrated questions is 73.362%, with a KMO value is 0.875, and the fit category as a measurement instrument is 48%. The percentage of metacognitive questionnaire measurability is 82.123%, with a KMO value is 0.578, and the fit category as a measurement instrument is 20%.

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