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EFFECT OF E-READINESS SKILLS, METACOGNITIVE AWARENESS, AND BIOLOGICAL LITERACY ON THE HIGH SCHOOL STUDENTS' MISCONCEPTIONS

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ABSTRACT

This study aims to determine the effect of e-readiness skills, metacognitive awareness, and biological literacy on students' misconceptions about the ecosystem concept. This type of research is quantitative descriptive with a survey method. The research subjects were 182 West Lombok high school students Regency. Data collection used an e-readiness questionnaire, MAI inventory, and a biological literacy test combined with the CRI method. Data analysis used descriptive analysis techniques and multiple regression analysis. The data analysis using multiple regression analysis with the help of the SPSS 26 program obtained the following results: partial multiple linear regression analysis found that e-readiness skills (sig. 0.000<0.05) and biological literacy (sig. 0.007<0.05) have a significant effect on students' misconceptions, while metacognitive awareness (sig 0.088>0.05) does not affect students' misconceptions. This study concluded that partially e-readiness skills and biological literacy had a significant effect on students' misconceptions, while metacognitive awareness had no significant effect on students' misconceptions. Simultaneously, e-readiness skills, metacognitive awareness, and biological literacy positively affect high school students' misconceptions about the ecosystem concept. Biology teachers are expected to pay attention to efforts to improve e-readiness skills, metacognitive awareness, and students' biology literacy to minimize their misconceptions about biology concepts in high school.

Keywords: biological literacy; e-readiness skills; metacognitive awareness; misconceptions

INTRODUCTION

A misconception is a misunderstanding of a concept that experts have agreed upon, confusing the concept itself (Jung, 2020). Misconceptions are irrelevant concepts to the scientific understanding of experts and can hinder students from understanding materials (Irani et al., 2020). The term misconception is still a discussion among educational researchers. An important implication for this discussion is bringing together a set of previously conflicting terms, for example, misconceptions, alternative conceptions, and alternative frameworks because they are considered to have a similar view of students' ideas (Leonard et al., 2014). Biology education researchers can substitute one or more relevant alternatives for misconceptions when feasible. Researchers are recommended to define the word misconception explicitly, relate it to learning theory wherever possible, and discuss how the term's use should guide their educational approach (Maskiewicz & Lineback, 2013).

Students who experience misconceptions can be seen from specific characteristics (Endsley, 2015; Lynn et al., 2020). According to Ferguson & Lievens (2017) and Coley & Tanner (2015), misconceptions in students can be caused by many factors. Students' misconceptions should be identified early in the first year and addressed with a

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more detailed visualization. Retesting should be done to determine whether students' understanding of a concept is correct or not (Reinke et al., 2019). From the results of their research, Prayitno & Hidayati (2022) recommended that when teaching general biology, lecturers should always present reliable knowledge, valid reading sources, valid learning media, and suitable learning models to avoid students' misunderstandings.

According to Permata et al. (2018), misconceptions in students are usually formed by students themselves and are influenced by experiences and the environment, which causes frequent errors in students' understanding of a concept. In addition, according to (Suprapto, 2020), different preconceptions that students have can also cause misconceptions in students. Misconceptions often occur in biology learning (Galvin et al., 2015). Lukša et al. (2016) found that primary and secondary school students did not understand the concepts of sex cells, mitosis, and meiosis. Students of both genders also show misconceptions about ovulation and the menstrual cycle.

According to Soeharto & Csapó (2021), students' varying understandings of various science concepts can lead to misconceptions. In any case, they are comparative across disciplines, particularly physics, biology, and chemistry. It suggests that students have varying levels of skill in resolving science-related problems. Kurniawati & Ermawati (2020) stated that due to students' initial misconceptions, students' misconceptions are also caused by students' incomplete reasoning. Because of these various causes, a way or method is needed to identify misconceptions that occur in students. For misconceptions to be overcome, it is necessary to analyze them to determine students' misconceptions because, according to Halim et al. (2018), students who do not know the concept and who experience misconceptions are different ways of handling it.

Unprepared students' use of information technology applications to obtain learning materials can also lead to misconceptions. E-readiness, or the ability to comprehend and apply digital information technology, is necessary for students to reduce misconceptions (Jamaluddin et al., 2021). Students in their learning must use internet-based digital devices and be ready to learn. E-readiness refers to students' ability to comprehend and use digital information and communication technology. Students cannot access their learning materials independently unless they have this ability. Students' e-readiness is another requirement for putting high school biology into practice in the West Lombok Regency. Students' E-readiness ability will help students to understand biological concepts scientifically. This is expected to minimize the occurrence of students' misconceptions.

Low understanding is due to students' unawareness of how they learn (Wang et al., 2017; Ramdani et al., 2021). According to Drigas & Mitsea (2021), if students can understand how they learn, or what is known as metacognitive awareness, information during learning can enter their long-term memory. This is because metacognitive awareness is a system that controls information processing. The relationship between academic success and metacognitive awareness is positive, according to Ward & Butler (2019). It demonstrates how crucial metacognitive awareness is to the learning process. It means the higher the metacognitive awareness, the better the learning outcomes.

Metacognition has the potential to significantly enhance learning, particularly concerning the intellectual abilities of students. By consistently implementing appropriate learning designs and monitoring students' progress in learning, metacognitive awareness and skills can be developed (Amin & Adiansyah, 2020). Teachers who know their students' metacognitive awareness will be motivated to develop it, ultimately impacting students' learning outcomes. There have not been many studies on students' metacognitive awareness in high schools in West Lombok Regency. The results of this study can be used as information for teachers to increase their students' metacognitive awareness because it is related to students' misconceptions about biology learning.

According to Wahyuningsih et al. (2017), students' misconceptions occur because of their low science literacy skills. Students' science literacy skills are closely related to their ability to understand and process information about the subject studied. Indonesian students' science literacy skills are still far behind other countries. Mastery of science literacy is the main focus of education. One factor that influences Indonesian students' low science literacy is misconceptions. Recently, research on the development of diagnostic tests on science literacy misconceptions has been minimal.

Ramdani et al. (2020) stated that based on the 2018 PISA results, students from Indonesia ranked 72 out of 79 participating nations. The students' average test scores were 371, 397, and 396 in reading, math, and science, respectively. While the average score of participating nations were 487 for reading skills and 489 for math and science skills, indicating that Indonesian score are below the average (OECD, 2019). These results

show a decline from the 2015 PISA test results, where Indonesian students recorded higher averages in all areas: 397, 386, and 403 in reading, math, and science, respectively (PISA, 2015).

Based on the literature review, several factors can cause students' misconceptions about biological concepts. However, no literature explicitly analyzes the effect of e-readiness skills, metacognitive awareness, and biological literacy on students' misconceptions of ecosystems. Therefore, an in-depth study is needed on this matter. The results of this study are important to increase the understanding of high school biology teachers about the factors that influence students' misconceptions of biology. Teachers' understanding of the profile and influence of e-readiness skills, metacognitive awareness, and biology science literacy on students' misconceptions is fundamental to minimizing their students' misconceptions. This study aims to analyze the effect of e-readiness skills, metacognitive skills, and biological literacy on students' misconceptions of ecosystems.

METHODS

This research design is quantitative descriptive with a survey method. According to Ponto (2015), survey research is a practical approach to help researchers describe and explore research variables. According to Creswell (2014), in survey research design, researchers describe a population's tendencies or behaviors quantitatively by examining a sample. From that sample, the researcher makes generalizations about the people.

The population and sample of the study were students in grades 10 and 11 of public high schools in West Lombok Regency. The research sample was 182 students who were determined using a purposive sampling technique based on the high school's location and the students' academic abilities. There are 12 public senior high schools in West Lombok Regency. Based on the location map of the school, four public senior high schools were determined as the research locations: SMAN 1 Lembar in the south, SMAN 1 Labuapi in the middle, SMAN 1 Narmada in the east, and SMAN 1 Gunungsari in the north. Two science classes with similar academic abilities were selected from each public senior high school, and eight classes with 182 students were obtained.

The data collection procedure uses research instruments consisting of an e-readiness skills questionnaire, a metacognitive awareness inventory (using the Metacognitive Awareness Inventory (MAI)), and a multiple-choice test, which is compiled referring to indicators of scientific literacy according to PISA 2018. Misconception tests were multiple-choice tests combined with the CRI technique. The CRI technique is used to identify students' misconceptions and distinguish students who understand and do not understand the concept using the reference in Table 1.

Table 1. Provisions to Distinguish between Students with Misconceptions, Students Who Understand the Concept, and Students Who Do Not Understand the Concept

Answer	Low CRI (<2.5)	High CRI (>2.5)
Correct	Correct answer but low CRI = do not understand concepts (*Lucky guess*)	Correct answers and high CRI = understand concepts
Wrong	Wrong answers and low CRI = do not understand concepts	Wrong answer but high CRI = misconception

Source*:* Hayati & Setyaningrum (2019)

Data were analyzed using descriptive statistical techniques and multiple linear regression tests. Descriptive statistical analysis determines each research variable's range, minimum and maximum values, mean, and standard deviation. Multiple linear regression analysis determines the effect of e-readiness skills, metacognitive skills, and biological literacy variables on students' misconceptions of ecosystems. The analysis was carried out partially and simultaneously using SPSS 26.

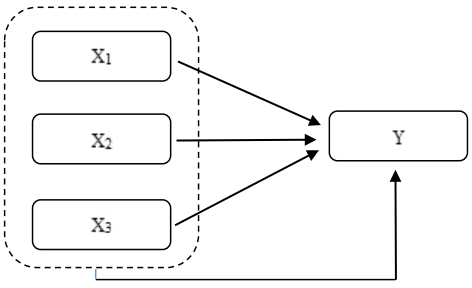

Figure 1. Partial and Simultaneous Linear Regression Analysis Model

RESULTS AND DISCUSSION

Goh and Blake's (2021) Integration Information Rich E-Readiness Assessment Tool was utilized for the data description of students' E-readiness for learning biology. The outcomes of the data analysis of the e-readiness profile of biology learning by high school students for each sub-component are shown in Figure 2.

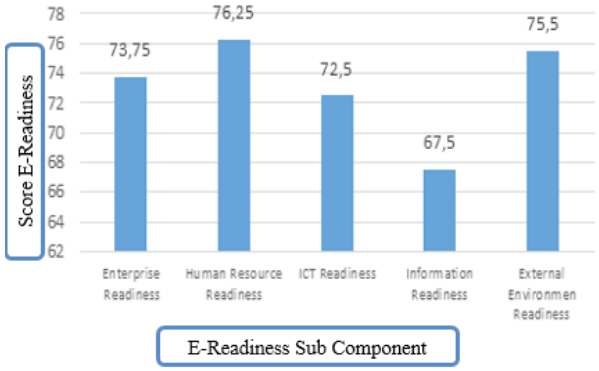

Figure 2. Average Profile of Students' E-Readines Skills for Each Sub-Component

The Enterprise Readiness Segment measures students' readiness to use ICT applications in biology learning. Ratheeswari (2018) explains that in this digital age, ICT must be used in the classroom to give students opportunities to learn and use skills of the 21st century. Students must have the readiness to use ICT applications in their learning. Idowu & Esere (2013) stated that research results in recent years show that Information and Communication Technology is an effective means of improving educational opportunities. However, most teachers do not use this technology in their learning or integrate technology into their curriculum. The results of this study showed that the average score of Enterprise Readiness Segment students was 73.75 (ready category). This indicates that, on average, West Lombok high school students can learn biology using applications for information and communication technology.

Students' readiness to utilize technology in biology learning is referred to Human Resources Readiness. The results showed that students' readiness in utilizing ICT to learn biology is known from 1) students' ability to use their computers/laptops/android phones to use the internet to find information or learning materials about biology; 2) students' ability to gain access to the biology learning materials-related information; 3) students' readiness to follow the development and update their gadget applications to obtain biology learning materials; 4) students' skills in searching and retrieving biology learning information that they have downloaded; 5) students' readiness to share learning material information through social media (Facebook, WhatsApp, blogs, and the like). The average score of students' Human Resources Readiness is 76.25. Based on the data, students of public high schools in West Lombok are skillful in using computers and other gadgets to support them in learning internet-assisted biology.

Students' ability to use gadgets is supported by Putra (2017), who states that in this digital age, the best way for students to learn is to invite them to learn in the digital world. Teachers should assist them in using gadgets to support their learning activities. The readiness of students and teachers to utilize ICT in learning in this digital era is critical. This follows the explanation of Singh & Chan (2014) that besides being viewed as a tool that can be incorporated into existing teaching methods, information and communication technology (ICT) is currently considered crucial for facilitating innovative educational approaches. Various educational institutions in the world have integrated ICT into learning. Teachers' and students' readiness to use ICT is crucial to the success of ICT integration in education.

The educational process will gain value by using tools for sharing and information technology. Universities will have the ability to be creative and innovative by making use of these tools. According to Kilani & Awad (2017), e-learning aids in developing, managing, and retaining students' knowledge while simultaneously enhancing learning performance and the capacity to remain innovative and competitive. ICT readiness segment comprises infrastructure and internet access readiness. Students cannot participate fully in e-learning unless they have these capabilities. This study's findings demonstrate 1) Students' ability

to search online for biology learning materials; 2) Students' ability to access biology learning materials via the fundamental internet methods of email, searching, and downloading; 3) Students' ability to do biology homework using social media; 4) Students' ability to utilize online resources to enhance their biology education; 5) Students' ability to use a basic computer, such as typing, creating, saving, and editing files. According to the findings, students in the ICT readiness segment had an average ability of 72.5, placing them in the ready category. The data analysis indicates that West Lombok high school students are ready and capable of using infrastructure and internet access to learn e-based biology.

The Information Readiness Segment measures the readiness of students' knowledge to access subject-specific information. This ability can be identified by: 1) Students' readiness to utilize online biology-related applications; 2) Students' readiness to access biology learning materials-related information; 3) Students' readiness to access biology content via mobile devices or computers; 4) Students' readiness to engage in social media-based biology learning; 5) Students' readiness to use e-books as a biology learning tool. The findings of this study indicate that, on average, students are quite ready to use information and communication technology applications to learn biology. Their level of readiness is 67.5.

This segment is the environmental support for students' use of ICT, which includes: 1) whether the electricity network is sufficient for students to access the internet at home and school; 2) Students' perceptions of educators' readiness to incorporate ICT into learning. Students believe educators are still unready to use social media to teach biology; 3) How educators use ICT for biology learning activities. The study results show that biology educators are prepared to use ICT in learning activities; 4) Support from the school to provide internet networks in the school setting. Students believe that the school is ready to support them by providing internet access; 5) the speed of the internet access that students and schools own. According to students' opinions, on average, they have good internet access to support readiness to learn biology.

In educational environments, it is essential to predict students' performance. All educational establishments have a long-term objective of increasing students' success. If educational establishments can accurately predict students' academic performance before their final exam, additional efforts can be made to provide low-performing students with the necessary assistance to improve their studies and achieve success. The family and academic environment significantly influence internal factors (achievement motivation, interest in learning, and academic self-concept) and readiness to learn independently (Ramli et al., 2018). Various internal and external factors greatly influence students' learning outcomes. Physiological factors (physical) and psychological factors (intelligence, interest, talent, attention, motivation, maturity, and readiness) are examples of internal factors. According to Hidayat (2014), external factors include social factors (family, school, and community environment) and non-social factors.

Zhang & Qin (2018) outline that metacognition, the ability to reflect on one's thoughts and experiences, is maybe an exceptional human capacity. Unlike animals, humans can reflect on life, thoughts, and actions. In addition, humans are the only species capable of anticipating what will happen to them, planning for the future, reflecting on their experiences, and learning from them. As a learning function, Sawhney & Bansal (2015) defined metacognition as an individual's awareness of their cognitive processes and capacity to regulate, monitor, and modify them. Students who do well in school often rely on their ability to think clearly and handle their learning. The results showed that undergraduate students with high and low metacognitive awareness scores performed significantly differently academically.

According to Abdellah (2015), learning relies heavily on metacognition. In order to encourage students to use metacognitive skills, which positively impact academic achievement and teaching performance, it suggests that college professors adapt their teaching methods and methods of delivering information to students. According to Novia et al. (2019), every person has the potential for metacognitive abilities because they are used to thinking about what they think, what they will do, and what they have done in the past. Similarly, when students participate in teaching and learning activities, some immediately consider what they will learn when they hear the material explained. A few will connect with the information they have learned, or maybe even in their minds. They will learn complex things, and other ideas will come to mind.

According to the explanation, supporting learning success necessitates metacognition. According to Zhao & Mo (2016), students' class performance is positively correlated with their metacognitive awareness, indicating that students with higher metacognitive awareness perform

better than those without it. These findings' implications for research and practice are discussed. High school students with high metacognition awareness have higher average learning outcomes than those with low metacognition awareness (Sonyinga et al., 2019). This study was carried out to ascertain students' metacognitive awareness because of metacognition's significance in fostering success in learning. One of the main factors in students' academic success is metacognitive awareness (Sukarelawan et al., 2021). By evaluating students' metacognitive awareness using Jr.MAI, teachers can comprehend the self-related information and knowledge of their students.

Data on metacognitive awareness in learning biology shows that 170 out of 182 students have achieved metacognitive awareness in the good category. A total of 10 students reached the moderate category, and only two reached the excellent category. Most students' awareness potential is good. For this reason, teachers, through biology learning, should pay attention to students' metacognitive awareness. Use their metacognitive abilities in learning. The results of the analysis of metacognitive awareness of West Lombok public high school students are in Figure 3.

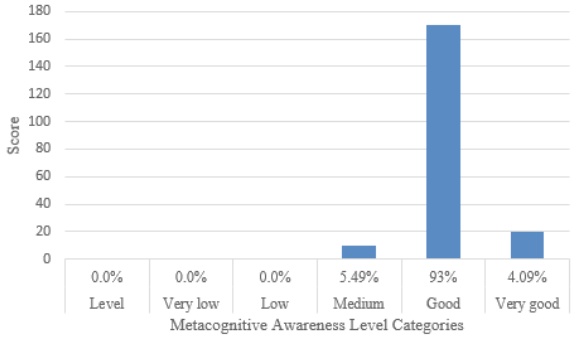

Figure 3. Metacognitive Awareness of West Lombok Public High School Students

The learning outcomes students achieve after going through learning activities are influenced by many internal and external factors, including their metacognitive awareness. According to Junina & Halim (2020), metacognitive teaching can improve students' self-regulated learning outcomes in adolescence, when academic achievement and motivation frequently wane. The findings showed that implementing self-regulated learning can influence academic achievement and digital learning environment optimization. Digital learning environments can be optimized for students with higher levels of self-regulation, allowing them to advance academically (Sutarni et al., 2021).

Self-regulation refers to learning that results from the thoughts and behavior of students themselves that are oriented toward achieving their learning goals. Self-directed learning involves goal-directed activities that students generate, modify, and maintain; for example, processing information, practicing, and relating new lessons to prior knowledge (Schunk & Zimmerman., 2013). In a technology-enhanced learning environment, self-regulated learning (SRL) skills are necessary for successful learning (Srivastava et al., 2022). According to Clement (2016), in online courses, successful students typically employed self-regulated learning strategies. There was a statistically significant relationship between students' success and self-regulation.

Metacognitive awareness encourages students to set learning goals and determine appropriate learning strategies to achieve these goals. Learning awareness affects students' learning independence and critical thinking skills. Learning awareness is related to metacognitive awareness. So learning awareness can be improved through empowering metacognitive awareness. Learning goals and strategies will be used, while motivation will direct students to achieve their learning goals.

Students with metacognitive awareness can organize and control their learning activities. Self-control activities can raise questions that students must answer and evaluate themselves. Finding answers to questions and self-evaluation will improve critical thinking skills, affecting students' learning outcomes (Malahayati et al., 2015). Critical thinking is an active process that involves the role played by metacognition (Fisher et al., 2015).

Çakici (2018) found a positive relationship between awareness and metacognitive regulation of critical thinking skills. The influence of other variables outside the research variables (metacognitive awareness and metacognitive regulation) was 35.3%, and the remaining 64.7% came from other variables. Thus, the higher the level of me-

tacognitive awareness and metacognitive regulation of students, the higher their critical thinking skills. According to Zhao and Mo (2016), students with higher metacognitive awareness perform better in the classroom than students with lower metacognitive awareness.

These metacognition skills can be empowered through several types of learning strategies and models. Edmodo-integrated flipbook media can also empower students' metacognition skills. When students already have a high level of metacognition skills, they will have no difficulty learning because of their good learning independence and critical thinking skills (Lalang, 2021). Therefore, Abdellah (2015) emphasized the significance of metacognition in learning and suggested that higher education lecturers adopt teaching methods and strategies for presenting information to students to encourage the use of metacognitive skills. Doing so will have a positive impact on both the academic achievement of students and the performance of lecturers.

The analysis of West Lombok public high school students' level of metacognitive awareness in each sub-component are shown in Figure 4.

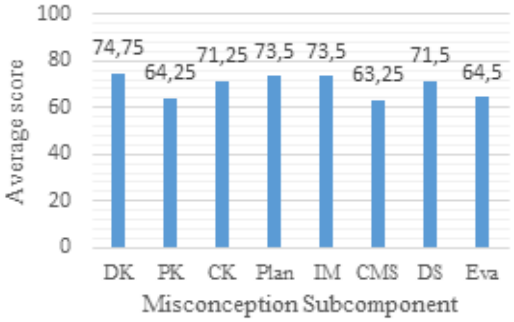

Figure 4. Profile of West Lombok public high school Students' Level of Metacognitive Awareness in Each Sub-Component
Information:
Eva = Evaluation;
DS = Debugging Strategy;
CMS= Comprehension Monitoring Strategy;
IM= Information Management;
Plan = Planning;
CK = Conditional Knowledge;
PK = Procedural Knowledge;
DK = Declarative Knowledge.

Metacognition is cognitive knowledge and regulation that refers to students' knowledge of their cognitive processes and the ability to control and monitor cognitive processes as feedback from the learning they receive (Novia et al., 2016).

From the research results, West Lombok high school students cannot use cognitive strategies to help their learning process. At the same time, using cognitive strategies is very helpful in creating an effective learning process and helping students achieve their cognitive goals. Birch et al. (2022) offer a few strategies for developing metacognitive behavior: recognizing what we know and what we do not, discussing our thoughts, tracking our thoughts, planning and self-regulation, asking the thinking process, and self-assessment. Evaluation is carried out so that students can analyze the strengths and weaknesses of their learning strategies. Furthermore, students can choose effective strategies to use in learning. The sub-component with the lowest level of metacognitive awareness is the Comprehension Monitoring Strategy sub-component. This sub-component is related to students' ability to analyze the performance and effectiveness of the strategies they use at the end of learning activities (Pujiank et al., 2016).

Biology learning is one of the vehicles to empower science literacy. Biology is one of the disciplines that considerably influences scientific knowledge and technology. Based on the biological literacy test results of West Lombok high school students, the average score is 59.89, with a sufficient category. Harahap & Manurung (2018) show that the literacy ability of high school students in Aceh Tamiang Regency is 40.61% in the low category. Likewise, the scientific literacy achievements of Indonesian students are still low.

The science literacy of students in West Lombok is still in the low category. Several factors cause the low science literacy skills of students. According to Ramdani et al. (2020), the

learning environment and climate at school affect variations in student literacy scores. Similarly, students' literacy achievement is significantly influenced by the state of school infrastructure, human resources, and organizational and management practices.

Several things cause the low science literacy of Indonesian students: teacher-centered learning, students' low positive attitudes toward learning science, and several competencies that students do not like related to content, process, and context. Students are accustomed to only filling in the tables provided by the teacher, so students' ability to interpret graphs/tables is also limited (Rahayu, 2017).

Nofiana (2017) found that students' mastery of concepts about science is still low. There is a school policy demand for teaching materials to be completed by teachers according to curriculum targets. This demand will force students to accept science concepts that may not be fully understood and make many concepts misconstrued (misconceptions) or just memorized and quickly forgotten. Students have difficulty connecting the knowledge they have gained to actual situations due to teachers' tendency to teach subjects without connecting them to real-world situations. Students' responses demonstrate that they are still very theoretical per the concepts taught in school and cannot apply them to solve science problems.

It is necessary to carry out learning innovations to increase students' scientific literacy, as shown by Ramdani et al. (2023), that Android-based learning media was effective in increasing students' scientific literacy. The developed interactive multimedia effectively improve students' scientific literacy (Widodo et al., 2020). However, multimedia does not satisfy Generation Z students. Students suggest visual, audio, and musical multimedia enhancements to use the device to enjoy the multimedia continuously. Rubini et al. (2018) found that content, science competencies, and science attitudes domains are multimedia based on science literacy on lightning. They are presented as text, images, animation, and videos that refer to the 2015 PISA framework. The expert and the teacher's feasibility test demonstrates that all multimedia components suit science learning. Multimedia can increase science literacy skills, especially in content and scientific attitude domains in the medium category and competency domains in the very good category (Rubini et al., 2018). This statement is supported by students' responses that multimedia is very good in literacy and motivation, whereas the aspect of operating multimedia is in a good category.

A misconception is a misinterpretation about connection of concepts, between new and old ideas, in students' minds so that an incorrect concept is formed. Students' conceptions contradict scientists' conceptions (Suprapto, 2020). Knowing students' alternative concepts can overcome misconceptions about their scientific literacy. Multiple-choice diagnostic tests are one technique to trace students' misconceptions (Wahida et al., 2019). There should be a shift in how certain concepts are taught, and the teaching content should be better distributed and tailored to students' interests and developmental levels. Future research should focus on a more in-depth examination of the identified misconceptions across all grades (Lukša et al., 2016). Individual misconceptions tended to be high, indicating that conceptual understanding must be considered when developing learning practices. Misconceptions by students should not happen, especially when learning science. According to the findings of this study, the degree of misconceptions in science learning varies between clusters. The challenges faced by students in each cluster were similar (Munastiwi et al., 2022).

The test results of ecosystem concept understanding can be seen in the number of misconceptions, students who do not know the concept, and students who understand the concept (Figure 5).

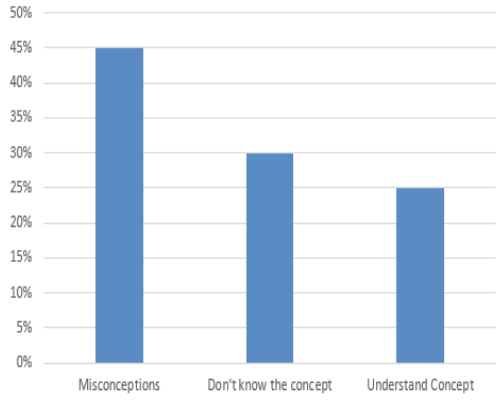

Figure 5. Ecosystem Misconception Data of West Lombok High School Students

From Figure 5, most students experience misconceptions. Suprapto (2020) identifies four factors contributing to misconceptions: students, teachers, teaching materials or literature, and context and teaching methods. It is intended that by identifying the types and root causes of students' misconceptions about science, teachers would be better able to discover effective ways to teach science concepts. Champagne et al. (2017), using the Biological Concepts Instrument (BCI) to diagnose students' misconceptions of biology concepts, showed that many students had misconceptions related to processes, interactions, and evolutionary structures of molecules. This may be because they failed to emphasize how their knowledge of physics and chemistry applies to the biology context in some instances.

The research results showed that fourth-grade elementary school students' misconceptions about light material were significantly reduced when inquiry learning was implemented with scaffolding. As a result, it is suggested that inquiry learning be combined with scaffolding support, which teachers can implement daily in class to prevent misconceptions, particularly regarding other content from elementary science. This study proved that students' misconceptions are reduced when inquiry learning is combined with scaffolding. However, additional research is needed to determine how inquiry learning with scaffolding affects students' process skills, learning success, and other aspects of learning that are likely to develop (Haidar et al., 2020).

The following are the causes of students' misconceptions, according to Widiyatmoko & Shimizu (2018):

1) Daily experience. Students spend much time outside of school and are accustomed to their surroundings. They comprehend the significance of the things in their immediate environment. The scientific meaning of these items is not consistent with their understanding. Students understand science concepts based on how they interact with the environment and experience life daily.

2) When everyday language incorporates scientific terms, students encounter difficulties. For instance, students believe that color is a property of objects rather than light.

3) Textbooks serve as guidelines for teachers and students and tools for the teaching-learning process. Students' conceptual understanding is constructed in large part by their textbooks.

4) Teachers. Teacher-student, student-student, student-matter, and teacher-matter interactions are the primary means of implementing science learning in the classroom. The teacher is regarded as the dominant figure in the science classroom because of their ability to direct students' learning. Therefore, the science teacher's role in shaping students' science learning experience is essential. Students may occasionally have misconceptions about science from teachers.

Students require a deeper comprehension of the concept or domain. In order to improve their students' ability to apply their knowledge, they must also create a network of that understanding with the newly presented context (Sarapak & Kearns, 2022).

A multiple regression statistic analysis technique was used to determine the effect of e-readiness skills, metacognitive awareness, and biological literacy on students' misconceptions about ecosystems. To determine the effect of each independent variable is done by partial double linear test technique. The regression analysis technique was carried out to determine the effect of e-readiness skills variables, metacognitive awareness, and biological literacy on students' misconceptions. Before the regression test was carried out, the data normality test was first carried out. The results of the normality test are presented in Table 2.

Table 2. Data Normality Test Results

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		182
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	8.96204116
Most Extreme Differences	Absolute	.053
	Positive	.053
	Negative	-.052
Test Statistic		.053
Asymp. Sig. (2-tailed)		.200[c,d]

Table 2 shows that the data is normally distributed so that it can be continued for multiple regression analysis with three independent variables. The analysis results are shown in Table 3.

Table 3. Partial Analysis Results of Multiple Linear Regression

Model		t	Sig.	Collinearity Statistics	
				Tolerance	VIF
1	(Constant)	2.456	.015		
	E-Readiness	4.717	.000	.935	1.070
	Metacognitive Awareness	1.755	.081	.875	1.143
	Literacy-Biology	2.701	.008	.927	1.079

a. Dependent Variable: Misconceptions

From Table 3, e-readiness skills significantly affect students' ecosystem concept misconceptions. E-readiness skills can contribute to correcting students' misconceptions. The better the e-readiness skills, the more students' misconceptions will be reduced. The t-count value of metacognitive awareness is smaller than the t-count of e-readiness skills and biological literacy. Its significance value of 0.081 is greater than 0.05, meaning metacognitive awareness does not affect students' misconceptions. The results of this study align with Eriyani (2020) that the metacognitive awareness of male and female prospective teacher students, as well as the metacognitive awareness of students in their second, third, and fourth years, are not significantly different. Additionally, there was only a marginally positive correlation between student achievement and metacognitive awareness. According to Fauzi & Saâdiyah (2019), seventh-graders in junior high schools have the lowest level of metacognitive skills, while senior high school students have the highest level. Since this skill can develop with students' grade improvements during the educational process, high school students have better metacognitive skills than junior high school students. The study also shows that students' metacognitive skills are not very good. In order to maximize students' metacognitive skills, various learning approaches are recommended throughout the learning process.

Biological literacy has a significant effect on students' misconceptions. It is indicated by the significance value of 0.008, which is smaller than 0.05, meaning that biological literacy can contribute to reducing students' misconceptions. It can be caused by students' errors in understanding biology subject matter during learning at school or independently. According to biological scientists, biological literacy skills are closely related to students' understanding of the correct biological concepts: the better students' biological literacy skills, the fewer misconceptions about learning biology.

The results of multiple linear regression analysis to determine the effect of e-readiness skills, metacognitive awareness, and biological literacy simultaneously are presented in Table 4.

Table 4. Simultaneous Regression Analysis Results

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3697.003	3	1232.334	15.089	.000[b]
	Residual	14537.591	178	81.672		
	Total	18234.593	181			

a. Dependent Variable: Misconception

b. Predictors: (Constant), Literacy-Biology, E-Readiness, Metacognitive Awareness

Based on the value of F = 15.089 with a significance value of 0.000 <0.05, it means that e-readiness skills, metacognitive awareness, and biological literacy significantly affect students' misconceptions. The findings of this study indicate that students' misconceptions can be minimized by empowering e-readiness skills, metacognitive awareness, and science literacy through biology learning. For this reason, teachers are expected to carry out biology learning by utilizing ICT, developing awareness of independent learning, and emphasizing mastery of biological concepts under scientific concepts to minimize students' misconceptions.

CONCLUSION

Based on the data analysis results, e-readiness skills, metacognitive awareness, and biological literacy all positively contribute to West Lombok high school students' misconceptions. Partially, e-readiness and biological literacy substantially affects students' misconceptions, whereas metacognitive awareness has no effect. Biology teachers are expected to pay attention to efforts to improve students' e-readiness skills, metacognitive awareness, and biological literacy to minimize their misconceptions about biology in high school.

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