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Research Article

The Trend of Metacognition Research Trend in Learning Biology in Indonesia

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Abstract.

This literature review aimed to get an overview of metacognition research in learning biology in Indonesia. Data were taken from Biology Education journals that had been accredited by the Ministry of Education and Culture in 2023. 20 journals, consisting of Sinta 2 and Sinta 3, journals were analyzed. Within the journals, 43 research articles were analyzed. Some of the aspects analyzed were the type of research, research subjects, instruments used, data analysis methods, treatments used and themes or topics. Data analysis showed that the majority of research conducted was experimental research, followed by Korean research. The most researched subjects were high school students, followed by college and junior high school students. In metacognition research in Indonesia, researchers often used the MAI instrument, and it is not completely defined. T-test analysis was the most used means of processing data, followed by descriptive data processing in the form of percentages. The topics used in the research showed that all topics were suitable for training students' metacognition.

Keywords: metacognition, research trend, MAI instrument

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1. INTRODUCTION

Education research now focuses heavily on metacognition and how it affects teaching and learning. Metacognitive training and instruction have been proven to improve children's performance in a variety of domains, including reading, arithmetic, and problem-solving, ever since the early days of metacognitive study [1]. Metacognitive training is used to enhance students' metacognitive thinking, their abilities (such as reading comprehension, problem-solving, or higher-order thinking abilities), as well as their knowledge and conceptual understanding [2]. One of the primary three recommendations for enhancing education that resulted from more than three decades of research on how individuals learn is the need for teaching metacognition [3].

The term comes from the term metamemory which was introduced in the 1970s. Metacognition is defined as students' knowledge of their own cognition, or refers to "knowledge about one's cognitive processes and products or anything related to them". Metacognition in the context of learning involves "thinking about thinking" as a conscious activity related to learner development and increased awareness. There is a difference between cognition and metacognition that is often debated. Metacognitive knowledge refers to the awareness that individuals have of themselves and others in their role as cognitive processors. Of the various definitions that have been elaborated on metacognition, the use of the definition by Falvell, 1979 is the earliest definition and forms the basis for the development of other definitions. Metacognition has several dimensions, namely metacognitive knowledge, metacognitive skills and metacognitive regulation [4].

The biology education community may benefit from a systematic analysis of the patterns and trends emerging from recent research in the field of metacognition in biology education. This is because metacognition is becoming increasingly important for improving learning and instruction, and because much of what we know about it and how to teach it seems to be contextualized and domain-specific. The basic goal of incorporating metacognition into biology education research is to look at what happens when this fundamental idea is combined with the many, frequently domain-specific processes associated with science learning. The purpose of the current study is to provide such an analysis and to highlight the takeaways from recent developments in the study of metacognition in biology education.

2. RESEARCH METHOD

This research is a systematic literature review using the principle of content analysis which aims to explore various findings that have been published related to metacognition in various journals in Indonesia in the field of biology for 10 years. Data were obtained from various accredited journals starting from 2013-2023.

The information was gathered from the findings of a content analysis of Biology education articles. The entire content was obtained from Biology education journals registered with Science and Technology Index (SINTA) in July 2018. SINTA (http://sinta2.ristekdikti.go.id/) is a platform for measuring science and technology development conceived and developed by Indonesia's Ministry of Research, Technology, and Higher Education. The SINTA database had 22 biology education journals in total. All articles that reviewed metacognitive were afterwards collected from each of those

journals. The publications under consideration in this study were published online for the past 10 years (2013-2023). There are 43 articles that discuss metacognitive among the hundreds of articles included. This study examined all of the papers.

The current study's instrument was a content analysis guideline with relevant features under observation. In this study, there were up to seven major aspects to examine for content analysis. These factors were (1) type of research, (2) the research subjects, (3) data collection tools (instrument), (4) data analysis methods. (5) treatments, and (6) the biology themes chosen for the studies. Aspects and categories of research can be seen in Table 1.

TABLE 1: Aspects and categories of research in the study.

No	Aspects	Categories	
.	Type of research	Eksperimental Correlation Descriptive	Survey R and D
2.	Research Subject	Lecturer Teacher Postgraduate	Undergraduate Senior High School Junior High School
3.	Data Collection Tools	Test sheet MSI MIA	Questionnaire sheet Observation sheet Undefinition
4.	Data analysis Methods	T test Anova Correlation	Percentage Combination
5.	Treatment	All that found in the article	
6.	Biology Theme	All that found in the article	

Each article was assigned to a certain category based on a specific feature that satisfied the criteria. The authors' abstract, method, and discussion sections were used to make the selection. Furthermore, the collected data was shown in the form of a bar chart.

3. RESULTS AND DISCUSSION

3.1. Number of Publications

Metacognition is a research variable that was originally used by psychology researchers in uncovering how a person understands the required way of learning. Research on metacognition in the world of education is starting to develop and become an important variable in delivering students to success in their studies. In Indonesia, research on metacognition in the world of education has not been widely carried out. Based on data analysis, it shows that in biology learning, research on metacognition has been carried out in the last 10 years 43 times.
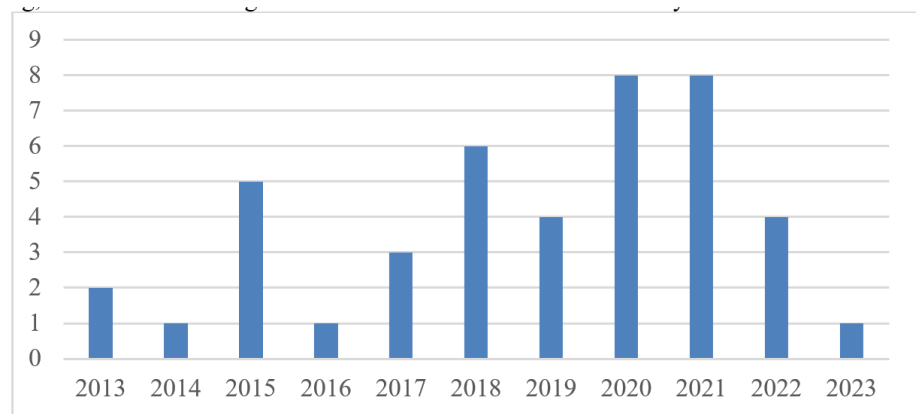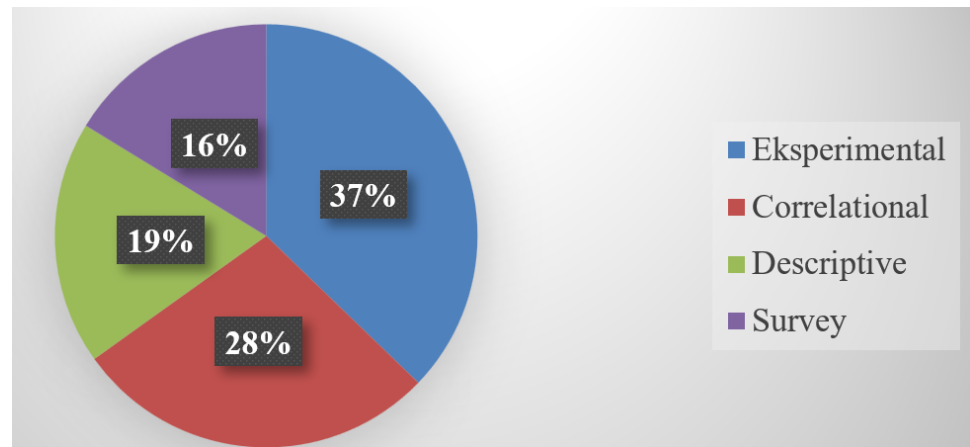
Figure 1: Frequency of research metacognitive in biology education.

Figure 1 above shows that research on metacognition in the field of biology education continues to grow from year to year. From the analysis of articles that have been published in various biology journals, it shows that the most metacognition research is in 2020 and 2021 with 8 articles followed in 2018 with 6 articles while at the beginning of 2023 only 1 article has been published. Research on metacognition in biology learning was carried out on various samples, various types of research, different instruments and carried out on different topics. Research on metacognition has also been carried out by other researchers in the field of science education by taking data from ERIC. The results of his research show that metacognition research has increased quite high in the field of science from 2000-2012, this indicates that metacognition is an important research in the field of Education [5]. The more the amount of studies exploring critical thinking ability, the greater the favorable impact that has on Indonesian educational growth. The hypothesis is founded on the assumption that the ultimate goal of research is to enhance educational practices[6, 7]. Furthermore, a research will influence educational practices for several different reasons, including the following: (1) its findings can be commonly referred to as credible information that teachers can implement; (2) it can be a crucial basis for educational making decisions at the national, local, or specific institution level; and (3) its the results may influence teachers' approaches to thinking.

3.2. Type of Research

The type of research that has been carried out with the theme of metacognition in the field of biology education has been analyzed in depth. Based on data analysis, some types of research are dominant compared to other types. As the type of research that is mostly carried out in metacognition research in the field of biology education

in Indonesia is experimental research of 37.21% followed by correlational research of 27.91%, descriptive research of 18.60% while the least type of research is survey research with a percentage of 16.28%. . The results of data analysis can be seen in Figure 2.

Figure 2: Type of research metacognitive in biology education.

Based on the data above, it can be seen that in Indonesia research on metacognition, especially in the field of biology, uses a lot of experimental research. Several experimental studies on biotechnology were carried out by [8–11].. Experimental research in the world of education continues to receive great attention and has a significant effect on various problems in learning and learning [12]. The data shows that metacognition in biology learning is carried out using experimental designs that vary from both the learning model and the chosen biology theme. Several learning models that have been carried out are using the inquiry model [13], jigsaw and PBL [14], 5E and Problem Solving [15], as well as STEM [16].

Correlational research design," according to Mc Combes (2019), "measures the association between two different variables without the researcher influencing either of them." In addition, correlation research is non-causal in nature, as neither variable is regarded to be the primary cause of the consequences' escalation or de-escalation [17]. Correlational research is commonly utilized in medical studies because it can be employed in any study where the independent variable(s) being researched is not manipulated (or cannot be manipulated). However, before a research study can begin, various factors must be determined, including the selection of appropriate variables, sample identification and selection, and the use of dependable tools [18]. In metacognition research in Indonesia, several variables that are correlated with metacognition are: creative thinking [19]; critical thinking [19] and problem solving skills [20].

In the literature, several definitions or goals of descriptive research have been identified: (1) to describe carefully and precisely the information and features of a given

population or area of interest; (2) to provide a precise representation or account of characteristics of a specific individual, situation, or group; (3) to represent the features of persons, situations, or communities; and the frequency with which certain phenomena occur5; these studies observe, explain, and document elements of a situation as it occurs naturally; (4) to uncover correlations or linkages between or within the variables chosen; (5) to provide answers to inquiries based on current events [21]. From the analysis of the data that has been done, it shows that metacognition is measured using descriptive research, one of which is carried out by various instruments, namely observation [22]; MAI [22] dan MSI [23].

Survey research entails gathering data from a sample of people based on their responses to a few questions. For the 2000 National Survey, the National Science Foundation chose survey research because it is an efficient tool for systematically gathering data from a diverse range of persons and educational settings. As you may have noticed, many researchers prefer this form of data collection [24, 25]. Metacognitive research on biology education in Indonesia has used a survey method to see how students' metacognition is at various levels in Indonesia, such as research conducted by [26].
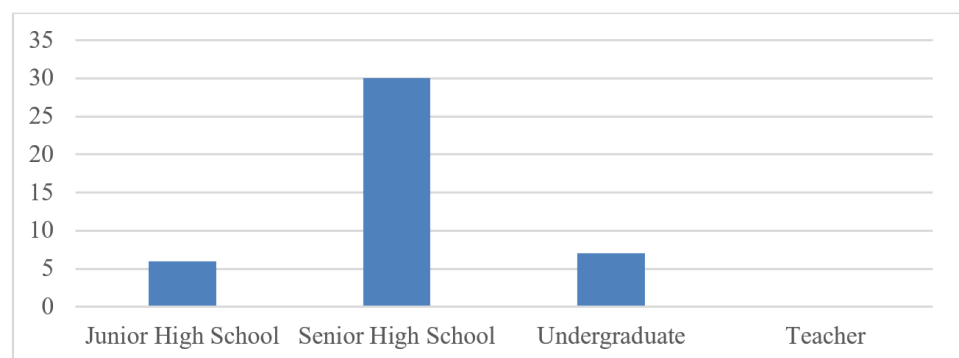
3.3. Research Subject

Figure 3: Type of sampel research.

Based on Figure 3, it shows that most research on metacognition in Indonesia is carried out at the senior high school level with a total of 30 articles followed by students with 7 articles, junior high school with a total of 6 articles and while research on teachers and lecturers was not found. The advantage of high school students was also demonstrated in a study by [27]. Building on their research, learning processes and students' conceptual understanding formed two of three topics that have frequently been chosen as the focus of research over the past 15 years. This result is similar to

[28], indicating that "students" was the most frequently searched keyword in educational research.

3.4. Data Collection Tools
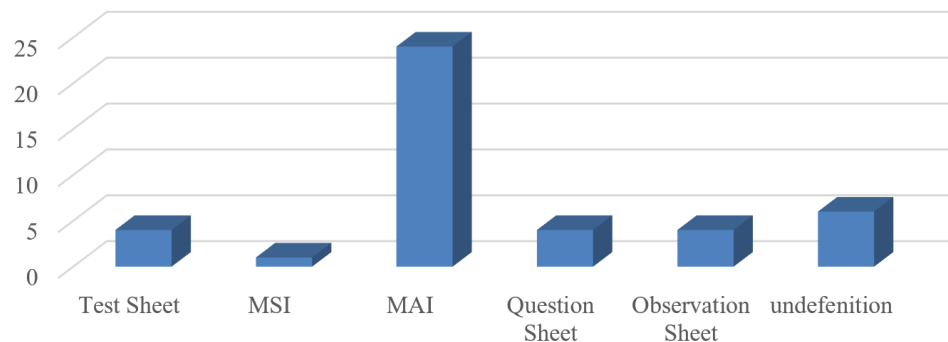
Figure 4: Type of instrument research.

Metacognition is research related to several aspects in the form of cognitive skills and attitudes [29–33]. The context taken in a metacognition study greatly determines the use of instruments in data collection [34]. Based on data analysis, it shows that the instruments used in metacognition research in Indonesia, especially in the field of biology education, use questions; [35]; [36], MSI [23], MAI [14, 15, 22, 37,38–40]; [8, 41]; [42, 43], Questionnaire Sheet [26]; [10], Observation Sheet [44]; [45] and some articles do not define clearly [46] an [13].

3.5. Treatment

Various dimensions of metacognition such as knowledge, skills and attitudes can be improved by various models, approaches, learning strategies [47]. The selection of the learning model used is adjusted to the content to be taught. In learning biology which is part of science, learning emphasizes direct experience so that learning becomes more meaningful. Various research results indicate that biological material has different characteristics so that the variations in the models used are also different. Learning by inquiry is a recommended model in science learning, but not all biology content can be taught with that model.

In addition to paying attention to the characteristics of the material, the selection of learning models is largely determined by what skills the teacher wants to develop. For example, if the teacher wants to develop social skills, then it is better to use a model that directs group work such as jigsaw or cooperative, but if problem solving skills are

expected to develop, then the suitable model is the PBL or PJBL model. In the context of developing metacognition in Indonesia, researchers use different models such as a jigsaw [35], service learning [11], PBL [14], reciprocal mind map [9], inquiri [19], TPS [48], and group investigation. 5E [15], JAS [22, 45], RQAAD [49], Discovery learning [43] dan STEM [9]. All models used are adapted to the selected content and skills developed in addition to metacognition.
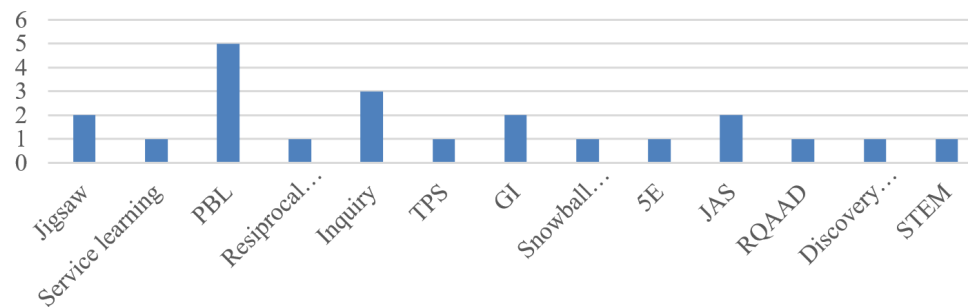

Figure 5: Treatment in research.

3.6. Biology Theme

Biology is one part of science education that is often avoided by students [50]. This is due to the dense and hard to understand material which is full of concepts. In metacognition research in Indonesia, especially in biology learning, of the 43 articles that have been published, there are 9 articles that clearly include biological material content that is used as a vehicle for improving metacognition, while most do not specifically mention the biology topics used. Some of the topics used are the circulatory system [37]; system gerak [51], sistem reproduksi [43, 52], motion sistem imun [46], ecosistem [53, 54], animalia [22] and environmental pollution [20].

4. CONCLUSION

Based on data analysis shows that the majority of research is dominated by experimental followed by Korean research. The most researched subjects were high school students followed by college and junior high school students. In metacognition research in Indonesia, researchers use the MAI instrument a lot and it is not completely defined, while t-test analysis is mostly used to process data followed by descriptive data processing in the form of percentages. The topics used in the research show that all topics are suitable for training students' metacognition.

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