

LEVEL OF COGNITIVE PROCESSES IN THE LEARNING TASKS OF BIOLOGY CLASS DURING COVID-19 PANDEMIC AND ITS IMPACT ON STUDENT'S COGNITIVE ANXIETY

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Abstract

Cognitive processes have four components called self-system, a metacognitive system, a cognitive system, and knowledge. The components of cognitive processes are divided into six levels called Retrieval, Comprehension, Analysis, Knowledge Utilization, Metacognition, and Self-system. Learning needs to pay attention to the six levels of cognitive processes. New learning process such as online learning and hybrid learning in covid-19 pandemic was new experience. That condition makes an adaptation process still needed and was not easily carried out by students in 10th grade. The process of adapting to new learning was a challenge and thought to cause cognitive anxiety. This research aims to analyse the level of cognitive processes in learning tasks and its relationship to students' cognitive anxiety in biology learning during the covid-19 pandemic. This research was descriptive research using a cross-sectional survey method. 446 students from 465 total students and 7 biology teachers have agreed to participate in the research. The instruments used in this research were learning task quantification rubrics and cognitive anxiety questionnaires. The results showed that biology learning modes during the COVID-19 pandemic had dominant learning tasks at the cognitive process level 1 (retrieval) and level 2 (comprehension). The proportion of learning tasks to develop cognitive processes at a higher level (analysis, knowledge utilization, and metacognitive) was still very small and no learning task trains cognitive processes at level 6 (self-system). This learning task condition has the potential impact to cause cognitive anxiety in students in the medium and high categories.

Keywords: Covid-19 pandemic, Learning tasks of biology class, Level of cognitive processes, Student's cognitive anxiety.

1. Introduction

The ability to think varies from person to person and is called the level of cognitive processing [1]. There are four components in a person's cognitive process. The components are the self-system, metacognitive system, cognitive system, and knowledge. The four cognitive processes are divided into six categories called Retrieval, Comprehension, Analysis, Knowledge Utilization, Metacognition, and Self-system. The six categories are arranged hierarchically, from low to high [2], and must be implemented during the learning process to make students use their knowledge meaningfully [3].

Learning that emphasizes six levels of cognitive processes [2] is also needed in Biology learning. Teaching and learning biology need special treatment [4-6]. This learning is needed because Biology material consists of facts, concepts to principles [7] with a wide scope of essential material [8-11]. There is a need for additional technology to support the teaching and learning process [12]. Thus, we can conclude that biology learning needs to be equipped with learning strategies that could provide direct experience [13].

Biology learning needs to facilitate students in developing thinking skills, mastery of concepts, and even scientific attitudes [14]. This learning can be done through activities that allow students to explore living things and explore their environment [14]. However, during the Covid-19 pandemic, the Biology learning process was still not optimal and Biology material was not delivered optimally to students [10, 15]. The covid-19 pandemic has changed the way of thinking and strategies for making excellent teaching and learning processes [16-21].

Biology learning during a covid-19 pandemic is carried out online and through hybrid learning. Schools that implement hybrid learning generally divide students in each class into two parts, i.e. 50% of students carry out online learning and 50% of other students carry out face-to-face learning (offline learning). In reality, learning during the Covid-19 pandemic seems less effective [10, 15]. The ineffectiveness of learning occurs due to reduced interaction with teachers and requires students to be independent in learning [22]. However, in reality, most students have not been able to learn independently. Students have not been able to sort out which material is important to learn, and which is less important, so there is a possibility that the amount of information that students receive is too much [23]. In addition, online learning and hybrid learning are new experiences for students, and an adaptation is still needed [24]. Adaptation new learning process is not an easy thing for students in 10th grade who have just entered the high school level [25]. 10th-grade students have to adapt to a new high school environment, new learning loads, new friends, and a new learning process. The process of adapting to new learning becomes a challenge [26] and can cause cognitive anxiety [27].

Cognitive anxiety is a feeling of tension, worry, fear [28, 29] or a person's awareness that the events they are facing are outside of the reach of their comfort zone, and makes that person cannot anticipate and integrate their experiences meaningfully [30]. Cognitive anxiety can explain a person's confidence in cognitive processes [31]. Cognitive anxiety occurs because of culture shock or someone's not getting used to the new condition, new culture, or new learning environment [24]. A person can experience cognitive anxiety if the events they face have many implications of unclear events that makes this person cannot anticipate or integrate the events they experience into meaningful experiences [30]. Furthermore,

cognitive anxiety can occur as a result of several conditions [30]. The first condition is stimuli that are very new (extremely novel stimuli) or have never been experienced before so the construction system in their cognition is not covered yet. Second, conditions that require additional construction (extra constructs needed) but are not available. The third condition is, inappropriate stimuli (incongruous stimuli) that create conflicts in their construction system. The fourth condition is the unavailability of a response (unavailable responses) so there is uncertainty in their construction system. The fifth condition is a high percentage of the stimulus or other problems that interfere with their cognitive system processing.

Students' high cognitive anxiety is thought to interfere with student performance through cognitive impairment [32]. These conditions make students unable to concentrate on learning [24] and make them underestimate their abilities or lack confidence [33], thus having an impact on decreasing student learning outcomes [24, 32, 33].

Based on the description above, we consider it important to analyse the Biology learning process carried out by teachers during the covid-19 pandemic. The analysis focused on the level of cognitive processes in the learning tasks given by the teacher to students and their impact on students' cognitive anxiety. This research was conducted based on the assumption that the cognitive process in the learning task given by the teacher facilitates the working of the construction system in students' cognition. If this construction system works well, more knowledge can be constructed and stored in long-term memory which is expected to reduce students' cognitive anxiety levels. The results of this study are expected to provide an overview of how important it is to pay attention to cognitive processes that are trained by teachers to students through learning tasks given during learning, especially in Biology learning.

2. Teaching Material of Biology: Animalia Kingdom and Ecosystem Concept

2.1. Animalia Kingdom

Kingdom Animalia is one of the biological materials with a fairly wide scope [9], [11, 34, 35], and contextual because the object can be observed directly, and has a specific and well-defined topic [36]. The main concepts taught are from the characteristics of phyla in Kingdom Animalia to the principles of classification [37, 38]. Kingdom Animalia material discusses animals from invertebrates to vertebrates [34, 35] which have nine sub-materials. This sub-material consists of the phyla Porifera, Coelenterata, Platyhelminthes, Nematelminthes, Annelida, Mollusca, Arthropoda, and Echinodermata which belong to Invertebrates, and the phylum Chordata [38] which includes all vertebrates (Vertebra). Vertebrata is the largest subphylum Chordata which consists of the classes Pisces, Amphibia, Reptilia, Aves, to Mammalia [39].

Animals are eukaryotic organisms that do not have cell walls, do not have chlorophyll, so they are heterotrophic organisms that cannot make their food. Animals can move their bodies freely to find food and defend themselves from predators or enemies. Animal movement can occur because animals have nerve cells and muscle cells, these cells distinguish between animals and plants.

Animals can be grouped based on several morphological characteristics. The first characteristic is distinguished based on the presence or absence of the body's constituent tissues. Animals that do not have true body tissue are called Parazoa, and animals with true body tissue are called Eumetazoa. The second characteristic is body symmetry. Eumetazoa animals can be distinguished based on their body symmetry, namely radial, bilateral, or asymmetrical body symmetry. The third characteristic is the embryonic layer. Animals that have two embryonic layers are called diploblastic, while animals that have three embryonic layers are called triploblastic [40]. The fourth characteristic is the presence or absence of a coelom or body cavity. Triploblastic animals are divided into acoelomate, pseudocoelomate, and coelomate. In the next classification, animals can be distinguished based on the perfection of the digestive tract, skeleton, appendages, and whether or not there is a spine. Animals that do not have a backbone are called invertebrates and animals that have a backbone are called vertebrates [39].

Invertebrates generally have the characteristics of an exoskeleton, incomplete excretory organs, a simple nervous system, and open blood circulation [41]. This group of invertebrate animals is grouped into several phyla, including Porifera, Cnidaria, Platyhelminthes, Nematelminthes, Annelida, Mollusca, Arthropoda, and Echinodermata. Vertebrate animals are a subphylum of Chordata (animals that have a notochord) [42] and are grouped into several superclasses, including Pisces and Tetrapods [43]. Tetrapods include the classes Amphibia, Reptilia, Aves, and Mammalia.

2.2. Ecosystem

Ecosystem material has characteristics that are not much different from the material in the Kingdom Animalia. Ecosystem material is material that connects organisms with their environment [44]. One of the methods are applying student worksheet [45]. This material is contextual [46]. Thus, it needs to be studied by using the environment around students as real objects [47]. Ecosystem material has a complete composition [48]. Students who study ecosystem material are required to think critically and be involved in preserving ecosystems. The same statement was also made in previous studies [44, 49] that in learning ecosystem material students need to be invited to make direct observations of the surrounding environment. Observations were made on both the biotic and abiotic components so that students were assisted in understanding the material and being able to relate what they had learned to the real conditions they faced. Ecosystem material has a wide scope. The scope of this material consists of material about the understanding of ecosystems, ecosystem components, energy flows, and interactions between living things in the environment [47].

The ecosystem is an ecological system of mutual relations between living things and their environment. There are two components of the ecosystem, namely natural ecosystems and artificial ecosystems. Natural ecosystems include aquatic ecosystems and terrestrial ecosystems that occur naturally, while artificial ecosystems are created to help or fulfil human needs [50]. There are several objects of study in ecology, starting from the organismal or individual level, then populations, communities, ecosystems, and biomes, to the biosphere. All of these components and objects interact and depend on each other [50].

3. Method

This research was descriptive and used a cross-sectional survey method to obtain facts from the learning process so that the level of cognitive processes in the learning task and its impact on students' cognitive anxiety in biology learning during the covid-19 pandemic could be observed. Data collection techniques in this study were carried out by providing closed questionnaires for students' cognitive anxiety data and documentation in the form of photos and videos of biology learning for data analysis of learning tasks and levels of cognitive processes.

3.1. Sampling technique and participants

Data were taken from five public high schools in one of the cities in West Java, Indonesia. The number of public high schools in this city is not much compared to the number of public high schools in other cities in West Java. The city only has five public high schools. Thus, a total sample of data can be taken from the population. In addition, the learning system in the five public high schools shows a variety of learning modes. This was a special attraction for research. Public high schools in this city have more varied student characteristics compared to private schools. This was a result of people's views that prefer public schools as places for their children's education. Two of the five high schools are classified as the favorite school category, two other schools are classified as ordinary schools, and one school is classified as a school that is still considered a new school even though it has been operating for several years.

For data collection, three 10th-grade classes from each public high school were selected and their biology learning was observed. From the 15 biology classes that were observed, there were 465 students and seven biology teachers who participated in the complete study. The research has been carried out from early February 2022 to April 2022. The observed biology learning includes two teaching materials such as Kingdom Animalia and Ecosystems.

3.2. Instrument

The instruments used in this research were the learning task quantification rubric and cognitive anxiety questionnaires. The learning task quantification rubric was based on the new taxonomy [2] which consists of six levels. Level 1 (retrieval), level 2 (comprehension), level 3 (analysis), level 4 (knowledge utilization), level 5 (metacognition), and level 6 (self-system). While the cognitive anxiety questionnaire was made based on the cognitive anxiety instrument [26]. The questionnaire consists of 27 statements that describe the level of cognitive anxiety of students in Biology learning during the Covid-19 Pandemic.

3.3. Data collection and analysis

3.3.1. Level of cognitive processes

The data was obtained in the form of documentation of learning activities in five public high schools. The data were grouped into several learning modes according to what the teacher was teaching. Each learning mode was then analysed for its learning task and then categorized based on the six taxonomy levels. After the categorization was completed, the learning task data was calculated and compared to the percentage per learning mode. This is also to see the tendency of the

complexity of each learning mode and its relationship to students' cognitive anxiety. The complete learning modes could be seen in Table 1.

Table 1. Teaching mode in biology class of five senior high school during covid-19 pandemic.

School	Teaching Mode	Learning Form	Learning Platform	Main Method	Teaching Material
A	Online Learning (Mode 1)	Synchronous	Zoom Meet / Google Meet	Teacher Presentation	Animal Kingdom; Ecosystem
B	Online Learning (Mode 2)	Asynchronous	Whatsapp Group	Assignment	Animal Kingdom; Ecosystem
C	Online Learning (Mode 3)	Synchronous	Google meet & Whatsapp Group	Teacher Presentation & Questioning	Animal Kingdom; Ecosystem
D	Hybrid Learning (Mode 4)	Synchronous & Asynchronous	Classroom Learning (offline) & Whatsapp Group	Teacher Presentation, Practicum, Discussion, & Assignment	Animal Kingdom; Ecosystem
E	Hybrid Learning (Mode 5)	Synchronous & Asynchronous	Classroom Learning (offline), Whatsapp Group, Google Classroom	Teacher Presentation, Discussion, and Assignment	Animal Kingdom; Ecosystem

3.3.2. Cognitive anxiety

The data was obtained in the form of cognitive anxiety scores of students in five schools. The data from the cognitive anxiety questionnaire was then averaged to see the level of cognitive anxiety of each student, after that the data obtained were analysed statistically using the ANOVA test to see the difference in mean using the IBM SPSS statistic 25. Cognitive anxiety data were then categorized to see the tendency cognitive anxiety level of students from each school.

4. Results and Discussion

4.1. Level of cognitive processes

The learning modes of Biology (Kingdom Animalia and Ecosystems) in the five schools studied during the Covid-19 pandemic were generally divided into five learning modes (Table 1). Three learning modes were carried out online with Zoom Meet, Google Meet, and/or WhatsApp Group, while the other two modes carried out hybrid learning, which combines online learning with offline learning. Hybrid learning was carried out by dividing 50% of students to carry out online learning

and the other 50% of students to carry out face-to-face learning (offline learning). The two groups took turns carrying out offline and online learning.

The five learning modes in general have a learning task weight (Fig. 1) which is more dominant at the cognitive process level 1 (Retrieval) and cognitive process level 2 (Comprehension). The dominance of these two levels occurs because most of the learning processes in the five learning modes direct students to activate the cognitive process of recognizing and recalling knowledge that they already have (Recall). Both cognitive processes were included in cognitive process level 1 (Retrieval). The learning process also directs students to simply understand the material in the form of integrating or symbolizing that were at cognitive level 2 (Comprehension). Only a small part of the learning process directs students to analyse (level 3), use their knowledge (level 4), or metacognitive (level 5). No learning mode directs students to level 6 cognitive processes (self-system).

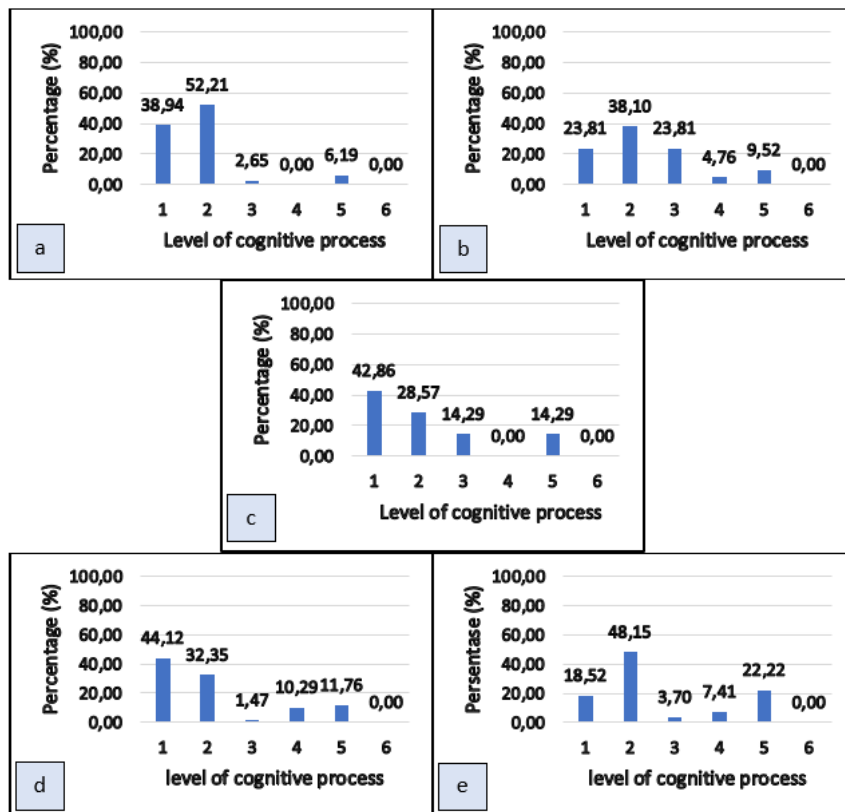


Fig. 1. Comparison of learning tasks in five learning modes.

(Description: a. Mode 1 (Online learning – Teacher presentation with video conference); b. Mode 2 (Online learning – assignment with WhatsApp group); c. Mode 3 (Online learning – Teacher presentation and Questioning with WhatsApp group); d. Mode 4 (Hybrid learning – Teacher presentation, discussion, practicum & assignment) Mode 5 (Hybrid learning – Teacher presentation, discussion &

assignment)), Level 1 = Retrieval; Level 2 = Comprehension; Level 3 = Analysis; Level 4 = Knowledge Utilization; Level 5 = Metacognition; Level 6 = Self-system.

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The more dominant level 1 and level 2 cognitive processes weights in each learning mode were thought to be a result of teachers still needing adaptation in this new learning process so that the learning that takes place was still minimal as long as the material could be delivered and students were not left behind in learning material [34]. In addition, the characteristics of teaching materials could also be the reason for learning tasks that were dominated by cognitive processes at level 1 and level 2. Biology teaching materials generally have a wide scope of essential materials [8-11] and are compact [34]. The character of the material makes most teachers deliver the material through the lecture method or direct students to read the teaching material to deliver all teaching material.

In detail, mode 1 (Fig. 1(a)) Kingdom Animalia and Ecosystems learning was carried out synchronously via Zoom Meeting or Google Meet with lecture methods interspersed with questions. Through the learning process, it could be seen that the learning tasks carried out by the teachers only make students answer the questions from the teacher or listened to the material presented by the teacher. Even when observing the questions asked by the teacher, it could be seen that the questions reveal more of the knowledge that has been learned by students at the previous level (recall). Questions like "what tool is used to measure temperature?" or "what examples of animals are herbivores?" or questions that reveal students' understanding of the material (integrating) such as "what happens if the animal population decreases?". Only a small number of questions lead students to the analysis process, for example when students were asked to read some statements and then students were asked to analyse whether the statement is true or false. For example, "True or false, if the population of frogs decreases, the population of grasshoppers and snakes decreases too?". Learning tasks that lead to level 5 (metacognition) were only in the form of questions related to monitoring clarity such as "was there any material that has not been understood?" or the question "is there anything you want to ask before moving on to the next material?". These things cause the learning task weight in mode 1 to be more dominant at level 1 and level 2. Biology material was not suitable if it was only delivered using the lecture method [41]. Biology learning needs to be equipped with learning strategies that could provide direct experience [13].

In mode 2 (Fig. 1(b)), learning was done online by giving assignments in the form of independent worksheets distributed in the WhatsApp Group by the teacher. This method requires students to study independently without direct guidance from

the teacher. In this learning mode, the learning tasks given by the teacher were stored in the student worksheet. The learning task has a more varied weight from level 1 to level 5, but the learning task has not trained cognitive processes at level 6 too. The weight of the learning task in mode 2 was more varied than in mode 1 because the worksheets given to students completely guide students to learn. Starting from the acquisition of material from YouTube videos that students should watch or from reading material, students were also directed to answer questions to strengthen the acquisition of the material, make direct observations of the environment around the house, identify, and analyse the results of observations, to the process of self-reflection also exists in the student worksheet.

Although mode 2 has been equipped with learning tasks that train cognitive processes that were more varied from level 1 to level 5, this mode does not provide direct guidance on the learning process carried out by students, so it does not guarantee that learning was carried out optimally. This was reinforced by the previous results [51]. The ineffectiveness of Biology learning during the Covid-19 pandemic was caused by the learning process that required students to study independently [42]. One-way communication through tasks sent in Whatsapp Groups was less effective because the tasks given were quite a burden for students [24, 43], especially for students who were learning new material. For students who were not familiar with independent learning, this could be the reason for a lack of student understanding [22, 52]. These statements indicate that supervision and guidance from teachers were still needed in the learning process.

In Mode 3 (Fig. 1(c)) learning was carried out through the same platform as mode 2, namely WhatsApp Group. The difference was, in mode 3, the teacher continues to guide students to gain knowledge even though the process was only through chat in the WhatsApp group. Initially, learning began with the provision of material by the teacher which was sent in the form of PowerPoint. Students must study interactive PowerPoint which already contains material as well as teacher voice recordings to make it easier for students to understand the Biology learning material. The teacher then directs students to ask questions so that level 5 cognitive processes, especially monitoring clarity occur here, even though their questions were not too complex. The teacher also gives some questions to students related to the material that has been given. However, most of the questions asked by teachers were still around level 2, such as "what is an ecosystem?" or "what is the difference between a detritivore and a decomposer, give an example?" There was only one question that begins to train students in level 3 cognitive processes, such as "what would happen if there were no decomposers?". After the questions and answers process was complete, the teacher then closes the lesson without directing students to conclude the learning outcomes.

The learning process in mode 3 produces learning task weights with a similar pattern to mode 1. The learning method was the same through lectures but differs in the learning platform. However, in mode 3 the weight of the cognitive process of learning task was more dominant at level 1, while in mode 1 the cognitive process was more dominant at level 2. Another weakness of learning in mode 3 was the WhatsApp application that was chosen for the learning process. The use of the WhatsApp application is only effective for teaching theory [51]. Through WhatsApp Group, learning is limited and it is rather difficult to implement a learning method that facilitates all the skills needed by students in learning Biology such as developing scientific attitudes [12].

The next learning modes were mode 4 (Fig. 1(d)) and mode 5 (Fig. 1(e)). These two modes were implemented in a hybrid learning way, which combined learning between offline learning and online learning, even though it was still limited. Mode 4 has taught students with lectures, discussions, practicums, and assignments. This learning mode produces learning task weights with varying cognitive processes, from level 1 to level 5. The same variation also occurs in learning mode 5. Learning in mode 5 takes place through lectures, discussions, and assignments. The difference between the two lies in the presence or absence of a practicum process, even online learning carried out was also similar. Both of these learning modes give student worksheets to online WhatsApp Groups or Google classroom as a task for students to do at home without any guidance from the teacher.

The difference in one learning method was enough to affect the weight of the resulting learning task. Mode 4 was more dominant at cognitive processing levels 1 and 2, while mode 5 was more dominant at cognitive processing level 2 (Figs. 5(d) and 5(e)). This was because, in mode 4, there are practicum activities that direct students to execute or do such as preparing tools and materials, as well as cutting specimens, so that level 1 cognitive processes were more dominant than cognitive processes at other levels. Different learning task weights occur in mode 5 with learning that directs students to discuss more to get answers to questions on the worksheet given so that level 2 cognitive processes were more dominant than other levels of cognitive processes.

In Biology learning, students must interact with objects and phenomena, ask questions, describe objects and events that occur, gain knowledge, build explanations of phenomena that occur, evaluate the explanations they get, and communicate their ideas Supriatno [7]. In addition, in Biology learning, students are also required to be able to work in groups, conduct joint explorations, and conduct experiments. One of the learning modes that could accommodate this was practicum. As implemented in learning mode 4. Practicum was a form of learning mode that aims to determine students' knowledge of subject matter with an application, analysis, even synthesis and evaluation of a theory [44-46]. The learning process through practicum will make students gain direct experience [44]. Experience is gained through activities ranging from cognitive, affective, and psychomotor domains [47]. Thus, students are active in every activity [48], have curiosity [49], and can build skills. in the acquisition of knowledge [50]. Practicum can increase motivation, enthusiasm [44, 46], students' interest in learning [12], and develop the concepts they are studying. These statements indicate that learning in mode 4 and mode 5 was more optimal in its implementation. Learning in modes 4 and 5 has facilitated students to develop their thinking skills, mastery of concepts, to scientific attitudes when compared to other learning modes. However, the facilitation of student self-development in the two modes must be carried out alternately.

Even though offline learning was carried out alternately during the Covid-19 pandemic, in modes 4 and 5 students seem enthusiastic about learning. This enthusiasm happened especially evident for the offline group students. During offline activities, there was a two-way interaction between the teacher and students, the teacher also provides feedback while studying, so that students feel confident about the acquisition of their knowledge. The teacher acts as a facilitator for offline group students, not as the main subject as in learning mode 1 and learning mode 3. These results were in line with previous report [51] research that teacher-centred learning will make students passive and occur boredom in learning. Students studying Biology

must be able to fulfil the following aspects, such as interacting with objects and phenomena, asking questions, describing objects and events that occur, gaining knowledge, building explanations of phenomena that occur, evaluating the explanations they get, and communicating their ideas [7]. All of these aspects could be obtained by offline group students in mode 4, while mode 5 fulfilled most aspects, but there was no direct interaction with objects and phenomena.

The results of the analysis of all learning modes show one pattern that needs to be paid attention to. There was no single learning mode that reaches level 6 cognitive processes or self-system. Not achieving this level occurs because in all learning modes there were no learning tasks that lead students to identify how important knowledge was for students (examining importance), identify self-confidence to improve their abilities (examining efficacy), identify emotional responses to knowledge (examining emotional response), or identify the overall motivation of students (examining overall motivation). To obtain meaningful knowledge, all components of the cognitive level must be carried out during the learning process [3], because each system influences the level of student success in learning [52].

Self-system is related to students' ability to regulate attitudes, beliefs, and emotions. All three cognitive processing components are interconnected in determining student motivation in learning. Whether learning tasks will be carried out or not, tends to depend on the character of the task. If the task is considered important or brings someone in a better direction and provides benefits, then motivation will arise, and the task will be carried out. The opposite process will occur if a person feels the task is not important [2].

In addition, the self-system plays a role in making decisions about new things, whether in the form of new circumstances, new people, new events, or new tasks. However, in the learning process. The self-system will also determine whether the given task will continue to be carried out or not depending on the level of motivation, before proceeding to cognitive processes at level 5 (metacognition) and 4 levels of the cognitive system below it. Cognitive processes at lower levels will provide an understanding of existing knowledge, while higher levels involve new knowledge [2] and self-control.

4.2. Cognitive anxiety of students

In general, students' cognitive anxiety levels in all learning modes are in the medium category. The results of the ANOVA test showed that there was no significant difference ($p > 0.05$) in the amounts of students' cognitive anxiety among the five Biology learning modes (Table 2). However, based on the results of the categorization of cognitive anxiety, shows that most students (more than 85% of students) in all learning modes have cognitive anxiety that falls into the medium and high categories. Only a small number of students (less than 15% of students) have low cognitive anxiety (Fig. 2). Based on this data, it could be said that all Biology learning modes in high school during the Covid-19 pandemic caused students cognitive anxiety in the medium category and even tended to be in the high category. Cognitive anxiety that tends to be high in all these learning modes if left for a long time will be difficult to reduce and ultimately affect learning outcomes [33] and student performance in learning [29, 53].

The level of moderate cognitive anxiety even tends to be high in this research was also in line with the results of previous research [54] on elementary school students during the Covid-19 pandemic. The level of cognitive anxiety that tends to be high in Biology learning during the Covid-19 pandemic was also in line with the previous results [55] on many learning researches articles during the Covid-19 pandemic, with the conclusion that changes in learning methods during the Covid-19 pandemic caused an increase in student cognitive anxiety. Most students who did online learning experienced severe or high levels of anxiety and none of the respondents experienced low anxiety symptoms [24]. Some of the results of these studies are certainly influenced by many things, especially different learning processes that cause culture shock or someone's unfamiliarity with the new culture and learning environment conditions [24]

Table 2. High school student’s cognitive anxiety scores on various Biology learning modes.

Mode	Mean*	Minimum Score	Maximum Score
1	55.53 a	19.44	81.85
2	57.06 a	34.30	82.41
3	54.40 a	24.74	79.70
4	57.45 a	32.04	87.74
5	55.98 a	27.07	86.67
Average	56.13	19.44	87.74

Note: The mean numbers followed by the same letter do not show a significant difference at the 5% confidence level.

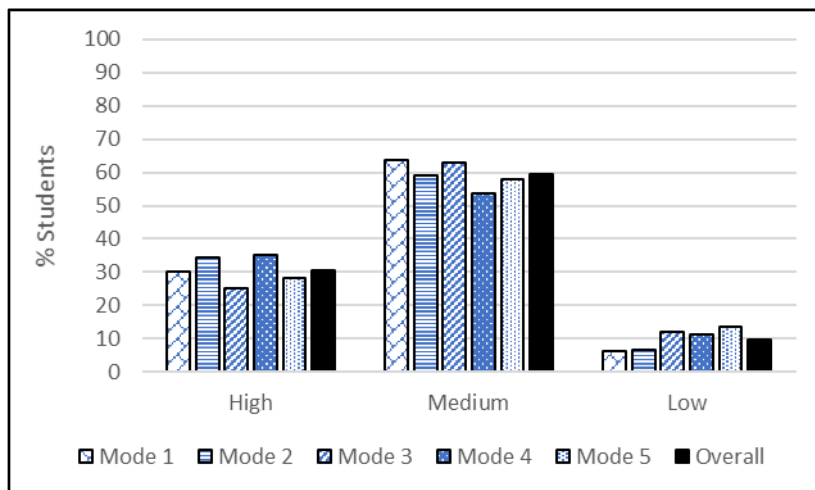


Fig. 2. Percentage of students in each category of cognitive anxiety.

Based on the literature [30], several conditions can cause cognitive anxiety. First, conditions that provide very new stimuli (extremely novel stimuli). This condition certainly occurred in the Biology learning process during this pandemic. Both online learning in mode 1, mode 2, and mode 3 as well as hybrid learning in mode 4 and mode 5 were new experiences for students and still need an adaptation process. Second, conditions that require additional construction but are not

available (extra construction needed). This condition may occur when students did not understand the material but no teacher guides, or there was no place to ask questions. Students were required to study completely independently. This condition is prone to occur in mode 2 which only provides independent assignments and in mode 4 or 5 for groups of students who study online because both are given independent assignments only. Third, conditions that provide inappropriate stimuli (incongruous stimuli). This condition can occur when the apperception made by the teacher while studying Biology was not accompanied by sufficient explanation or students were left to find their answers, resulting in conflicts in their construction system. Fourth, the condition in which learning does not provide unavailable responses. This condition results in the uncertainty of the construction system in students. Fifth, conditions where other factors such as limited internet network, and other technical conditions during Biology learning interfere with processing in the cognitive system.

Furthermore, if the high cognitive anxiety of students in biology learning during the Covid-19 pandemic was associated with the level of cognitive processes in the learning tasks given by the teacher in each learning mode, the main cause of students' cognitive anxiety might have been a result of the low-level cognitive processes that trained through the given learning task. As a result, conditions, where students need additional construction, were not available [30].

In addition, the low level of cognitive processes required in the learning task could make learning conditions inconsistent with the demands and learning objectives to be achieved. The covid-19 pandemic has forced the learning process to be done in online learning or hybrid learning and requires students to study more independently. With learning tasks in low-level cognitive processes, students' cognitive systems become less trained to use high-level cognitive processes, especially when students were asked to learn independently. Learning tasks that train cognitive processes at a high level in Biology learning, will help students develop independent learning which in turn will reduce students' cognitive anxiety. Providing learning tasks that carry cognitive processes at level 6 (self-system) will train students in making decisions to choose to do their new task or situation. If this happens to students, then the metacognitive system (cognitive process level 5) will take over by making goals and the best strategies to achieve their goals.

Furthermore, the cognitive system (cognitive processes at levels 4, 3, 2, and 1) will be responsible for processing important information on new tasks or situations given in learning. The cognitive system will analyse an event, make a conclusion, compare, classify, and so on [2]. This process is certainly a very important part and is closely related to the self-system and metacognitive system [52] which in the end students will gain meaningful knowledge. Thus, when level 6 (self-system) is not raised in the Biology learning task as it occurs in all learning modes, there may be students who are passive during the learning process and choose not to pay attention to the learning process. Students do not contribute more to ongoing Biology learning because their self-system chooses not to be connected or not involved with new situations. Situations like this can lead students to high cognitive anxiety. Students feel tense, worried, or afraid [28, 29] when faced with the process of evaluating learning outcomes or a test to see the success of learning. In addition, during biology learning students seem confused because they feel that the events, they are facing are outside the reach of their comfort zone. Thus, students cannot anticipate and integrate their experiences in a meaningful way [30].

5. Conclusions

The results of this research conducted in five high schools in one city in West Java show that the biology learning mode implemented during the COVID-19 pandemic carried a dominant learning task in developing cognitive processes at a low level, such as retrieval and comprehension. The percentage of learning tasks to develop cognitive processes at a higher level (analysis, knowledge utilization, and metacognitive) was still very small. There was no learning mode with learning tasks aimed at developing level 6 cognitive processes (self-system). Biology learning carried out during the COVID-19 pandemic with the dominance of learning tasks in low-level cognitive processes has the potential to cause cognitive anxiety in students in the medium to high category.

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