

# Analysis of Critical Thinking Dispositions as a Predictor of Students' Critical Thinking Skills in Biology Learning

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## ABSTRACT

Some experts say that critical thinking disposition is a predictor of a person's critical thinking skills. This study aims to assess the extent to which students possess critical thinking disposition, in order to forecast their critical thinking abilities in the context of biology education. This study employed descriptive research using a qualitative methodology, involving 74 students from 2 classes as respondents. The instrument used is CTDBT, which includes 7 indicators: Truth-seeking, Open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity. The results show that students have critical thinking dispositions in the weak category for maturity indicators, medium categories for indicators of open-mindedness, analyticity, systematicity, and self-confidence, and high categories for indicators of truth-seeking and inquisitiveness. Students at the senior high school level generally have a high curiosity and are always eager to prove the truth of something, but they still seem rushed, vulnerable, and unstable, so they require the development of skills and maturity in making decisions to solve problems.

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## 1. INTRODUCTION

Critical thinking consists of two essential parts, namely critical thinking dispositions and critical thinking skills (Fikriyati et al., 2021). Critical thinking dispositions and critical thinking skills are components that a person needs to achieve and improve critical thinking (Ana et al., 2021). Critical thinking dispositions have a positive influence on student learning success (Bell & Loon, 2015). Before someone has skills in interpreting, analyzing, concluding, explaining, and evaluating, one must be able to cultivate a will to seek the truth, think openly, analyze, systematically, and have curiosity and confidence so that one will be able to solve problems appropriately (Facione, 2000). Therefore, knowing and developing one's critical thinking disposition is very important because someone who has skills does not necessarily want to use the critical thinking skills he has. Facione (2020) explained that there are seven indicators of critical thinking dispositions, namely: Open-mindedness, Analyticity, Cognitive Maturity, Truth-seeking, Systematicity, Inquisitiveness, and Self-Confidence.

Understanding and cultivating students' critical thinking tendencies is a crucial endeavour in addressing information disruption, enabling students to resolve problems effectively and make informed judgements. Dispositions and critical thinking abilities can be cultivated through an efficient learning process, specifically through learning that allows students to connect the subject to everyday phenomena. One instance of this is biology education (Radila et al., 2021). Multiple studies on critical thinking dispositions have been conducted, including a research study by Fitriani et al. (2018) that examined gender-based differences in critical thinking dispositions. The findings revealed that male and female students exhibit distinct dispositions towards critical thinking in various aspects, indicating the need for further improvement. In their study, Boonsathirakul and Kerdsomboon (2021) examined the relationship between gender, academic level, and critical thinking tendencies. Muzakki et al. (2017) conducted a study on the correlation between critical thinking dispositions and the writing abilities of students from Pekanbaru High School.

Critical thinking is a thought process that a person has to be more reflective and reasonable in gathering, analyzing, and evaluating before making a decision. A person with critical thinking will use his cognitive knowledge to find alternative solutions to problems through questions and basic assumptions (University of Sydney, 2014). Critical thinking is always related to higher-order thinking skills. Students with high-level thinking will be trained to solve problems encountered, where students not only memorize and remember learning material but are able to understand and reason about it before making decisions (Mislia et al., 2018). This explains that students who have high-order thinking skills will be accustomed to being involved in problem-solving by conducting analysis, interpretation, and evaluation before making decisions.

One of the skills needed by students in learning biology is critical thinking skills. With critical thinking skills, students can solve problems and find alternative solutions to problems encountered in everyday life (Cindiati et al., 2021). Critical thinking skills are skills acquired through guided practice, not inherited results that students need to become independent and successful in the future (Setiawati & Corebima, 2017). Critical thinking skills are undeniably important skills to be developed in the 21st century. The facts so far show that it is still difficult to develop critical thinking skills due to operational learning and assessments that have not been carried out properly (Head et al., 2020). Malik & Ubaidillah (2020) in their research revealed that one of the problems found in current learning is the development of critical thinking skills which is still minimal. The learning process has not facilitated students' practice of critical thinking skills. Ansori et al., (2018) added that critical thinking including dispositions and skills is still rarely practiced in biology learning. The disposition to think critically is needed to ensure students can think critically consistently.

Students' critical thinking can be developed through well-designed learning processes such as learning methods and media (Abdullah, 2021). Therefore a teacher must be able to plan creative and innovative learning to be able to facilitate the development of student's critical thinking skills properly (Prafitasari et al., 2021). This is in line with the statement of Purwaningsih & Wangid (2021) that a teacher must be able to develop creative learning media, to be able to improve students' critical thinking skills. As with critical thinking skills, critical thinking dispositions can also be developed and trained through innovative learning processes. Emiliannur et al. (2023) also stated that innovative learning and appropriate assessment strategies can support the development of students' critical thinking dispositions.

Based on the explanation above, it can be concluded that dispositions and critical thinking skills are closely related, including efforts to develop or improve them. The first step that needs to be done is to know the extent of students' interest and willingness to use the skills they have. Therefore, this study aims to analyze the level of students' critical thinking disposition, which is useful as a reference in predicting the level of students' critical thinking skills in the future. Thus the research question is how the level of students' critical thinking dispositions in learning biology.

## 2. METHODS

This study employs descriptive research utilising a qualitative technique. This study is the initial phase of implementing a prognostic assessment of critical thinking tendencies on the critical thinking abilities of high school pupils. The data collection was conducted in a high school, specifically targeting a sample of 74 students from two different courses. The research involved analysing the students' level of critical thinking disposition by administering the Critical Thinking Disposition Biology Test (CTDBT) instrument to a group of respondents (students) prior to the learning process. The CTDBT instrument comprises various markers of critical thinking disposition, specifically TS (Truth-seeking), OM (Open-mindedness), AN (Analyticity), SIS (Systematicity), SC (Self-confidence), IN (Inquisitiveness), and MA (Maturity). The citation is from Syahfitri et al., 2019a.

CTDBT is a valid and reliable instrument consisting of 10 groups of questions with each group composed of 7 indicators (Truth-Seeking, Open-Mind, Analyticity, Systematicity, Self-Confidence, Inquisitiveness, and Maturity) so that CTDBT has a total number of questions of 70 questions in multiple-choice form (Syahfitri, 2019b). The validity and reliability of CTDBT is shown from the Average Extract Variance (AVE) and Composite Reliability (CR) scores for each indicator, namely the value of truth-seeking (AVE = 0.67 and CR = 0.95), open-mind (AVE = 0.63 and CR = 0.94), analyticity (AVE = 0.63 and CR = 0.94), systematicity (AVE = 0.52 and CR = 0.91), self-confidence (AVE = 0.72 and CR = 0.960), inquisitiveness (AVE = 0.73 and CR = 0.96), and maturity (AVE = 0.75 and CR = 0.95), (Syahfitri et al., 2019c).

The acquired data on students' critical thinking dispositions are qualitatively analysed by presenting them in tables, images, and graphs, accompanied by a comprehensive explanation of the data's significance. The critical thinking dispositions of numerous students were evaluated and categorised into four groups based on each indicator: high, moderate, ambivalent, and weak/low dispositions (Fuloso & Caserina, 2014), (Foluso, 2014).

**Table 1.** Interpretation Criteria for Critical Thinking Disposition Scores

No	Score Range	Critical Thinking Disposition
1	$\bar{X} > 50$	High
2	40 – 50	Medium
3	30 – 40	Ambivalent
4	$X < 30$	Low

The results of the analysis of students' critical thinking dispositions will later become a guide or reference for researchers in determining and answering the question of whether critical thinking dispositions can be a predictor of students' critical thinking skills in biology learning. It is also the first step in determining how effective the CTDBT instrument is in predicting students' critical thinking skills.

## 3. FINDINGS AND DISCUSSION

The results of the analysis of the level of disposition to think critically in biology learning for each indicator explained that the average student had a disposition in the high category for the Truth-seeking and inquisitiveness indicators, a disposition in the medium category for the indicators of open-mindedness, analyticity, systematicity, and self-confidence. While students are said to have a disposition in the low category for maturity indicators. This is described in detail in Table 1.

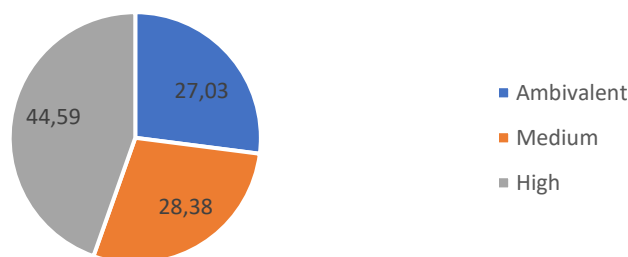
**Table 2.** Mapping of students' critical thinking disposition levels in biology learning

Indicator of CTD (N=74)	Min	Max	Total Skor of CTD	Category
Truth-seeking	30	70	52.57	High
Open-mindedness	20	70	41.89	Medium
Analyticity	20	70	42.84	Medium
Systematicity	20	70	41.62	Medium
Self-Confidence	20	70	44.73	Medium
Inquisitiveness	30	70	50.14	High
Maturity	20	70	39.39	Low

The distribution of critical thinking dispositions from a total of 74 students for each indicator is as follows:

### 3.1 Truth-seeking

Based on the analysis of students' critical thinking dispositions on the truth-seeking indicator, 44.59% of students showed high scores, 28.38% of students showed moderate scores, and 27.03% showed ambivalent scores. Picture 1 describes that the majority of students already have a high critical thinking disposition.

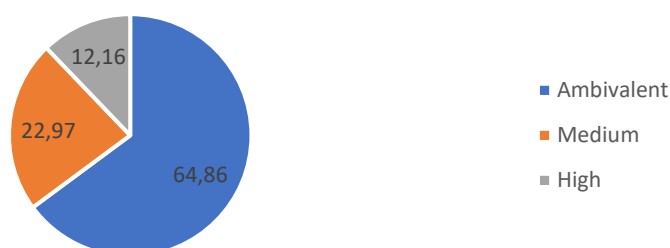
**Figure 1.** Profile of Critical Thinking Disposition on Truth-Seeking Indicator

Learning biology can help students practice solving problems through natural phenomena. Students tend to be interested and challenged when given a case or problem, thus motivating them to seek and collect evidence to answer the problem. Rahmawati et al (2021) explained that through the habit of problem-solving carried out by students, they exhibit critical thinking behavior, especially in terms of seeking the truth. Truth-seeking can be said to be a predictor of someone in critical thinking behavior.

Truth-seeking is a person's habit of always looking for evidence against the information he receives. Truth-seeking can be the main characteristic of someone to think critically. Someone with good truth-seeking can have a good critical thinking disposition, whereas someone unable to have truth-seeking cannot have a critical thinking disposition (Rohma et al., 2022). Truth-seeking is a tendency of a person's critical thinking disposition to solve problems. When solving problems, students can show how hard they try to find the truth through evidence (Prasetya et al., 2023).

### 3.2 Open-mindedness

Picture 2 describes that the majority of students have a disposition in terms of open-mindedness in the ambivalent category of 64.86% and followed by 22.97% of students who have open-mindedness in the medium category and only 12.16% of students have a disposition in terms of open-mindedness in the high category.



**Figure 2.** Profile of Critical Thinking Disposition on Open-Mindedness Indicator

Open-mindedness behavior is an ideal component for someone to have critical thinking as a whole (Siegel, 2009). This confirms that someone who already has open-minded behavior means that the student is already able to think critically. Vice versa, when students still show ambivalent open-mindedness, it means that they may not be ready to use critical thinking skills, affecting their ability to solve problems. Pertiwi (2019), in her research, explains that someone with an open-minded style has a positive relationship with problem-solving abilities.

Open-mindedness will influence students in making decisions independently and rationally (Polat et al., 2019). Indicators of open-mindedness include a person's attitude of being tolerant and respectful of different views, being able to distinguish between right and wrong, and being able to understand the thoughts of other people (Gunawan et al., 2019).

### 3.3 Analyticity

Students' critical thinking disposition on the analyticity indicator obtained four categories, namely low, ambivalent, medium, and high. Several 52.7% of students showed analyticity that was still ambivalent and followed by 22.97% of students showing high analyticity, 18.92% of students with medium analyticity, and 5.4% of students with low analyticity.

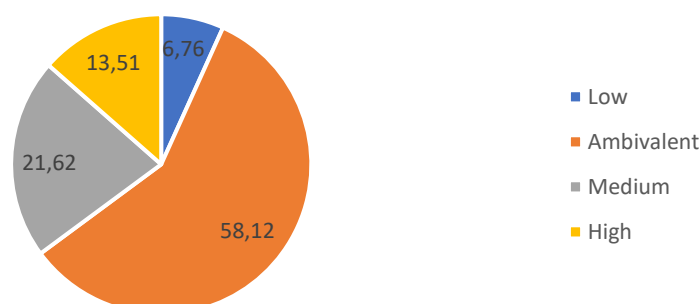


**Figure 3.** Profile of Critical Thinking Disposition on Analyticity Indicator

The tendency of students to analyze can interpret their level of readiness for critical thinking. On the other hand, students with ambivalent analytic tendencies can have difficulties finding solutions or answering the questions they face. Students may be still not trained in formulating and identifying problems based on their knowledge. Furthermore, Redhana et al. (2017) explained that students who have a critical thinking disposition in terms of analyticity tend to analyze possibilities that may occur in the future and make connections between their knowledge and events encountered in everyday life. This makes students more careful with the situation that occurs.

### 3.4 Systematicity

Overall, students have a disposition toward systematicity indicators in the ambivalent category, which is 58.12%. The data also shows that the systematicity of students is grouped into four categories namely low, ambivalent, medium, and high.

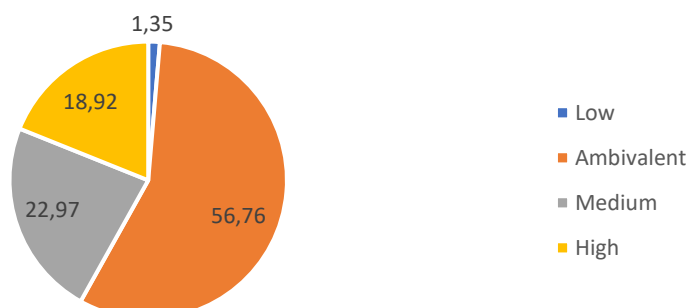


**Figure 4.** Profile of Critical Thinking Disposition on Systematicity Indicator

Picture 4 explains that in learning biology students are generally not optimally able to compile and plan problem solving systematically. This is because students are still not used to and understand strategies or approaches to solving problems. This statement is supported by the results of research conducted by Badenhorst (2019) that systematicity is a person's tendency to get used to trying to solve a problem in a disciplined, orderly, and systematic manner. Someone who is not used to being organized will show the opposite behavior. There is even someone who is systematic but does not know the approach given and is not used to using certain problem-solving strategies but shows the behavior of wanting to try to approach questions and problems systematically. Cubukcu (2006) emphasized that someone with a systematic tendency can be more objective and careful in planning and organizing a study.

### 3.5 Self-Confidence

The categorization of self-confidence indicators based on critical thinking dispositions is classified into four distinct categories: low, ambivalent, medium, and high. According to Figure 5, a significant proportion of students (56.76%) exhibit a critical thinking disposition characterised by a mixed level of self-confidence. Conversely, students with moderate self-confidence accounted for only 22.97%, students with high self-confidence accounted for 18.92%, and students with low self-confidence accounted for a mere 1.35%.



**Figure 5.** Profile of Critical Thinking Disposition on Self-Confidence Indicator

Self-confidence is the confidence that a person has in solving the problems faced. The data explains that the majority of students are still ambivalent and hesitant in solving problems found in everyday

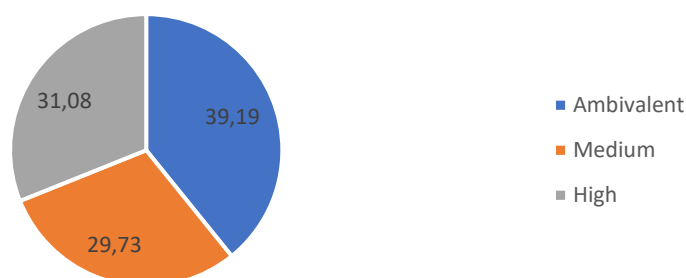
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life. This is probably because students still tend to be afraid of being wrong, lack knowledge and experience, and are unsure of their own abilities.

Self-confidence is needed by students in developing critical thinking. Nurkholifah et al (2018) explained that students' self-confidence can foster creative thinking in solving problems and students are more courageous in expressing opinions. Students with good self-confidence can support the use of critical thinking skills (Razfy & Pradipta, 2022), (Setiawan et al., 2021), (Zulfa & Sukarjo, 2021). Self-confidence is referred to as a student's capital to actualize their critical thinking skills (Umbara & Priatna, 2022). For example, students who have high self-confidence always dare to try, are not easily discouraged, and are afraid of being wrong in solving a problem. Thus students can construct their knowledge based on their experience, so they can cultivate thinking skills.

### 3.6 Inquisitiveness

The mapping analysis of critical thinking dispositions on inquisitiveness indicators obtained 3 categories, namely ambivalent, medium, and high inquisitiveness.



**Figure 6.** Profile of Critical Thinking Disposition on Inquisitiveness Indicator

The picture above describes students' critical thinking disposition on the inquisitiveness indicator 31.08% of students showed high scores and 29.73% of students showed medium scores. Although according to the distribution of 39.19% of students showed scores that were ambivalent, the overall analysis showed that the majority of students had strong inquisitiveness.

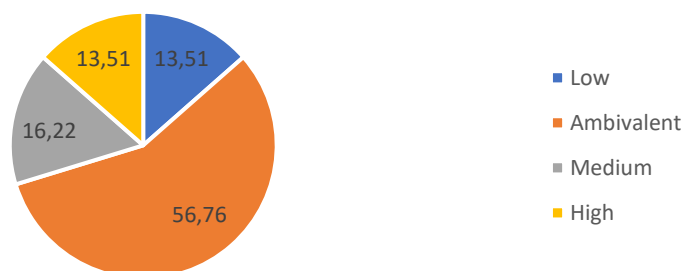
One way of the existence of adolescents in actualizing themselves to be more meaningful is through great curiosity. Curiosity about something increases motivation to be better than before (Tarigan and Nugroho, 2019). Students have a strong curiosity about learning science, especially biology. The characteristics of learning biology, which mostly include phenomena that are directly related to everyday life, foster students' curiosity in learning and understanding them. Fadilah & Kartini (2019) in their research stated that students in high school or equivalent have a strong curiosity about learning science. The curiosity that is owned raises the motivation and desire of students to investigate phenomena that occur in nature in an effort to find out new things.

Noviyanto et al. (2021) emphasized that curiosity is a prerequisite that someone must possess to be motivated to explore learning. Curiosity will be a capital that will stimulate someone to find out about science that was not known before. Raharja et al. (2018) explained that students who have high curiosity can be seen from the desire to explore information, the ability to explore knowledge, and the willingness to ask questions.

Based on the explanation above, it can be concluded that the curiosity possessed by students will affect their success in learning biology. Students with strong curiosity have a good critical thinking tendency which is shown through the desire to explore the knowledge by asking questions.

### 3.7 Maturity

The analysis of critical thinking disposition on maturity indicators reveals that the majority of students exhibit ambivalent maturity, accounting for 56.76% of the sample. Additionally, only 16.22% of students demonstrate cognitive maturity falling into the moderate group. 13.51% of students exhibit low maturity, whereas an additional 13.51% have great cognitive maturity.



**Figure 7.** Profile of Critical Thinking Disposition on Maturity Indicator

Students at the high school level are identical to teenagers who have increasingly abstract, logical thoughts and are starting to be able to develop systematic problem-solving plans (Sary, 2017). However, students at this time are still vulnerable and unstable in making decisions to solve problems (Miski & Mawarpury, 2017). Cognitively mature students tend to think critically in dealing with problems. Students are used to being motivated and responsible for solving problems, including learning (Redhana et al., 2017). Some of the characteristics of a person with cognitive maturity are listening to other people's opinions, being wise about conflicting opinions, finding alternative solutions to solving problems, and asking questions (Irani et al., 2007). Someone with high maturity will be able to manage emotions both in conditions that support or otherwise. Students who already have mature cognitive skills can be more careful and calm when dealing with problems.

After analysing the results and discussing the critical thinking mapping for each indication, it is evident that several indicators have a mutual influence on each other. For instance, an individual with traits such as strong self-assurance, methodical thinking, analytical skills, and a receptive mindset might exert an impact on the decision-making process of pupils' maturity. In their study, Ghadi et al. (2015) found a positive correlation between analyticity, truth-seeking, self-confidence, and maturity. A learner who possesses analyticity is able to predict the outcomes that result from the application of logical reasoning. In addition, students who are receptive to new ideas can actively pursue the truth in order to substantiate and resolve the issues they encounter. Similarly, students who possess self-assurance will have the capacity to rely on their cognitive faculties, so facilitating the process of scrutinizing and reaching conclusions.

Educators should take initiative in cultivating students' comprehension of critical thinking tendencies. Promote learners to contemplate their cognitive patterns and dispositions towards the process of resolving problems. The increased level of self-awareness can serve as a basis for the enhancement of more robust critical thinking abilities.

## 4. CONCLUSION

High school students typically exhibit moderate critical thinking skills when learning biology, but demonstrate a limited inclination towards maturity. Possessing a critical thinking disposition is a crucial prerequisite for utilising critical thinking skills. While a someone may possess the ability to engage in critical thinking, they may not necessarily be inclined or accustomed to utilising it. Therefore, cultivating a critical thinking disposition requires deliberate work in order to enhance one's critical

thinking abilities. Evaluating and charting the essential tendencies of thinking of children can aid a teacher in identifying strategies to cultivate both their dispositions and critical thinking abilities. This disposition mapping will furthermore aid the teacher in forecasting the potentialities and prospects for students to employ their critical thinking abilities in the future. The researcher formulated a provisional inference or forecast, based on the results, that a grand total of 74 students will possess critical thinking abilities falling inside the medium range in the future. In order to validate this hypothesis, further investigation will be conducted by implementing a learning intervention, followed by an assessment of critical thinking abilities subsequent to the midterm examination. This study is limited in that it only examines students' basic critical thinking dispositions and does not consider additional variables. Hence, it is recommended that forthcoming researchers investigate critical thinking dispositions in relation to demographic factors such as gender, age, and socioeconomic status.

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