The Potential for the Development of Critical Thinking Tests : An Overview of Educators' Perceptions

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Abstract: This study aimed to investigate teachers' perceptions about the need to develop critical thinking tests. The research method used quantitative descriptive. Research involved 20 biology teachers who taught at the senior high school in Riau. The data collection instrument was a questionnaire accompanied by a discussion with the teacher. The questionnaire contained questions regarding the teacher's knowledge of critical thinking, the availability of critical thinking instruments, and their implementation in learning. Data analysis was carried out in a quantitative descriptive. The results of the study show that the teachers' knowledge of critical thinking is developing. The teacher also explained that it is crucial for students to have critical thinking skills so that measurements need to be taken. The availability of instruments to measure critical thinking when viewed from the percentage of teachers who provide them is 70%. In its implementation, the teacher makes critical thinking questions sourced from the question bank, articles, and books. The questions prepared by the teacher are also able to measure critical thinking even though they do not yet cover all aspects of critical thinking. Based on the research results, it can be recommended that the development of critical thinking tests can be carried out by the aspects of critical thinking (basic clarification, bases for a decision, inference, advanced clarification, supposition and integration, and strategies and tactics) and in line with the material being studied at school.

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Introduction

One of the aims of formal education is to equip individuals to have critical thinking skills. This is also in line with the paradigm shift in education which is more process-oriented. Not only in the field of education, but today's society also requires critical thinking skills (Durnalı et al., 2019; Orakcı, 2020). The basis for his consideration is that we are currently in an era of an abundance of easily accessible information. As a consequence, sometimes this information is selectively intended only to support what they want to hear and see (Hernandez, 2017; Kwayu et al., 2021). One way to overcome this is by starting to understand the various ways of viewing, examining, and filtering information by using critical thinking skills. Critical thinking skills are one of the most current and essential issues in educational research and attract the attention of researchers (Huber & Kuncel, 2016).

The term critical thinking is more often translated as the ability to analyze arguments, predict potential consequences, develop strategies, find alternatives and appropriate ways to deal with situations, and make decisions (Alsaleh, 2020; Lai, 2011), about procedures, practices, and characters that include reflective thinking, reasonable and good (Ghanizadeh, 2017). The detailed conceptualization of critical thinking is an assessment of one thing through self-regulation to produce interpretation, analysis, evaluation, conclusions, and explanations. All of that is done with consideration of conceptual, methodological, criteria, or

contextual evidence that forms the basis of the assessment (Facione, 2015). Critical thinking skills refer to the ability to analyze arguments, claims, or evidence; judge or evaluate arguments; make decisions or solve problems; draw conclusions using various standard patterns of reasoning such as induction and deduction; predict; verbal reasoning; interpret and explain; identify assumptions; define terms; asking questions for clarification (Davies, 2014).

Looking at the starting point of the framework or aspects of critical thinking has been explained through Bloom's Taxonomy of learning objectives, which consists of evaluation, analysis, synthesis, and application. This taxonomy is identified as Bloom's higher-order thinking skills. Meanwhile, Facione (2015), identified aspects of critical thinking consisting of evaluation, analysis, inference, deductive reasoning, and inductive reasoning as key critical thinking skills. Ennis (2011) also describes several aspects of critical thinking, namely basic clarification, bases for a decision, inference, advanced clarification, supposition and integration, and strategies and tactics. Other aspects of critical thinking also include skills such as analysis, evaluation, and inference (Bezanilla et al., 2019).

The concept of critical thinking can be explained through several characteristics. First, aims to decide what to believe or what to do (D'Alessio et al., 2019). Second, it requires a person to try to meet competency and accuracy standards appropriate to that type of thinking (Bezanilla et al., 2019). Third, requires meeting relevant standards up to a certain threshold level (Murawski, 2014). Alsaleh (2020) underlines that critical thinking is considered a crucial thinking ability and one of the most important indicators of the quality of student learning. Furthermore, as part of higher-order thinking skills, critical thinking is the desired and fundamental result that students need to obtain to successfully fulfil expectations both at the individual and societal levels in today's world (Petek & Bedir, 2018). Despite the various definitions of critical thinking, there are key characteristics in critical thinking, namely cognitive skills that can be taught to students through various approaches (Bellaera et al., 2021).

The benefits of having critical thinking skills enable students to play a better role in today's modern era, become active learners, and contribute to students' real-life skills (Evens et al., 2013). These skills also assist students in making more accurate daily life decisions (Kerdsomboon & Boonsathirakul, 2021), improving language and presentation skills (Muhammadiyeva et al., 2020), and examining problems systematically (Akcao lu et al., 2022). By thinking critically, we can begin to question the information we are given and seek ways to understand truth and reality better. Awareness of the importance of critical thinking has grown in the context of education and life. A large number of studies conducted over the years have revealed the importance of having critical thinking skills (Chang & Yeh, 2021; Gurcay & Ferah, 2018; Kondakçi & Aydin, 2013; Liu & Pásztor, 2022).

Critical thinking is also considered one of the key skills highlighted in education policy in line with its growing importance in educational contexts (Calma & Davies, 2021; Orakcı, 2020). Teachers need to be equipped with critical thinking and use it to help students (Bellaera et al., 2021; Parra et al., 2021). The impact of critical thinking in the world of education is very broad. Holistically, the teacher is a determining factor for the critical thinking ability of the whole society. Teacher involvement in critical thinking increases the level of students' critical thinking. In the end, this will affect society as a whole because students are part of society. The use of critical thinking in society leads to effective problem-solving and decision-making for the good of society (Renatovna & Renatovna, 2021).

Information about students' critical thinking skills is necessary to be assessed. Assessment of critical thinking skills is carried out by the teacher in the learning process. Various ways can be done by the teacher to assess students' critical thinking skills. One of

them is using a test. Tests used to measure critical thinking have existed since 1941. The test developed by Watson & Glaser is the first test to directly measure critical thinking in the field of psychology. This test is known as the WGCTA, namely The Watson Glaser Critical Thinking Appraisal (O'Hare & Mcguinness, 2015). Another critical thinking test was developed by Facione and his colleagues. Facione and colleagues designed two standardized tests for critical thinking, namely The California Critical Thinking Skills Test (CCTST) and The California Critical Thinking Disposition Inventory (CCTDI) (Schuhfried, 2017). This existing critical thinking test is a standardized test for measuring critical thinking. Teachers can also develop critical thinking tests according to the material being studied by students. Teachers' understanding of critical thinking, the availability of critical thinking instruments, and the forms of their implementation in schools require further discussion. Therefore, this research aimed to investigate teachers' perceptions about the need to develop critical thinking tests from the point of view of teachers at the senior high school level.

Research Method

The research method used quantitative descriptive with involved twenty teachers from various high schools in Pekanbaru who taught classes X, XI, and XII. Determination of the sample using random sampling. Educators involved in the research have varied teaching experience ranging from 5 to 25 years. All educators were responsible for delivering Biology subjects in their respective schools. To find out perceptions about the need to develop critical thinking tests, educators were asked to fill out an opinion collection form or questionnaire and then participated in the discussion. This form consisted of three indicators; knowledge about critical thinking, availability of critical thinking instruments, and implementation of critical thinking. The data were analyzed descriptively to provide an overview of the potential for developing critical thinking tests. Descriptive descriptions are also supported by calculations through the percentage of responses given by the teacher when filling out the questionnaire. The percentage of the responses given by the teacher were grouped into four categories, namely Emerging (0-25), Developing (26-50), Proficient (51-75), and Exemplary (76-100).

Results and Discussion

The teacher's knowledge of critical thinking is related to the teacher's ability to develop critical thinking instruments. Assessment of critical thinking can be done by using a measuring instrument in the form of a test. This study examines the teacher's perception of the need to develop critical thinking tests. The teacher's knowledge of critical thinking skills can be seen in Figure 1.
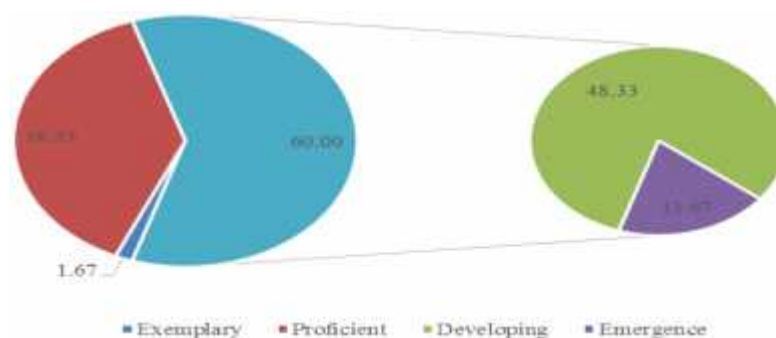

Figure 1. Teacher's Knowledge of Critical Thinking Skills

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The information presented in Figure 1 can be seen that the teacher's knowledge of critical thinking is developing, although it is still found that the teacher's knowledge of critical thinking is in the emergence category but the number only 11.67%. Teachers have heard or read about critical thinking. The good level of teacher knowledge of critical thinking is due to the easier it is to access information. The access to information that is getting easier in this era allows teachers to obtain information about critical thinking. Sources of information about critical thinking are obtained by teachers from various online seminars or conferences. Apart from going through seminars, teachers can also easily access a variety of information about critical thinking through scientific articles obtained online. The use of information technology causes access to knowledge and communication to no longer to be limited by space and time (Kwayu et al., 2021; Qi, 2018; Wei et al., 2018). In the world of education, the development of information and communication technology allows more information services to be used in educational applications, especially by teachers and students (Haldorai et al., 2021).

Searching for information through ICT allows teachers to be more flexible in increasing their knowledge. Based on the responses given by the teacher when filling out the questionnaire, the teachers had often heard or read about critical thinking. Complete teacher knowledge about critical thinking will assist teachers in improving students' critical thinking skills and developing appropriate tests or instruments to measure these critical thinking skills. To help students develop critical thinking skills, teachers need to have sufficient knowledge and understanding of critical thinking, and teachers must also see critical thinking as a systematic process that involves objectively questioning a problem from various perspectives (Kavanoz & Akba , 2017), Even Oner & Aggul, (2021) said that to foster critical thinking in their students, educators themselves must first become critical thinkers.

To support the data regarding this knowledge of critical thinking, it was also asked about the meaning of critical thinking understood by the teacher. Information regarding the various meanings of critical thinking understood by the teacher and the efforts made by the teacher for the emergence of critical thinking has been summarized in Table 1.

Table 1. The Meaning of Critical Thinking Understood by Teachers and Efforts to Encourage the Emergence of Critical Thinking

The Meaning of Critical Thinking	Efforts to Encourage the Emergence of Critical Thinking
The ability to think more clearly and more rationally about what students should do	Problem-based learning (EW)
Think critically/think hard	Responding to questions by analyzing facts for rational or reasonable judgment
The ability to think rationally about what to do and about making the best decision	Instruct students to ask more questions so that curiosity arises in students
A person's ability to think rationally by connecting his creative ideas with a logical mindset so that the best decision or conclusion is obtained.	Directing students with one or several problems encourages them to have curiosity and then be able to collect ideas or information so that problems can be solved logically
The ability of students to ask questions and then collect information to answer these questions	Applying opening question
The ability to use various types of reasoning (inductive, deductive, etc.) that are appropriate in everyday life	Applying inquiry learning models, discussion methods, and others
The ability to provide simple explanations, make initial explanations, and make integrations	Asking question

Ability to perform various analyses, assessments, evaluations, reconstructions, and decision making	Discussion activities

Teachers provide various meanings to explain their understanding of critical thinking including thinking more clearly and rationally, connecting creative ideas with logical mindsets, and using various reasoning. Some teachers include the terms think hard and think analytically. Teachers do give various descriptions, but all agree that critical thinking is not just remembering facts. One concept that is repeatedly described in teachers' understanding of critical thinking is being able to make decisions. Butler et al., (2017) also strengthen this explanation that critical thinking skills can predict actions to be taken by making decisions about what to believe and/or do (Kong et al., 2014). Various literature has explained in detail the definition of critical thinking (Alsaleh, 2020; D'Alessio et al., 2019), and the aspects contained in critical and technical thinking teach it to students (Bellaera et al., 2021).

The teacher's level of understanding of critical thinking can also be seen through the efforts made by the teacher to improve students' critical thinking. As shown in Table 2, there are various ways that teachers do to improve critical thinking including implementing learning that focuses on discussion and inquiry, and problem-based learning so that students are sparked with curiosity and open questions. Based on the information conveyed by the teacher, it can be said that the teacher has carried out various strategies in training students' critical thinking skills. There are various ways to improve students' critical thinking, including through learning that teaches them to deal with real-world problems (Seibert et al., 2021), encourages open class discussions (Zhang & Chen, 2020), and encourages inquiry-oriented experiments. All these things will provide excellent opportunities for the further development of critical thinking skills.

The teacher's knowledge of critical thinking will impact the teacher's efforts to provide instruments to measure critical thinking. In this study, we also asked about the need to measure critical thinking and the availability of critical thinking instruments. A recapitulation of this can be seen in Figure 2.
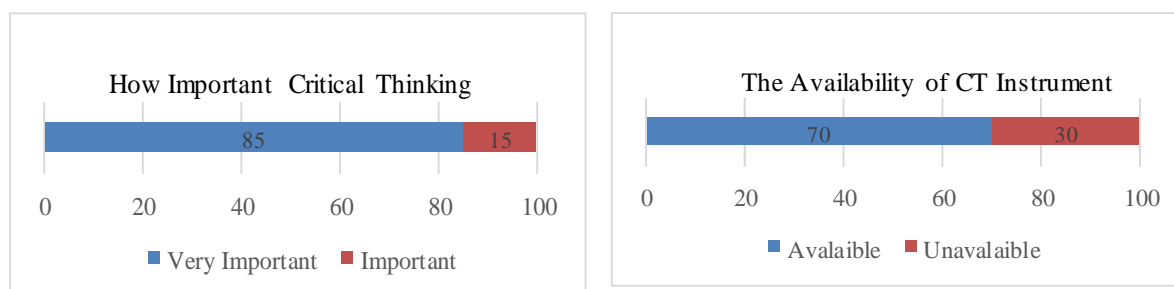

Figure 2. The Important of Critical Thinking and The Availability of Instruments

Teachers believe that critical thinking skills are very important for students and this can be seen from their answers shown in Figure 2, namely 85% said it was very important and 15% said it was important. Teachers also try to teach critical thinking skills, but they are not sure about how to assess critical thinking so in this study, it was found that 30% of teachers did not make instruments to assess critical thinking. The previous paragraphs that explain the teacher's critical thinking knowledge do not seem to be in line with the availability of instruments prepared by the teacher to measure critical thinking. For teachers who have not provided instruments to assess critical thinking due to several reasons. First, teachers understand the definition of critical thinking but they still don't understand what aspects must be in questions that are characterized by critical thinking. Another reason is that the teacher thinks that critical thinking questions can only be solved by students with the high

academic ability so it is feared that not all students can answer them. Research conducted by Schulz & FitzPatrick (2016) revealed that teachers show uncertainty about the meaning of higher-order thinking, and believe that they are not ready to teach or assess higher-order thinking.

The information presented in Figure 1 shows that there are 1.67% of teachers understand critical thinking because they have often heard or read information about critical thinking. Ideally, the teacher's high level of knowledge about CT will be implemented in the questions provided by the teacher to measure students' abilities. As an illustration of examples of critical thinking questions that have been made by the teacher, it can be seen in Table 2. Some teachers did not write down sample questions because they had never made questions to measure critical thinking.

Table 2. Examples of Critical Thinking Questions by the Teachers

No	Content	Examples of Critical Thinking Questions
1	Growth and development	In the process of photosynthesis, can it take place if sunlight is replaced with light? (AI)
2	Bacteria	What would happen if there were no bacteria on this earth? (DI)
3	Environment and microorganisms	Salsa is observing the types of microorganisms found in the pond water near her house. In his observations he found two types of microorganisms, namely: The first microorganisms were spherical, had a cell wall and contained DNA in the cytoplasm. The second microorganism is irregular in shape and has locomotion in the form of pseudopodia. Based on the above observations, it can be concluded that the two microorganisms are …. (PM)
4	Pollution and environmental change	The habit of throwing garbage in the river has become commonplace for people who live in river basins. What do you think the community has done? What will happen if the custom of the community continues to be carried out? (MK)
5	Catabolism and anabolism	How does the process of cellular respiration occur so that it can produce energy (catabolism) and how does the process of photosynthesis occur (anabolism) (SH)
6	Environmental changes	How do you respond to environmental problems in the articles that you shared? (RM)
7	Cell division	What do you think about our material at this meeting?(SY)
8	Animal cells and plant cells	Given pictures of animal cells and plant cells complete with their descriptions. From the picture above, explain the 3 differences between animal cells and plant cells! (ER)

Table 2 shows an example of a question made by the teacher to measure critical thinking. These examples of questions are appropriate for measuring critical thinking. For example, the teacher asks students to compare two organisms based on their characteristics, then determines the type of organism based on those characteristics. This form of question not only requires the ability to memorize but also requires the ability to determine the basis for decision-making. That is, students need to find the right source of information by paying attention to the credibility of the source of information Critical thinking is something

comprehensive because it includes the tendency and capacity to be reflective so that one can decide what to believe or do (D'Alessio et al., 2019; Lai, 2011).

Information obtained from the teacher that these critical thinking questions are arranged according to the learning objectives. The questions used by the teacher consist of multiple-choice questions and essays. When asked whether these questions were also adjusted to indicators of critical thinking, the teacher explained that they had not adjusted to indicators of critical thinking. The preparation of this question is more to the level of analysis. Critical thinking skills are not only related to the ability to analyze but also include other aspects or indicators. Some literature describes aspects of critical thinking. Some conceptualize it as reasoned argumentation (Kuhn, 1991 quoted from Liang & Fung, 2021), analyzing facts, generating and organizing ideas, defending opinions, making comparisons (Chance 1986 cited in Calma & Davies, 2021), argumentation active, logical reasoning, inference and evaluation of information in making value judgments, drawing conclusions, evaluating arguments and solving problems (Behar-Horenstein & Niu, 2011).

The examples of critical thinking questions in table 2 are indeed appropriate for measuring critical thinking, but there are also teachers who have not made or measured critical thinking in the learning process. The reason teachers have not measured critical thinking in the learning process is that they think critical thinking is something that is difficult and cannot be understood by students. Teachers are more focused on teaching content first and critical thinking is used as enrichment. Learning that encourages critical thinking can be done in two ways, namely intertwined or connected directly to the material or content, or explicitly, namely lessons specifically designed to provide guidance in certain critical thinking skills. The research results of Marin & Halpern (2011) show that explicit learning gives better results.

Teachers who have compiled critical thinking questions assume that CT needs to be owned by all students. Students need to master low-level thinking skills and higher-order thinking skills such as critical thinking. The emergence of the idea that critical thinking might also be able to be done by students with low academic achievement because critical thinking involves various abilities. All students have the opportunity to develop critical thinking skills and demonstrate them effectively in the learning process. Educators have a responsibility to assess students' abilities as critical thinkers through reliable learning practices (Liyanage et al., 2021).

Critical thinking is a competency that students need to have. The teacher's understanding of critical thinking determines the teacher's ability to prepare tests to measure critical thinking. The benefit of having a critical thinking allows students to play a better role in the current modern era, become active learners, and contribute to students real-life skills (Evens et al., 2013). By thinking critically, we can begin to question the information we are given and seek ways to better understand truth and reality. One of the most important indicators of the next quality of student learning, as part of high-level thinking skills, critical thinking is the desired and fundamental result that students need (Petek & Bedir, 2018).

Conclusion
The conclusion from the results of this research is that the teacher's knowledge of critical thinking is developing. Teachers have heard or read about critical thinking from online seminars or conferences, and articles. The teacher has made a critical thinking instrument even though it has not fulfilled all aspects of critical thinking. The form of the test developed by the teacher consists of multiple choice and essays. The teacher's perception of measuring

critical thinking is very important to do so it is necessary to provide a test to measure critical thinking.

Recommendation

Teachers have understood critical thinking and realized its important role in the learning process. In principle, teachers' knowledge of critical thinking will make it easier for them to develop critical thinking assessment instruments. By considering the significant role of critical thinking in student success and the demands of educators about the need to provide critical thinking tests, this study provides recommendations for developing critical thinking tests in accordance with the content or material in subjects at school.

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