Evaluation of critical thinking skills of class X high school students on the material of Newton’s laws

R Febriana¹* and P Sinaga²

¹Program Studi Pendidikan Fisika, Sekolah Pasca Sarjana, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No.229, Bandung, Indonesia
²Departemen Pendidikan Fisika, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

*ritafebrianafisika@gmail.com

Abstract. This study aims to determine of critical thinking skills of class X high school students in the material of Newton’s laws. The research subjects used 36 students consist of 18 male and 18 females with their average age 15 years old of class X at one of the high schools in Duri City. The research instrument used is the problem description which was constructed using indicators of critical thinking skills proposed by Ennis. Data analysis is based on the percentage of critical thinking skills. The results of total number of students, aspect of critical thinking skills providing simple explanations worth 49%, aspects of basic skills in making decisions, 39.5% of students were able to work on problems in skills Inference aspects worth 59.3%, aspects of advanced clarification skills worth 56.5%, and on aspects of strategy and tactic skills worth 57%. The results of these data indicate that students' critical thinking skills are still low. The results of this study can provide teachers as an educator with information and illustration about the condition of students' critical thinking skills. Teachers can make various efforts in improving students' critical thinking skills in accordance with the demands of the curriculum in the 21st century.

I. Introduction

This industrial revolution 4.0 era is a condition when all activities change significantly. The sophistication of technology and information is developing so rapidly. This revolution does not only affect the industrial development but also various fields including labor and the education system in the world [1]. The rapid development of the world must be accompanied by educational practices that are in accordance with the demands of the times. Educational Development in the era of the industrial revolution 4.0 is expected to be the right answer to the evolving human and technological needs [2]. Humans must be able to become a resource producing brilliant new ideas. Students must have critical thinking skills in receiving and checking the truth of information that comes from various sources.

Educational characteristics in the era of the industrial revolution 4.0 are characterized by (1) learning anytime and anywhere; (2) learning according to the abilities of each student; (3) choosing a way or style of self-study; (4) more emphasis on project-based learning; (5) real experience in the field; (6) able to describe and analyze written data and numbers; (7) student assessments are carried out in different ways; (8) consider students' opinions in designing curriculum; (9) mentoring becomes more important [3]. This educational feature emphasizes students to be more active, critical, creative, responsive, innovative, and able to compete in social life so as to produce people who have strong abilities and quality.
One of the skills that are highly needed in the 21st century so that students can contribute to society is critical thinking skills [4]. The 21st Century learning combines academic knowledge in the form of cognitive, psychomotor, and attitude with 4C skills (critical thinking, communication, collaboration, and creativity), all of which aim to develop the potential that exists in students [5].

Critical thinking can be interpreted as the ability to provide logical reasoning and reflective thinking centered on beliefs and behavior [6]. Reasoning is one of the most significant components in critical thinking [7]. Critical thinking prepares students to practice reasoning, analysis, and depth especially in learning science. The ability to think critically on students does not improve spontaneously; instead, awareness and practices are needed in order to have the ability to think critically in solving a problem. Students build their experience and knowledge actively with the assistance of the teacher as a facilitator. Through the process of critical thinking, students will be led to learn to organize abilities and strategies in solving a problem.

The demands of 21st century skills have slowly changed the education system in Indonesia. Schools and teachers are challenged to find and develop new forms of learning needed by students in facing global challenges so that later they have the competencies needed to face the 21st century. This is in line with curriculum demands, that the role of teachers in the 21st century is expected to shift from knowledge growers, towards the role of a guide, discussion director and gauge of student learning progress. However, physics learning processes are still found that are not in accordance with the demands of the curriculum so that the role has not been fully implemented as expected by the curriculum until nowadays.

Critical thinking skills are needed in processing all the information needed and obtained in the all-digital era. The validity of information can be criticized for making a decision. The ability to evaluate and then decide to use the correct information requires the ability to think critically [8]. The teacher's role is to guide and train students' thinking skills so that they do not only accept information directly, but can also act as users of good information [9]. The teacher must be able to create a learning atmosphere that can activate students during the learning process. To support such a thing, of course, it must be supported by appropriate and adequate learning tools.

Information gained from an interview with one of the physics teachers at Duri is that students' critical thinking skills were not guided well. Most of the students do not care in solving problems given by the teacher. Most students lack the courage to express ideas or opinions and questions in discussions, group work or during the learning process. Students find it difficult to ask at a high level so at the time of discussion tends to be quiet rather than asking questions. In addition, teachers also only use textbooks that are available either at home and at school, even though the textbooks are not yet orien to developing critical thinking skills in students. The teacher does not have a textbook that is suitable for measuring students' critical thinking skills.

Another problem that often occurs in the learning process is that most teachers still apply conventional learning and do not refer to students' critical thinking skills. The learning process has not facilitated students to develop concepts independently, teachers are less creative in using appropriate media and learning models so that the implementation of learning tends to be monotonous. The learning model or methods applied are usually lectures, discussions, and demonstrations. Such learning methods cannot involve and activate students in learning, and there are still many students who have not been able to cultivate their reasoning, questioning, and analysis skills. In addition, another factor that also affects students' critical thinking abilities is that learning that takes place in the classroom is still teacher-centered, making students only receive teacher information, thus causing learning activities in class to appear bored, and lack of enthusiasm.

The problems mentioned above can result in low critical thinking skills of students. Students are not able to solve and provide solutions to problems encountered. Sometimes students misinterpret learning concepts that result in less self-confidence. If in a prolonged period of time these problems continue to occur, the aim of education to produce students who are competent and skilled in solving problems in their daily lives in facing the challenges of the 21st century cannot be achieved.
The focus of the problem in this study is the evaluation of critical thinking skills of high school students. The purpose of this study is to determine the profile of students' critical thinking skills in Newton's law material using a test instrument adapted from Ennis. With this research, it is expected to contribute information and images to the teacher as an educator about the description of the condition of students' critical thinking skills, so that teachers can design teaching materials and make improvements in the quality of the learning process that can encourage students to train and develop their critical thinking skills.

2. Methods
This research uses a descriptive method with a quantitative approach. The research subjects used 36 students consist of 14 males and 22 females with their average age 15 years old of class X Academic Year 2019/2020 at one of the high schools in the City of Duri. The sampling technique in this study uses a simple random sampling technique which is a sampling technique where each element that forms a population is given the same opportunity to be selected as a sample.

The instrument used in this study was in the form of a critical thinking skills test set in the form of description questions with a total of 20 items. As for indicators measured is giving a basic explanation, basis for making decisions, inference, further clarification, strategy and tactic. The description items used are constructed using indicators based on indicators of critical thinking skills proposed by Ennis. The validity of the test instrument used in this study is the content validity by asking judgment from one expert lecturer to determine the suitability of the questions with the indicators as well as the answer keys and the language of the presentation of the questions. The reliability of the instrument used is by means of a single test that is given to the subjects in one implementation in the form of a test result score. After the score of the test results was calculated it turns out that from 20 items, 15 valid items are obtained. A valid problem is then analyzed based on this its reliability of the items with the reliability coefficient values being in the sufficient category.

The data that has been collected is then processed and analyzed using descriptive analysis techniques based on the percentage of students who answer correctly or incorrectly from the critical thinking skills test given. The percentage value calculation is as follows:

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\text{Percentage value} = \frac{\text{(acquisition score)}}{\text{(maximum score)}} \times 100\% \quad (1)
\]

Then the percentage value of critical thinking skills obtained is interpreted using the category.

3. Result and Discussion
Based on the results of the analysis and calculation that has been done, the average percentage of scores obtained from the critical thinking skills of 36 students is as follows:

![Figure 1. The percentage of the average scores of overall values of student’s critical thinking skills](image-url)
From Figure 1 above, it can be seen that in general the average scores of students' critical thinking skills are in the low category. There are no students whose critical thinking skills are in the very high category. 5.56% students, critical thinking skills are in the high category, 16.67% students, critical thinking skills are in the medium category, and 5.56% students, skills critical thinking is in the very low category. The low critical thinking skills of students can be seen in their inability to solve and solve physical problems both problems found in daily life or physics problems in the form of problems. Most students are not familiar with solving problems by presenting facts in detail from the problem.

The low ability of students' critical thinking skills can also be caused by other factors, including the selection of learning strategies or methods that are less precise so that the habit of training students to develop critical thinking skills is not implemented in the learning process. The teacher does not have the skills in making teaching materials that can improve students' critical thinking skills. Consequently, the teacher only uses textbooks in school that only measure the students' critical thinking skills.

The average results of each aspect of indicators of students' critical thinking can be seen in the following figure 2:

According to the information from the figure 2 above about the critical thinking, it is known that from the total number of students, 49% of students can work on problems in the aspects of critical thinking skills providing simple or basic explanations, 59.3% of students can work on problems in aspects of critical thinking skills, namely the basic in making decisions or support, 39.5% of students can work on questions on aspects of critical thinking skills Inference, 56.5% of students can work on questions on aspects of critical thinking skills further clarification, and 57% of students can work on problems on aspects of critical thinking skills strategy and tactics. The results of these data indicate that students' critical thinking skills are still low. This means that there are many students who have not mastered the ability to think critically well.

Based on figure 2, it can be seen that in the third aspect, for the indicator of inference, most students are in the very low category. In this case most students are not accustomed to deducing and educating the logic of thinking in answering the problems presented. Most students in the first aspect of the indicator, giving a simple explanation, are also in the low category. This is possible because students are not accustomed to asking and expressing their opinions during the learning process so that students have difficulty when face questions that ask for an explanation. The fourth aspect of the indicator of further clarification is that the average student is in the low category. Students are unable to analyze reasons that are not stated in the problem. This is because learning is often limited to the lecture method, so students only hear what is conveyed by the teacher. The second and fifth indicator aspects are also in the low category. This is because students are rarely involved in thinking and developing their mindset in making decisions or conclusions during the learning process.
Critical thinking skills require students' abilities to make their thinking patterns broader than students' learning experiences. The use of teaching models, media and learning resources that contain information and phenomena that occur in everyday life will provide opportunities for students to be able to explore their critical thinking skills deeper. With this kind of learning, students are expected to be accustomed to using their reasoning power so that they can become equipped in socializing in society and produce graduates who are able to face challenges in the 21st century. This is in line with previous research conducted by applying the OR-IPA teaching Model developed to improve the critical thinking skills of student high school [10].

4. Conclusion
Based on the results of the data analysis and discussion, it can be concluded that the critical thinking skills of Mandau 3 High School students in Bengkalis Regency are still relatively low. This is indicated by the results of students' critical thinking skills tests. The results of this study can provide teachers as an educator with information and illustration about the condition of students' critical thinking skills.

Teachers can make various efforts in improving students' critical thinking skills in accordance with the demands of the curriculum in the 21st century. Some of these efforts are through learning innovations. Replacing old learning methods in the form of lectures with appropriate learning models applied in the learning process in an effort to improve students' critical thinking skills, among others (1) Problem-based learning; (2) inquiry learning models; (3) Contextual learning; (4) Learning cycle; (5) problem-based learning model, and so forth. These learning models will provide learning experiences for students in developing critical thinking skills.

Teachers should also be able to design learning strategies, learning resources, and teaching materials and improve the quality of the learning process. Teachers should be able to innovate in selecting and determining learning strategies in schools that are appropriate and can develop resources and teaching materials that are able to improve students' critical thinking skills to train and develop their critical thinking skills.

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