

# Critical Thinking Analysis of Rigid Body Equilibrium During the COVID-19 Pandemic

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## ABSTRACT

These skills are ways of thinking that help you make the decisions necessary to live in the 21st century. The purpose of this study was to analyze the effectiveness of critical thinking on rigid body equilibrium during this pandemic, student learning outcomes, student responses, student activities, and barriers during the study. This type of research is in the form of library research with a number of journals that can be accounted for related to learning during the COVID-19 pandemic and critical thinking skills. Using the root cause analysis method, to find out what are the root causes of learning disorders during the pandemic. The search results show that training students' critical thinking skills by using rigid body equilibrium is effective. With learning, every student can overcome the COVID-19 pandemic and improve student learning outcomes.

**Keywords:** *Critical thinking skills, COVID-19 pandemic, Root cause analysis.*

## 1. INTRODUCTION

One form of long-term investment that is important for everyone is education [1]. Education is a process that never stops, because it will produce sustainable quality to be aimed at how one's future is and in accordance with cultural and Pancasila values [2]. The 21st century is known as the age of knowledge. Education is expected to be able to prepare the golden generation both through innovation and revolution [3]. This agrees with Ikuenobe (2001) which states that 21st century learning requires students to be skilled, one of which we are currently making for research. [4].

Critical thinking means having the ability to use focus to make decisions about what to believe and what to do. [5]. Critical thinking skills that are expected are students trying to think logically in understanding and making difficult choices, and trying to solve the problems they face independently, compiling, expressing, analyzing and solving problems [6]. Training students to think critically in this pandemic period online, will require more focus than learning in class.

Now, in Indonesia even the world has been infected with COVID-19. This causes interaction to be limited, called the physical distancing policy, which affected

various fields including education [7]. The physical distancing policy has finally created the implementation of learning from home, with the help of information technology [8]. This time, students feel tired & bored because they are online (in the network). These inhibiting factors include not all students have smartphone & there are still many parents who are busy working so that online learning is less effective [9].

But several studies have shown that learning physics can be done online using PBL-STEM in the COVID-19 Pandemic era, and it has been proven effective in using PBL-STEM and has also received positive responses from students by giving excellent assessments [10]. The results of other research are the results that in the virtual classroom google classroom has been effective so that it is used as a learning application in the virtual classroom, but google classroom in learning physics is still less effective. If it is concluded that learning physics still requires teachers directly for their students. [11].

Although learning during this pandemic has several obstacles, what is used in this research is expected students to try to think about criticizing problems that exist real world help teachers in virtual classes. Based on the description above, the researcher needs a more detailed study with the title "Critical Thinking Analysis

of Rigid Body Equilibrium during the COVID-19 Pandemic”.

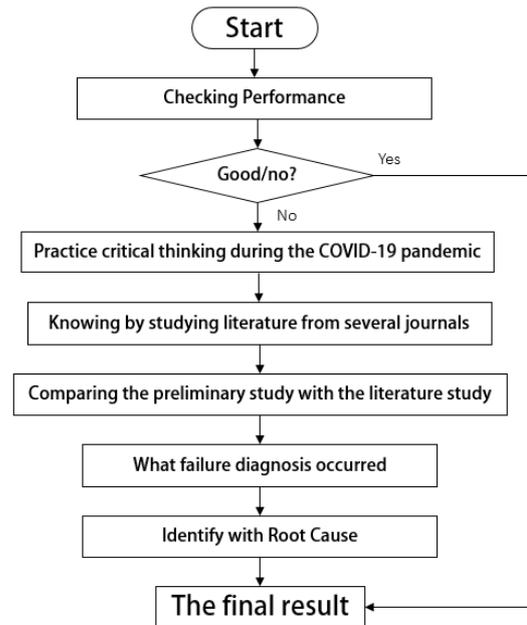
**2. METHODS**

Selecting a research method used is literature study, namely by investigating the need for analytical concepts that allow us to find our way through a large number of materials that are potential study subjects [12]. The sources used in this research are a number of journals related to critical thinking skills in COVID-19 pandemic. All data in this study are secondary data. Secondary data is data obtained indirectly or through intermediaries, usually obtained from various sources such as journals, books, and archives [13]. Qualitative data analysis techniques were used in data analysis. According to Miles and Huberman, there are 3 qualitative data analysis techniques, namely reducing data, presenting data, and drawing conclusions [14].

The sources used as references are sources in the field of education, which are related to critical thinking skills and learning during the COVID-19 pandemic. There are no specific criteria in choosing a journal but it is better to look for journals that match my research, look for reputable international journals and reputable national journals. Belows are 10 journal sources that are used as references:

1. IOP Conf. Series Journal of Physics
2. Physical Review Special Topics – Physics Education Research
3. Journal of Physics Education Forum
4. SAGE Journals - Active Learning in Higher Education
5. Indonesian Journal of Science & Technology
6. Scientific Journal of Education Horizon
7. Unnes Physics Education Journal
8. Journal of Education (Theory and Practice)
9. Journal of Science Education Research (JPPS)
10. Journal of Madrasah Education

I use the journal above because it fits my research needs and includes the above criteria. The analytical method used is the root cause analysis (RCA) method, which is part of several event factors that contribute, or give rise to possible causes and are followed by unexpected consequences [15]. The root cause analysis (RCA) chart is explained below:



**Figure 1** Root Cause Analysis Flowchart.

By analyzing the critical thinking skills of the rigid body equilibrium during the COVID-19 pandemic in accordance with the predetermined analytical process, to produce critical thinking skills during the COVID-19 pandemic, to show learning problems that occur during the pandemic due to definite obstacles occurs when there is a new learning system. Therefore, online learning plays an important role here and saves the analysis parameters according to the literature study. As a result, preliminary data are compared with literature studies to determine their effectiveness. Thus, we make better solutions through more information and more rigorous analysis of the sensitivity of the process and any failures that occur.

The standard of critical thinking ability in this study is Critical Standard Thinking according to Facione. Facione stated that in critical thinking skills there are cognitive abilities and affective dispositions. Interpretation, analysis, evaluation, conclusion, explaining, and self-regulation are cognitive abilities. While the affective disposition is systematic, curious, wise, truth-seeking, analytical, open-minded, and confident in thinking. [16].

**3. RESULTS AND DISCUSSION**

The use of online learning as an alternative step to break the chain of transmission of the COVID-19 virus in learning during this pandemic continues. In the world, the internet is used as a benchmark in this 4.0 industrial revolution. Learning with a rigid body equilibrium to train critical thinking through the use of pre-test questions conducted using the PBL method. This means that every student must be able to understand the video

problem. Then discuss to find tools to solve problems in the video. Conduct investigations for group discussions to find solutions. After finding a solution, it is presented. A problem can be described as a difficulty that we face when faced with a problem that cannot be solved. This skill is a form of critical thinking that enhances intelligent abilities. To rank critical thinking criteria, a detailed description of these skills is required. The following is a basic overview of critical thinking skills in cognitive skills:

1. Interpretation: A person is able to understand and express the meaning or importance of various situations, data, experiences, events, judgments, beliefs, rules.
2. Analysis : A person can recognize the relationship between statements, questions, concepts, descriptions, or other forms of representation that have been concluded to prove beliefs, information, opinions or other reasons, experiences, reasons, information, or opinions.
3. Evaluation: One can judge the validity of a statement based on one's perception, situation, experience, judgment, belief, or opinion; other relationships between statements, descriptions, questions, or others

4. Conclude: One can identify information to draw reasonable conclusions; may consider permanent data information, statements of principles, beliefs, evidence, judgments, opinions, descriptions, concepts, questions, or others
5. Explain: One can state the result of his reasoning; in terms of the historical, methodological, conceptual, critical, contextual basis considerations from which the results are obtained; and can convey one's reasoning in the form of convincing arguments.

Below is a Table 1 to facilitate journal analysis of critical thinking, rigid body equilibrium, and learning relationships during the COVID-19 pandemic.

**Table 1.** Analysis of the relationship between learning journals during the COVID-19 pandemic, rigid body equilibrium and critical thinking skills

Journal Source	Review Journal
PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH 17, 010117 (2021) [17]	<i>Title:</i> Studying physics during the COVID-19 pandemi: Student assessments of learning achievement, perceived effectiveness of online recitations, and online laboratories <i>Authors:</i> P. Klein, L. Ivanjek, M. N. Dahlkemper , K. Jeličić , M.-A. Geyer, S. Küchemann, and A. Susac <i>Journal Results:</i> Significantly, this COVID-19 pandemic is affecting education around the world, which are forced to turn to distance learning. Distribution of questionnaires to 578 physics students. The relationship between student self-efficacy assessments and behavioral measures of self-study skills is due to this correlation. <i>Study Results:</i> The multidimensional questionnaire had satisfactory results on its psychometric properties. During the COVID-19 pandemic in physics courses there is this information
IOP Publishing WEAST 2020 Journal of Physics: Conference Series 1899 (2021) 012178 [18]	<i>Title:</i> Student's Learning Motivation and Interest; The Effectiveness of Online Learning during COVID-19 Pandemic <i>Authors:</i> Zaenol Fajri, Hasan Baharun, Chusnul Muali, Shofiatun, Lilik Farida, & Yulis Wahyuningtiyas <i>Journal Results:</i> Educators and students use online learning as a learning solution during the COVID-19 pandemic. Nurul Jadid University students use zoom meetings as an alternative to traditional classroom activities.. <i>Study Results:</i> The Zoom Cloud conferencing application is proven to be effective for online learning, motivating students to learn and becoming more interested in learning..
IOP Publishing. International Conference on Science and Technology 2019 Journal of Physics: Conference Series 1569 (2020) 042065 [19]	<i>Title:</i> Online-based Learning to Train Students Critical Thinking in Physics Teacher Training Programs <i>Authors:</i> R Kustijono and SR Hakim <i>Journal Results:</i> Aspects of online physics learning techniques received a good response from students, because it can be operated anytime and anywhere. And encourage students to practice critical thinking. <i>Study Results:</i> In the physics training program, online learning is proven to be effective and can train critical thinking skills. And received a very positive response.

Journal Source	Review Journal
Journal of Physics Education Forum (2018) Vol.3 No.2 : 25-30 [20]	<p><i>Title:</i> Application of Project-Based Learning to Improve Scientific Creative Thinking Skills and Scientific Critical Thinking of High School Students on Rigid Body Equilibrium Material</p> <p><i>Authors:</i> Ida Rachmawati, Selly Feranie, Parlindungan Sinaga, Duden Saepuzaman</p> <p><i>Journal Results:</i> After the project was completed, students analyzed the pre-test and post-test data to determine the improvement of creative thinking and critical thinking skills.</p> <p><i>Study Results:</i> This project helps improve creative thinking and critical thinking skills..</p>
SAGE Journals Active Learning in Higher Education 2019, Vol. 20(1) 25–37 [21]	<p><i>Title:</i> The effects of collaborative testing on higher order thinking: Do the bright get brighter?</p> <p><i>Authors:</i> John W Mahoney and Brooke Harris-Reeves</p> <p><i>Journal Results:</i> On higher order thinking questions, overall students performed better under the conditions of collaborative submission. When comparing the various academic abilities of students, it is expected that these differences will be the same.</p> <p><i>Study Results:</i> In general, through collaborative tests, students perform better in higher order thinking problems.</p>
Indonesian Journal of Science & Technology, Volume 5 Issue 2, 2020 (283-298) [22]	<p><i>Title:</i> An Instructional Design for Online Learning in Vocational Education according to a Self-Regulated Learning Framework for Problem Solving during the CoVID-19 Crisis</p> <p><i>Author:</i> Thorsporn Sangsawang</p> <p><i>Journal Results:</i> The facilities for this research activity use multimedia games for SRL-based critical thinking activities supported by academic achievement tests and questionnaires during the COVID-19 crisis.</p> <p><i>Study Results:</i> It is proven that the post test has higher results than the pretest, so this method can effectively improve student achievement.</p>
Educational Horizon, Vol. 38, No. 3, October 2019 (511-526) [23]	<p><i>Title:</i> Can Argument-Driven Inquiry Models Have Impact On Critical Thinking Skills For Students With Different personality Types?</p> <p><i>Authors:</i> Invite Rosidin, Nina Kadaritna, Neni Hasnunidah</p> <p><i>Journal Results:</i> All male and female students can accommodate the ADI model with many types of personality because it does not show too much difference.</p> <p><i>Study Results:</i> It is proven that the overall ADI model can improve students' critical thinking.</p>
Unnes Physics Education Journal 8 (3) (2019) ISSN 2252-6935, 248-253 [24]	<p><i>Judul:</i> The Effectiveness of STEM-Based Worksheets (Science, Technology, Engineering and Mathematics) to Train Students' Critical Thinking Skills in High School Physics Learning</p> <p><i>Author:</i> Slamet Harjo Santoso, and Mosik Mosik</p> <p><i>Journal Results:</i> STEM-based worksheets for students' critical thinking have a moderate effect, by measuring pre-test and post-test questions.</p> <p><i>Study Results:</i> Learning with STEM LKS assistance is included in the profile of critical thinking skills because it increases.</p>
Journal of Education (Theory and Practice) Volume 3 Nomor 1 Tahun 2018 Halaman: 38-44 e-ISSN: 2527-6891 [25]	<p><i>Title:</i> Development of Project Based Learning-Based Temperature and Heat Module To Improve Science Process Skills And Critical Thinking Skills For High School Students</p> <p><i>Authors:</i> Izzatul Hasanah, Sarwanto, Mohammad Masykuri</p> <p><i>Journal Results:</i> Project-based training with modules on the physics of temperature and heat of materials aims to determine the module's ability to determine its effectiveness.</p> <p><i>Study Result:</i> The material on temperature and heat in the project based learning module is proven to be effective in improving science process skills and critical thinking.</p>
JPPS (Journal of Science Education Research),5(1), 802-810 [26]	<p><i>Title:</i> Development Learning Tools Physics Problem Based Learning Model To Train Students Critical Thinking Skills;</p> <p><i>Authors:</i> Sulardi, Mohamad Nur, Wahono Widodo</p> <p><i>Journal Results:</i> It is proven that all students experience an increase in critical thinking in the PBL model of physics in terms of validity, practicality and effectiveness on the material of rotational dynamics of rigid bodies and center of gravity.</p> <p><i>Study Results:</i> The PBL model with physics learning tools is proven to be valid, practical and effective for critical thinking.</p>

Journal Source	Review Journal
Journal of Madrasah Education, 5(2), 187-194. [27]	<p><i>Title:</i> Effectiveness Learning Brave in Subjects Science in the Pandemic Covid-19: Comparative Study Learning Offline and Online on Students Science Junior High School</p> <p><i>Author:</i> Anita Ekantini</p> <p><i>Journal Results:</i> For teachers it is very useful to develop simple projects with online learning science. Students will be helped to make it easier to understand natural phenomena and think with their own knowledge.</p> <p><i>Study Results:</i> Offline science learning is not effective, so there are differences in science learning outcomes.</p>

Based on Table 1, it can be stated that online learning during the COVID-19 pandemic can be declared effective. It has been found by previous research that online learning and practicing critical thinking skills have the same impact as previous research. This is in accordance with other studies, namely the use of whatsapp and google forms proved to be effective and can facilitate during the learning process [28]. From this analysis, it is also known that the results of other studies, namely the overall critical thinking ability of students have a percentage of 41.17% in the medium category [29]. You can also use the Zoom meeting app in the cloud, which can enhance student learning outcomes in physics learning, through this zoom cloud meetings application, students are proven to have increased activity. From the 3 relevant studies, online learning to the fullest will make students' critical thinking skills even more optimal. So that learning will be more effective as well.

#### 4. CONCLUSION

The results of the study show that learning at during the COVID-19 pandemic could effectively train critical thinking skills in rigid body equilibrium material in cognitive abilities in the form of interpretation, analysis, evaluation, conclusion, and explanation. It should be noted that the explanation of each critical thinking skill criterion used by the researcher and the journal being studied is different, thus allowing for inaccuracies in the analysis. Researchers hope that there will be other research with the subject of practicing critical thinking skills during the COVID-19 pandemic.

#### AUTHORS' CONTRIBUTIONS

All the authors have designed this study together. All authors contributed to the revision of the manuscript. The scriptwriter has completed the final version.

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