Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 12, 1551-1557

Measurement Of Students' Critical Thinking Skills In Solving Contextual Problems Of Spherical Triangles In Maritime Academic

Ari Sriantini[1], Mega Teguh Budiarto[2], Abadi[3]

[1]Postgraduate Program in Mathematics Education, Universitas Negeri Surabaya, Surabaya , East Java, Indonesia
[2]Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya, Surabaya, East Java, Indonesia
[3] Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya, Surabaya, East Java, Indonesia
Email: ari.21008@mhs.unesa.ac.id

Abstract

Background and Objective:
Critical thinking is a 21st-century skill, so students must think critically in facing global competition. This is a challenge for higher education, including shipping colleges. Critical thinking requires a person to think rationally and logically in making decisions. Critical thinking skills are a process of Interpretation, analysis, inference, and evaluation. Therefore, students need to be trained to have essential by relating the material being studied to contextual problems. Contextual problems are problems related to students' daily life, namely the shipping field.

Method:
This research is descriptive research with a quantitative approach. Semester I students for the 2022/2023 academic year Ship Operations Engineering Technology Study Program, totaling 21 students as subjects in this study. The data collection method used a critical thinking skills test, and the questions tested were declared valid with $r_{xy} = 0.871 > r_{table} = 0.413$. In comparison, the data analysis technique uses percentages.

Results:
The research results are the results of measuring students' critical thinking skills in solving spherical triangle contextual problems. Students' skills in Interpretation are known to be shallow, with a percentage of 42.85%. On the analysis indicators, it is also in the low category, with a rate of 50.59%. In comparison, the evaluation and inference indicators are high, with the respective percentages being 75.79% and 80.15%.

Keywords:
Measurement, Critical thinking skills, Spherical Triangle, Contextual Problems

Introduction

One of the 21st-century skills that every student must have is critical thinking. As in (The Partnership for 21st Century Learning, 2015) that 21st-century skills include: (1) critical thinking and problem solving, 2) communicating and collaborating, and (3) creativity and innovation. Ennis (2011)states that critical thinking is 'critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do.' Critical thinking is also a metacognitive process through reflective assessment of self-regulation

aimed at analysis, evaluation, and conclusion skills (Dwyer & Walsh, 2020**).** Besides that, critical thinking will direct students to carry out the process of analysis, evaluation, and synthesis in solving mathematical problems (Sumarna & Herman, 2017), routine and non-routine problems.

Someone with critical thinking has skills in interpreting and solving problems. Facione (2011) said that critical thinking skills are a process of Interpretation, analyzing, making conclusions, evaluating, explaining, and self-regulation. In the process of Interpretation, analysis, evaluation, and conclusion, all of them aim to solve the problem. Glaser(in Zulmaulida, Wahyudin, & Dahlan, 2018)states that critical thinking involves several things, namely: (1) a wise attitude in considering problems', (2) 'knowledge of the logical investigation,' (3) 'skills in applying the methods of critical thinking.' Critical thinking also requires a person to have a wise attitude in considering the problem at hand by conducting an investigation using his critical skills. Critical thinking is an active and skilled process of conceptualizing, applying, analyzing, synthesizing, and evaluating information to conclude (Angelo, 1995).

From various arguments, it can be concluded that critical thinking is a skill to review and analyze certain information, identify evidence, identify assumptions, and apply multiple strategies to conclusions based on assessment standards (Angelo, 1995; Ennis, 2011; Peter a. Facione, 2011; Watson & Glaser, 2008).

Problems with real contexts in experience are usually called contextual problems (Gravemeijer & Doorman, 1999). The problems can be a basis for linking informal and formal mathematical knowledge. Contextual problems associated with learning materials in class can increase student motivation in learning and interest in a subject because students will have an idea of the problems encountered in the work world. Thus, making the material studied more meaningful for students. Contextual problems can foster students' critical thinking skills because they make students relate the material they have learned to the context of everyday life(Kurnia & Caswita, 2020). Spherical triangle problems, which are often encountered in the field of shipping, include determining the sailing distance, the ship's bow, and the coordinates of the ship's position at sea. Contextual problems improve critical thinking skills(Lestari, Ahmadi, & Rochmad, 2021).

Critical thinking is reasoning and makes sense in assessing something. Before a decision is taken, collecting as much data as possible related to the problem at hand is necessary. Critical thinking skills in solving problems are closely associated with critical thinking indicators. Facione (2011) said that there are six critical thinking skills, namely:

(1) Interpretation

Interpretation is a skill in uncovering the meaning of various information, data, events, arguments, rules, criteria, and procedures, which is demonstrated by the ability to write down what is known and what is asked.

(2) Analysis

An analysis is defined as a skill in identifying inferential and actual relationships between statements, concept descriptions, and other representations that aim to uncover arguments, beliefs, and reasons.

(3) Evaluation

Evaluation is defined as skills in assessing the truth of a statement or representation, a report or hypothesis, and a situation.

(4) Inferences

The inference is defined as a skill in identifying and obtaining the elements needed to draw logical conclusions, make assumptions, and hypotheses, consider

related information and draw conclusions from the arguments or news brought.

Apart from Interpretation, evaluation, analysis, and making conclusions, there are two more skills delivered by Facione (2011), namely explanation and self-regulation. Between explanation and self-regulation, both contain the meaning of explaining what they think and how they arrive at the conclusion stage that has been obtained at the time of inference.

This preliminary study measures students' critical thinking skills in solving spherical triangle contextual problems. The spherical triangle material is one of the materials in applied mathematics courses that students of the Ship Operations Engineering Technology Study Program must understand. Research instruments were designed following the purpose of the study. Knowing critical thinking skills will make it easier for lecturers to develop lectures and determine the right strategy to improve student abilities.

Methodology

Research subject

The subjects of this study were first-semester students of the Ship Operations Engineering Technology Study Program at Hang Tuah University in Surabaya, East Java Province, Indonesia. The issues amounted to 21 students. The students in the first semester of the Engineering Technology Study Program were chosen because these students received an applied mathematics course in which there was material on spherical triangles. The spherical triangle material studied by students of the Ship Operations Engineering Technology Study Program is related to the shipping field, a contextual problem for students of Ship Operations Engineering Technology.

Types of research

This research uses a descriptive method with a quantitative approach. The data collection technique uses purposive sampling, and the data collection method uses critical thinking skills tests.

Instruments

The researcher developed the critical thinking skills test items used. The written test is in the form of a description test consisting of one thing. The test items cover the spherical triangle contextual problems in the shipping field. The given issues are determining the distance in the voyage from the port of departure to the port of destination, determining the bow of the ship, and determining the estimated time of arrival at the port.

The questions to be tested are validated first. Content validation was carried out by two lecturers, one mathematics lecturer and one marine science lecturer. Content validation includes the suitability of the test items with the material being taught, the use of sound and correct Indonesian, not using ambiguous sentences, and the suitability of the items with completion indicators. Furthermore, revisions were carried out according to expert advice. After the instrument is declared valid, the tool is tested. The validity of the test instrument in the form of an essay is measured using the Pearson Product Moment formula. The test results obtained r_{xy} = 0.871 and r_{table} = 0.413. Because $r_{xy} > r_{table}$, the question is declared valid. Then, the test questions were tested for reliability. The reliability test is measured using the Cronbach Alpha formula and displayed as reliable with a reliability coefficient of 0.838. The test results are then scored based on the rubric developed based on the indicators of critical thinking skills used in this study—the adaptation scoring rubric (P.a. Facione & Facione, 1994).

Indicators of students' critical thinking skills are shown in table 1 below:

Table 1. Critical Thinking Skills Indicators

Indicator	**Sub-Indicators**
Interpretation	Understand the problem indicated by correctly writing down what is known and what is asked in the question.
Analysis	Identify the relationship between statements and the facts in the questions by making the correct mathematical model and providing the correct explanation.
Evaluation	Using the right strategy in solving problems completely and correctly in doing calculations
Inferences	Make conclusions using sentences that are clear and follow the problem.

Facione Adaptation (2011)

The test results are then analyzed using the formula:

$$\text{Persentase} = \frac{\text{Skor yang diperoleh}}{\text{Skor maksimal}} \text{x } 100\%$$

The percentage value of critical thinking skills obtained from the calculation is then categorized according to table 2 below (Setyowati & Subali, 2011):

Table 2. Percentage Category of Critical Thinking Skills

Interpretation	**Category**
$81.25 < X \leq 100$	Very high
$71.5 < X \leq 81.25$	High
$62.5 < X \leq 71.5$	Moderate
$43.75 < X \leq 62.5$	Low
$0 < X \leq 43.75$	Very low

RESULTS AND DISCUSSION

The questions tested on students follow the research objectives: measuring students' critical thinking skills in solving spherical triangle contextual problems. Twenty-one students were working on the test questions. Furthermore, the test results are scored by referring to the scoring rubric of critical thinking skills. The test results that have been achieved are then calculated as a percentage for each indicator and interpreted based on the category (Setyowati & Subali, 2011).

The recapitulation results of students' critical thinking skills tests for each indicator are shown in table 3 as follows:

Table 3. Recapitulation of Student Critical Thinking Skills Test Results per Indicator

Indicator	**Percentage (%)**	**Category**
Interpretation	42.85	Very low
Analysis	50,59	Low
Evaluation	75,79	High

Inferences	80,16	High

Table 3 shows that classically, students' critical thinking skills per indicator are spread into three categories: very low, low, and high. The interpretation indicator is included in the very low category with a presentation of 42%. Shows that the skills of the Ship Operations Engineering Study Program students in interpreting problems are still shallow. Of the 21 students who took the test, the interpretation indicator obtained a total score of 72. The maximum score on the interpretation indicator should have been 168. Shallow student skills in interpreting the problems given because many students did not write down what was known or what was asked in the questions in detail. Complete and precise. However, some students only write down what is known or what is asked correctly, so they get a low score too.

The total score obtained from 21 students on the analysis indicator is 85, and the maximum score on the analysis indicator is 168. So, if divided between the total and top scores and multiplied by 100%, you will get a percentage of 50.59%. If interpreted using the category table of critical thinking skills, this is classified as low. They define that students' skills in analyzing problems are still low. This soft analytical skill is because many students do not make a mathematical model of the situation given correctly. Even though several students made mathematical models, the model was not transparent and did not fit the problem.

Student skills in evaluating problems are relatively high, with a percentage of 75.79%. Shows that students are skilled in conducting evaluations. The high skill of students in assessing is because students have begun to be competent in determining the right strategy for solving problems. Even though some students choose methods that are not appropriate and unclear, this is a small percentage.

Students' skills in concluding are high, with a percentage of 80.16%. A define that students are skilled in making appropriate conclusions under their problems. Students mastery in making conclusions is shown by the ability of students to make conclusions in clear and precise language and by following the situation. However, some students get low scores on this indicator because the written findings do not follow the problem and are inappropriate.

The interpretation indicator is classified as very low. This is because many students still make mistakes and do not know what is known and what is being asked. The unskilled students in writing down what is known and what is asked are caused because students do not understand the problem given. This is because the given issues involve contextual problems, so students need a long time to understand the problems. As stated by (Ismail, Muhammad, Kanesan, & Ali, 2019), critical thinking skills can be hampered due to lack of practice, time allotted, and wrong views of subjects.

The analysis indicator is in a low category, which shows that students cannot determine the mathematical model correctly. The problem is contextual, so the solution requires an appropriate mathematical model. Contextual issues can motivate students to connect mathematical concepts (Reinke, 2020). In addition, non-routine and contextual questions can improve students' critical thinking skills (Lestari et al., 2021). However, many students still cannot recognize the problem and determine the right mathematical model to solve the given situation. Thus, there is a need for continuous training by providing problems related to contextual issues, especially those related to shipping.

CONCLUSION

Based on data analysis, the results obtained from measuring students' critical thinking skills in solving contextual problems of spherical triangles in the field of shipping, classically, the interpretation indicator is included in the very low category, with a percentage of 42.85%. The analysis indicator is classified as low, with a rate of 50.59%. The evaluation and inference indicators are included in the high category, with percentages of 75.79% and 80.16%.

REFERENCE

Angelo, T. A. (1995). Beginning the Dialogue: Thoughts on Promoting Critical Thinking. Classroom Assessment for Critical Thinking. Teaching of Psychology, 22(1), 6–7.

Dwyer, C. P., & Walsh, A. (2020). An exploratory quantitative case study of critical thinking development through adult distance learning. Educational Technology Research and Development, 68(1), 17–35. https://doi.org/10.1007/s11423-019-09659-2

Ennis, R. H. (2011). The Nature of Critical Thinking : An Outline of Critical Thinking Dispositions. 1–8.

Facione, P.a., & Facione, N. C. (1994). Holistic critical thinking scoring rubric. Retrieved July, 19, 2007. Retrieved from http://aacu-secure.nisgroup.com/meetings/pdfs/critical thinkingrubric.PDF

Facione, Peter a. (2011). Critical Thinking : What It Is and Why It Counts. In Insight assessment. Retrieved from https://www.insightassessment.com/CT-Resources/Teaching-For-and-About-Critical-Thinking/Critical-Thinking-What-It-Is-and-Why-It-Counts/Critical-Thinking-What-It-Is-and-Why-It-Counts-PDF

Gravemeijer, K., & Doorman, M. (1999). Context problems in realistic mathematics education: A calculus course as an example. Educational Studies in Mathematics, 39(1–3), 111–129. https://doi.org/10.1023/a:1003749919816

Ismail, S. N., Muhammad, S., Kanesan, A. G., & Ali, R. M. (2019). The influence of teachers' perception and readiness towards the implementation of Critical Thinking Skills (CTS) practice in mathematics. International Journal of Instruction, 12(2), 337–352. https://doi.org/10.29333/iji.2019.12222a

Kurnia, I., & Caswita. (2020). Students' critical thinking ability in solving contextual problems at a junior high school. Journal of Physics: Conference Series, 1521(3). https://doi.org/10.1088/1742-6596/1521/3/032067

Lestari, F. P., Ahmadi, F., & Rochmad, R. (2021). The implementation of mathematics comic through contextual teaching and learning to improve critical thinking ability and character. European Journal of Educational Research, 10(1), 497–508. https://doi.org/10.12973/EU-JER.10.1.497

Reinke, L. T. (2020). Contextual problems as conceptual anchors: an illustrative case. Research in Mathematics Education, 22(1), 3–21. https://doi.org/10.1080/14794802.2019.1618731

Setyowati, A., & Subali, B. (2011). Implementasi pendekatan konflik kognitif dalam pembelajaran fisika untuk menumbuhkan kemampuan berpikir kritis siswa SMP kelas VIII [Implementation of conflict cognitive

approach in physics learning to foster critical thinking skills of junior high school students]. Indonesian Journal of Physics Education/ Jurnal Pendidikan Fisika Indonesia. Retrieved from https://journal.unnes.ac.id/nju/index.php/JPFI/article/view/1078

Sumarna, N., & Herman, T. (2017). The increase of critical thinking skills through mathematical investigation approach. Journal of Physics: Conference Series. https://doi.org/10.1088/1742-6596/812/1/012067

The Partnership for 21st Century Learning. (2015). P21 Framework Definition. Донну, 1–9. Retrieved from http://www.p21.org/our-work/p21-framework

Watson, G., & Glaser, E. (2008). Watson Glaser Critical Thinking Appraisal. Pearson, 24–26. Retrieved from http://www.pearsonvue.com/phnro/wg_practice.pdf

Zulmaulida, R., Wahyudin, & Dahlan, and J. A. (2018). Watson-Glaser ' s Critical Thinking Skills Watson- Glaser ' s Critical Thinking Skills. 2nd International Conference on Statistics, Mathematics, Teaching, and Research, 1–6. Retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/1028/1/012094/pdf