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Critical Thinking Skills Mapping of State Junior High School Students Throughout the City of Surabaya Through Critical and Independent Learning Design

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ABSTRACT. Critical Thinking Skills (CTS) are one of the most significant skills in the 21st century. Students as potential superior human resources must have high CTS, because those who have high CTS can effectively solve problems. This study defines the mastery of Junior High School students' CTS throughout the city of Surabaya. The form of this study was quantitative descriptive. This study involved 74 students from 3 state junior high schools in Surabaya City, with high (State Junior High School A), medium (State Junior High School B), and low (State Junior High School C) levels. Students' CTS was measured using a Critical Thinking Skills Test that has been developed previously thus its validity is guaranteed and it is suitable to be used in measuring Junior High School students' mastery of CTS. The results of the study showed that the critical thinking skills of State Junior High Schools A students were in the high CTS category with an n-gain score of 0,73, the State Junior High School B students were in the high CTS category with an n-gain score of 0,71, and the State Junior High School C students were in the medium CTS category with an n-gain score of 0.70. The average increase in the CTS of Junior High School students in Surabaya was in the high CTS category with an average n-gain score of 0,71. This research is expected to be a recommendation for education policy-makers in Surabaya regarding the learning design used, thus the CTS of Junior High School students in Surabaya can increase at all levels.

1. Introduction

Critical Thinking Skills (CTS) and learning independence contribute to the development of better students' character and skills. Students who have critical thinking skills and are independent in learning tend to be more able to develop the skills necessary to excel and be highly competitive (Juliyantika dan Batubara, 2022; Ariadila et al., 2023). CTS for students has an important role as a provision for making decisions, formulating and defending opinions, and solving problems in the future. CTS is also important for students in making good decisions, understanding their actions, and solving problems (Reddington, 2012). Therefore, practicing CTS will also prepare students for success in the future.

CTS does not only cover cognitive science, but also plays an important role in fostering an attitude of independence in learning (Siagian et al., 2021; Wardana et al., 2021). Learning independence can affect students' critical thinking skills (Siagian et al., 2021). Therefore, student-centered learning and facilitating students to learn independently can help develop students' CTS and their learning independence. (Wardana et al., 2021).

Facts based on previous research showed that 27 grade VIII students in Surabaya had low levels of critical thinking skills, with an average score of 4,39 from 1-10 (Hasyim et al., 2020). This fact is in line with Arini and Juliadi's research (2018), which showed that students obtained an average critical thinking skills mastery score of 35,91% (low category) in the vector critical thinking skills test. In order to improve students' CTS, a learning model that is unique and in accordance with the characteristics of the CTS is needed (Yohanie & Samijo, 2019).

Some of the facts above are in sync with the results of the Programme for International Student Assessment (PISA) in 2018, especially for the science category, Indonesia was ranked 9th from the bottom (ranked 71st). Indonesian students' scientific literacy skills were in the 71st position with a score of 396. This score was below the average score of the Organisation for Economic Cooperation and Development (OECD) countries, which was 489. Furthermore, based on the results of PISA in 2018 for the science category, Indonesian students were still at level 1 out of the 6 levels in PISA. Level 1 PISA can only present routine scientific explanations, while critical thinking so that students can think complexly is at level 5, that is being able to make explanations based on evidence and arguments based on critical analysis (OECD, 2018).

The result of PISA is consistent with the result of the Trends in International Mathematics and Science Study (TIMSS) in 2015, where Indonesia was in the 44th position out of 47 participating countries. Based on TIMSS in 2015 for the science and cognitive aspects (understanding, application, and reasoning), Indonesian students scored 397, far below the international average of 500. It means that Indonesian students do not have scientific reasoning skills in constructing explanations based on arguments and evidence using critical analysis (TIMSS & PIRLS International Study Center, 2015).

One of the learning designs created to improve students' CTS is critical and independent learning. The relevant learning model is the Critical Thinking-Independent Learning (CTIL) model which is valid and practical to improve students' critical thinking skills. In this context, the CTIL model has five syntaxes, namely: 1) motivation, 2) identification and analysis of phenomena, 3) self-investigation, 4) interpretation of data and communication of results, 5) reflection. All syntaxes of the CTIL model have subsyntaxes that are proven to increase students' critical thinking skills indicators, including interpretation, analysis, evaluation, inference, explanation, and self-regulation indicators (Hasyim, 2024).

Based on the findings of the previous research mentioned above, a measurement of the CTS of Junior High School students in Surabaya is needed thus it can be used as a recommendation for education policy-makers in Surabaya, especially the Junior High School level, thus the CTS of Junior High School students in Surabaya increases. The focus of this research is to determine the mapping of Junior High School students' CTS throughout the city of Surabaya. This research was conducted to find the answer to the question: how is the mapping of Junior High School students' CTS throughout the city of Surabaya?

2. Research Methods

This study aims to describe the CTS of Junior High School students throughout the city of Surabaya. Therefore, this study was a quantitative descriptive type. Descriptive research is research that reveals and describes an event that occurs in current conditions (Hasyim, 2020). The subjects of this study were 74 students, consisting of 27 students in grade 7 of high-level State Junior High School (State Junior High School A), 23 students in grade 7 of medium-level State Junior High School (State Junior High School B), and 24 students in grade 7 of low-level State Junior High School in Surabaya (State Junior High School C). The selection of the three schools for data collection used the purposive sampling technique, which was based on the average National

Examination score for science subjects in 2018 for the State Junior High School throughout the City of Surabaya (www.puspendik.kemdikbud.go.id, 2019). The assessment instrument was in the form of a critical thinking skills test which has been developed previously thus its validity is guaranteed and it is suitable to be used to measure the mastery of Junior High School students' CTS. The test was developed according to CTS' criteria according to Facione, which consisted of indicators of interpretation, analysis, evaluation, inference, explanation and self-regulation (Facione, 2015).

The samples were first trained with the CTIL model to have the same treatment. The results of the measurement of students' CTS in 3 schools were then analyzed based on n-gain (normalized gain) which showed an increase in the CTS level. Hasyim, et al., (2020) stated that the n-gain value can be found using this formula:

$$n - gain = \frac{post\text{-}test\ score\ -\ pre\text{-}test\ score}{maximum\ score\ -\ pre\text{-}test\ score}$$

The CTS' n-gain categories are as shown in Table 1.

Table 1. CTS' n-gain categories

n-gain Score	*n-gain* Category
0,70 < *n-gain*	High
0,30 ≤ *n-gain* ≤ 0,70	Medium
n-gain < 0,3	Low

(Permana et al., 2023)

3. Results and Discussion

The CTIL model that is valid and feasible to be used as a learning model can improve students' CTS (Hasyim, 2024). All samples from the 3 State Junior High Schools in Surabaya first used the CTIL model in learning. The results of CTS measurements on 74 students in 3 State Junior High Schools throughout the city of Surabaya using the CTS test instrument are presented in tables 2 and 3 for the data of State Junior High School A, tables 4 and 5 for the data of State Junior High School B, and tables 6 and 7 for the data of State Junior High School C. The results of the CTS measurements at State Junior High School A can be seen in Tables 2 and 3.

Table 2. Description of CTS Pre-test and Post-test in State Junior High School A

Description	*Pre-test*	*Post-test*
Lowest Score	17	46
Highest Score	50	100
Average Score	29	81
Number of Students	27	
The Average of n-gain	0,73	
Category	High	

Table 2 shows that the average pre-test score for State Junior High School A was 29, and the average post-test score was 81. It means that there was an increase when viewed from the average pre-test and post-test scores. This is supported by the average CTS n-gain of 0,73, which was in the high category. The n-gain scores for each CTS indicator in State Junior High School A are also presented in Table 3.

Table 3. n-gain Score of CTS Indicator in State Junior High School A

CTS Indicator	*Pre-test* Score	*Post-test* Score	*n-gain*	Category
Interpretation	34,26	87,04	0,80	High
Analysis	49,54	82,41	0,65	Medium
Evaluation	24,07	90,74	0,88	High
Inference	15,28	66,67	0,61	Medium
Explanation	14,35	83,33	0,81	High
Self-Refulation	37,50	76,85	0,63	Medium

Average	29,17	81,17	0,73	High

Table 3 shows that the n-gain score was between 0,61 in the medium category and 0,88 in the high category. CTS indicators included in the high category were interpretation, evaluation, and explanation, while indicators included in the medium category were analysis, inference, and self-regulation. Although several CTS indicators were in the medium category, the average n-gain score of the State Junior High School A CTS indicators was 0,73, which was in the high category. The results of the CTS measurements in State Junior High School B can be seen in Tables 4 and 5.

Table 4. Description of CTS Pre-test and Post-test in State Junior High School B

Description	Pre-test	Post-test
Lowest Score	33	67
Highest Score	67	96
Average Score	52	86
Number of Students	23	
The Average of n-gain	0,71	
Category	High	

Table 4 shows that the average pre-test score for State Junior High School B was 52, and the average post-test score was 86. It means that there was an increase when viewed from the average pre-test and post-test scores. This is supported by the average CTS n-gain of 0,71 in the high category. The n-gain scores for each CTS indicator in State Junior High School B are also presented in Table 5.

Table 5. n-gain Score of CTS Indicator in State Junior High School B

CTS Indicator	Pre-test Score	Post-test Score	n-gain	Category
Interpretation	63,04	92,39	0,79	High
Analysis	73,91	92,93	0,73	High
Evaluation	51,09	76,63	0,52	Medium
Inference	39,13	69,57	0,50	Medium
Explanation	33,70	92,39	0,89	High
Self-Regulation	50,00	91,30	0,63	Medium
Average	51,81	85,87	0,71	High

Table 5 shows that the n-gain score was between 0,52 in the medium category and 0,89 in the high category. CTS indicators included in the high category were interpretation, analysis, and explanation, while indicators that fell into the medium category were evaluation, inference, and self-regulation. Although there were several CTS indicators that were categorized as medium, the average n-gain score of the CTS indicators of State Junior High School B was 0,71, which was categorized as high. The results of CTS measurements at State Junior High School C can be seen in Tables 6 and 7.

Table 6. Description of CTS Pre-test and Post-test in State Junior High School C

Description	Pre-test	Post-test
Lowest Score	13	46
Highest Score	46	96
Average Score	30	79
Number of Students	24	
The Average of n-gain	0,70	
Category	Medium	

Table 6 shows that the average pre-test score for State Junior High School C was 30, and the average post-test score was 79. It means that there was an increase when viewed from the average pre-test and post-test scores. This is supported by the average CTS n-gain of 0,70 in the medium category. The n-gain scores for each CTS indicator in the State Junior High School C are also presented in Table 7.

Table 7. n-gain Score of CTS Indicator in State Junior High School C

CTS Indicator	Pre-test Score	Post-test Score	n-gain	Category
Interpretation	41,67	85,42	0,75	High
Analysis	35,42	81,25	0,71	High
Evaluation	32,81	81,25	0,72	High
Inference	21,88	69,79	0,61	Medium
Explanation	20,31	75,00	0,69	Medium
Self-Regulation	28,12	79,17	0,61	Medium
Average	30,03	78,65	0,70	Medium

Table 7 shows that the n-gain score was between 0,61 in the medium category and 0,75 in the high category. CTS indicators that were included in the high category were interpretation, analysis, and evaluation, while indicators that were included in the medium category were explanation, inference, and self-regulation. The average n-gain score of the CTS indicators of State Junior High School C was 0,70, which was categorized as medium.

The mapping of the overall State Junior High School students' CTS in Surabaya was in the medium and high categories, with a complete distribution that can be seen in table 8.

Table 8. CTS Mapping of State Junior High School Students in Surabaya

School	n-gain	Category
State Junior High School A	0,73	High
State Junior High School B	0,71	High
State Junior High School C	0,70	Medium
The Average of 3 schools' n-gain	0,71	High

Table 8 shows that the three State Junior High Schools where the measurements were taken had an average n-gain in the high category, which means that the average level of CTS improvement from the three schools was in the high category. After implementing the CTIL model in learning, students' CTS in science lessons increased (Tables 3, 5, and 7). Students have been able to interpret, analyze, evaluate, conclude, argue, and regulate themselves. The percentage of completion of each CTS indicator on temperature and heat material increased as seen from the average n-gain score of the CTS indicators in the high category. CTS' improvement data were obtained by analyzing n-gain against pre-test and post-test scores per CTS indicator. Based on Tables 3, 5, and 7, it can be seen that the CTS n-gain score was in the medium and high category range with the average score of CTS n-gain from the three schools of 0,71. It means that the average level of CTS' improvement from the three schools was in the high category. This is probably because the phases of the CTIL model can train the CTS indicators (Jatmiko et.al., 2018; Prayogi et.al., 2018; Akhdinirwanto et.al., 2020).

Students are expected to have high CTS so that higher students' learning outcomes can be achieved (Dwyer et al., 2014). In addition, students who have high CTS will also be able to use their minds to think abstractly, be

open to everything, and be able to build communication with other people effectively (Hasyim, 2024). This is in accordance with the curriculum in Indonesia, namely the latest curriculum which states that science learning is expected to lead students to meet 21st century skills, including: 1) critical thinking skills and being able to solve problems, being creative and innovative, and being able to communicate and collaborate; 2) being skilled in using media, and information and communication technology (ICT) (Fadlillah, 2014). Based on the Minister of Education and Culture Regulation No. 20-21 of 2016 concerning graduate competency standards and content standards for elementary and secondary education, in science learning, students are expected to be able to demonstrate critical and communicative reasoning, processing and presenting skills. (The Ministry of Education and Culture, 2016). Therefore, the CTS that students have must be trained and improved through science learning using appropriate learning models.

Critical and independent learning design using the CTIL Model has the characteristic of a learning environment allowing students to be actively involved in developing CTS during the learning process. It happens because the model gives students the opportunity to improve their CTS achievements which are reflected in the syntax phase.

Based on the discussion above, the mapping of the CTS of State Junior High School students in Surabaya after learning using independent critical learning design, namely the CTIL model, has a high category average. Therefore, this study can be used as a recommendation to the relevant institution thus the use of appropriate learning models can train students' CTS.

4. Conclusion

Based on the research results from students' critical thinking skills mapping, the research results obtained showed that the CTS of State Junior High School A students were in the high category with the n-gain score of 0,73, the State Junior High School B students' were in the high category with the n-gain score of 0,71, and the State Junior High School C students' were in the medium category with the n-gain score of 0,70. The average increase of State Junior High School students' CTS in Surabaya was in the high CTS category with the average n-gain score of 0,71. This study is expected to be a recommendation for education policy-makers in Surabaya regarding the learning design used, thus the CTS of State Junior High School students in Surabaya increases at all levels.

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Author Contributions

FH is responsible for writing the main ideas of the research, data collection, data analysis, writing and revising the article.

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