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Preliminary Studies of Critical Thinking Skills on Subject of Matter and Their Changes on Middle Schooles

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Article Info

ABSTRACT

Purpose of the study: This research aims to describe or provide an initial picture of the level of critical thinking skills of junior high school students on the subject of research and its changes in South Sumatra identfy and analyze preliminary studies of students critical thinking skills.

Methodology: The methodology of this study is survey- quantitative descriptive research. Data collection techniques was carried out through critical thinking skill questions of matter and their changes. The research location is at Junior High School 1 Banyuasin Regency, South Sumatera. This Study sample consist of 139 Class 7 Students.

Main Findings: The findings of this study of critical thinking skill average were Class 7A had an average percentage of 28.73% in the low category, class 7B had an average percentage of 61.83% in the high category, class 7C had an average percentage of 43.43% in the sufficient category, and class 7E had an average percentage of 32.32% in the low category. Overall, the average critical thinking skills of students was 41.34% in the sufficient category.

Novelty/Originality of this study: The novelty of this research lies in the contribution of the research to students' skills in answering critical thinking questions on the concept of matter and its changes. The findings can provide new insights in the context of education and researchers to develop appropriate methods and strategies to improve students' critical thinking skills.

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1. INTRODUCTION

The development of the world is increasingly rapid and complex in the era of the 21st century, education is becoming increasingly important to ensure that learners have the skills to learn and innovate, the skills to use technology and information media, work, and survive by using life skills [1]. Today's learning, also called 21st century learning, is focused on critical thinking and problem solving, creativity and innovation, cross-cultural understanding, media literacy, information and communication skills, computing and ICT literacy, and life and career skills [2]. Critical thinking, creativity, communication, and teamwork are skills that students should be taught [3].

Students' critical thinking skills in Indonesia are still low [4]. On 2022, Indonesia's PISA scores declined in all aspects, placing Indonesia 66th out of 81 countries. The low level of critical thinking skills indicates that the learning applied has not fully familiarized students with critical thinking to solve problems [5], [6].

Natural science is one of the studies in senior high schools related to daily of life [7]. The scientific component of modern life is inseparable from the knowledge and technologies that are currently experienced [8]. Some of the causes of students' low critical thinking skills were the first was the instructor's repetitious function in the learning process; the teacher is essential to helping pupils improve their critical thinking abilities [9]. Students' level of thinking skills will be impacted by the implementation of an appropriate problem based learning model [10]-[12], game based learning in education [13], [14] the cooperative learning model based on differentiated learning [15], [16], STEM-based Project Based Learning (PjBL) Learning Model [17] are some ways to improve students' critical thinking skills.

The second is teaching materials; teaching materials that only utilize printed books monotonous teaching materials do not attract students' attention. To overcome, teachers can use electronic teaching materials like Interactive E-Module Tipe Connected as a Learning Support System [18] Interactive E-Book Canva [19]. Digital E-book Using Professional Flipbook PDF [20], Book Creator E-Module Teaching Materials [21], [22], and guided inquiry e-LKPDs assisted by hands-on worksheets [23] they are very effective for improving students' critical thinking skills.

The third is the asessment test, Assessment in education serves as a material to determine abilities and difficulties at the time and identify what is really needed for learning. The test can be administered online through a website or as a computer-based test (CBT) [24]. CTDBT tool to determine whether there were variations in critical thinking dispositions [25] Ennis indicators are methods that can be used to gauge pupils' critical thinking proficiency. Critical thinking indicators fall into five types, per Ennis [26]: elementary clarification, basic support, inference advanced clarification , strategies and tactics.

The other aspect is the use of technology; teachers frequently have to combine traditional classroom instruction with the use of technology. Augmented reality technology, which has significant advantages in the field of education, can be used to help students think more critically [27], [28]. Students can be virtually taken to a range of learning scenarios that demonstrate real-world implications by leveraging the immersive capabilities of virtual reality technology [29], [30]. The ongoing development significant change in educational processes is represented by the incorporation of AI into the transformation of conventional teaching methods, which combines technology, instruction, and learning [31], [32]. There are many causal factors that influence students' critical thinking skills

Therefore, it is necessary to conduct preliminary research to evaluate the level of thinking ability of students in middle school. The initial research will focus on subject of matter and their changes, which is an emancipated curriculum material for class VII phase D. Through observations and interviews with physics teachers in secondary schools in South Sumatra, it was found that the material of substances and their changes is quite difficult, so students need help to understand it. The questionnaire instrument was distributed to determine the level of critical thinking skills of students in five classes of students of Junior High School 1 Air Kumbang on the material of subject of matter and their changes and to find out what factors cause low or high levels of critical thinking skills of students on the material of substances and their changes in South Sumatra.

2. RESEARCH METHOD

The method of this study by using a qualitative descriptive method, this study aims to describe or provide an initial picture of the level of critical thinking skills of junior high school students on the subject of research and its changes in South Sumatra. In this study, the research subjects were not treatment students; instead, students were given an instrument to see the level of critical thinking skills of junior high school students of subject of matter and their changes.

To obtain an initial picture of the level of students' thinking skills, it is done by giving an instrument in the form of a questionnaire that represents 5 indicators of critical thinking skills [26]. Rasch model analysis and Winstep software are used in the critical thinking skills test. validity of the instrument if it meets the subsequent requirements [33]:

1. $0.5 <$ Outfit MNSQ $< 1,5$ is the MNSQ Outfit Value (Mean Square).
2. The ZSTD (Z-Standard) value is $-2,0 <$ ZSTD $< +2,0$.
3. The correlation between the point measures is $0,4 <$ pt.meassure correlation $< 0,85$.

The instruments used were 12 questions with the research subjects, namely 5 classes with 139 students who were willing to be analyzed and had implemented the emancipated curriculum in South Sumatra. Data analysis determined the percentage of students' ability in South Sumatra junior high schools on substances and their changes. For analysis and comparison, the results of student answer scores were compared for each indicator and school. If translated mathematically, the results are as follows:

$$Score = \frac{\sum Correct\ Scores}{Maximum\ Scores} \quad ...\ (1)$$

Next, Table 1 categories are used to interpret the percentage of students' creative thinking [34], [35].

Table 1. Criteria for the level of critical thinking Skills

Category	Persentage (%)
Very High	81-100
High	61-80
Sufficient	40-59
Low	20-39
Very Low	0-19

3.   RESULTS AND DISCUSSION

Critical thinking skills are measured consisting of 5 indicators, which consist of elementary clarification, bases for decision, inference, advanced clarification , strategies and tactics. The five indicators are contained in 12 multiple choice questions that have been tested for validity and reliability using winstep by rasch model analysis tested on 65 students.

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TABLE 10.1 excel validasi soal Listiyorini.xlsx  ZOU066WS.TXT  Oct 15 2024 16:27
INPUT: 65 Person  12 Item  REPORTED: 65 Person  12 Item  2 CATS MINISTEP 4.8.2.0
-----------------------------------------------------------------------------
Person: REAL SEP.: 1.62  REL.: .73 ... Item: REAL SEP.: 1.91  REL.: .78


        Item STATISTICS:  MISFIT ORDER


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|ENTRY   TOTAL  TOTAL           MODEL|  INFIT  |  OUTFIT  |PTMEASUR-AL|EXACT MATCH|      |
|NUMBER  SCORE  COUNT  MEASURE   S.E. |MNSQ  ZSTD|MNSQ  ZSTD|CORR.  EXP.| OBS%  EXP%| Item |
|----------------------------------+---------+---------+----------+----------+------|
|   10     30     65     .39     .32|1.19  1.34|1.47  1.82|A .53   .61| 73.2  73.3| 10   |
|    5     45     65   -1.07     .32| .96  -.22|1.45  1.38|B .50   .50| 71.4  73.8| 5    |
|    6     43     65    -.87     .32|1.20  1.49|1.25   .93|C .43   .52| 67.9  72.5| 6    |
|    3     18     65    1.85     .40|1.19   .82| .98   .12|D .64   .68| 80.4  85.4| 3    |
|    8     31     65     .29     .32|1.17  1.19|1.12   .58|E .55   .61| 66.1  72.8| 8    |
|    4     32     65     .19     .31|1.00   .04| .88  -.48|F .61   .60| 71.4  72.5| 4    |
|    1     31     65     .29     .32| .99   .00| .99   .03|f .61   .61| 73.2  72.8| 1    |
|    9     34     65     .00     .31| .97  -.22| .88  -.53|e .61   .59| 75.0  71.8| 9    |
|   11     34     65     .00     .31| .94  -.39| .89  -.46|d .61   .59| 75.0  71.8| 11   |
|    2     39     65    -.48     .31| .86 -1.10| .75 -1.08|c .61   .55| 80.4  71.7| 2    |
|   12     35     65    -.10     .31| .80 -1.62| .82  -.83|b .65   .58| 83.9  71.8| 12   |
|    7     39     65    -.48     .31| .79 -1.70| .67 -1.52|a .64   .55| 76.8  71.7| 7    |
|----------------------------------+---------+---------+----------+----------+------|
| MEAN   34.3   65.0     .00     .32|1.01    .0|1.01    .0|           | 74.6  73.5|      |
| P.SD    6.7     .0     .72     .02| .14   1.0| .25   1.0|           |  5.0   3.6|      |
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Figure 1. Fit Order Critical Thinking Instrument By Winstep

These methods allow researchers to assess if the items in their tests are effectively measuring the construct they are attempting to assess. In order to determine whether the things work properly for measurements, the item fit order quantifies the degree of item fit, or validity. On a scale of $0.5 < MNSQ < 1.5$, all question items are eligible based on the MNSQ score. On the scale of $-2.0 < ZSTD < +2.0$, the ZSTD value of 12 question items is likewise within the acceptable range. Additionally, every item on the Pt. Meassure Correlation scale falls between 0.4 and 0.85. The tool can generate consistent measurements and measure the subject of the study in a trustworthy way [36].

After conducting research on seventh-grade students at the fifth class in Junior High School 1 Air Kumbang an investigation was conducted. Thus, according to Ennis [26], the average of critical thinking skill studentsare divided into five indicators that are displayed in diagram, like:

3.1. Elementary Clarification Indicator

The elementary clarification aspect consist of several parts, such as focusing question, analyzing arguments, dan ask and answer questions that require an explanation. Three items containing aspects of elementary clarification have been developed in the test instrument. These items are question numbers 1, 2 and 3. The result are shown in figure 2.
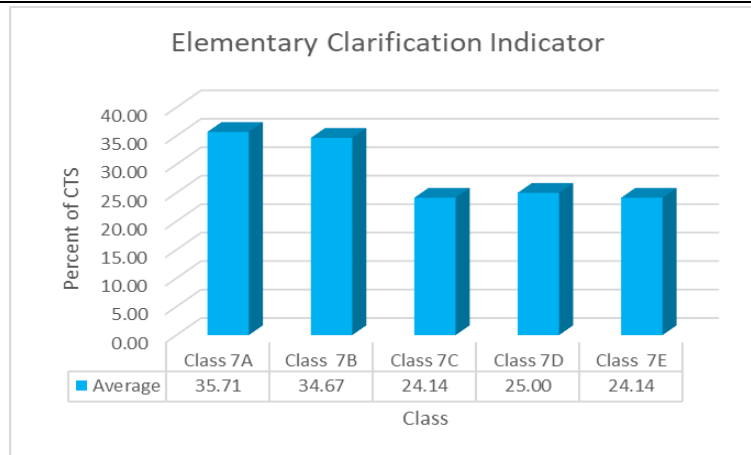
Figure 2. Elementary Clarification Diagram

In Figure 2, the indicator of critical thinking ability in 5 classes at Junior High School 1 Air Kumbang shows the results, like Class 7A shows an average percentage score of 35.71% with critical thinking skills in the low category. Class 7B showed an average percentage score of 34.67% with critical thinking skills in the low category. Class 7C of the three schools showed 24.14% with a low critical thinking ability level category, Class 7C showed an average percentage score of 25.00% with a low critical thinking ability level category and 7D showed an average percentage score of 24.14% also with a low critical thinking ability level category. This shows that all classes have an average percentage score of thinking skills in the low category on the elementary clarification indicator, this is because most students are not used to being trained to think to focus statements, analyse arguments, and ask and answer questions that require explanation. This is caused by several factors, namely the learning model used, the teaching materials used, and the use of technology (facilities and infrastructure) in the learning process is still limited. The most critical results in the area of elementary clarification indicator were also obtained from research conducted by Ni'mah [37] on Madrasah Aliyah Negeri Demak students. This is because there is a lack of soal exercises that can help students understand the subject, which leads to students' reluctance to participate in soal exercises that cover all aspects of elementary clarification indicator.

3.2. Bases for decision Indicator

The Bases for decision aspect consists of several parts, such as considering the credibility of sources, observing and considering the results of observations. Two items containing the bases for decision aspect have been developed in the test instrument. These items are question numbers 4 dan 5. The results of students' critical thinking skills on the bases for decision indicator average are shown in Figure 3.
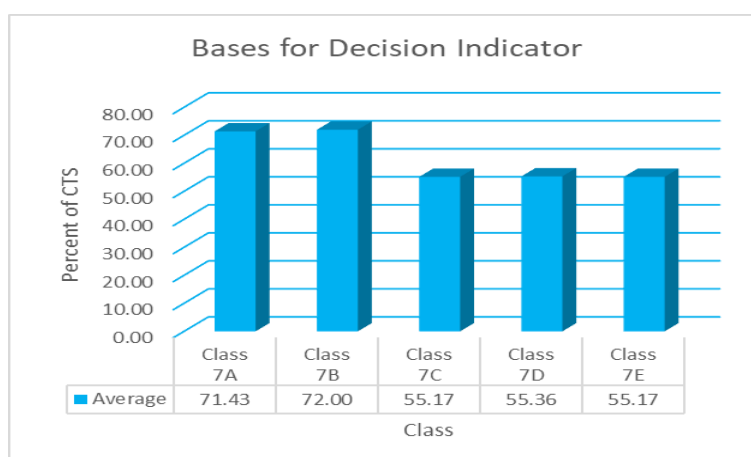

Figure 3. Bases for Decision Diagram

Figure 3 the bases for decision indicator tested on 5 classes at Junior High School 1 Air Kumbang shows the results, like class 7A shows an average percentage score of 71.43% with a high category of critical thinking skills, class 7B shows an average percentage score of 72.00% with a high category of critical thinking skills, class 7C shows an average percentage score of 55.17% with a sufficent critical thinking skills level category, class 7D shows an average percentage score of 55.36% with a sufficient critical thinking skills level

category and Class 7E shows an average percentage score of 55.17% with a sufficient critical thinking skills level category. This shows that of the 5 classes studied, 2 classes have an average percentage score of high critical thinking skills and 3 classes have an average percentage score of moderate critical thinking skills. These results are in accordance with the results of research conducted by Oktariani et al., [38] on education students that in this aspect students are in the High critical thinking criteria. In this indicator, students have better achievements compared to the elementary clarification indicator, this shows that students when conveying arguments and opinions and answers to questions will be sourced from credible and appropriate sources and use the right reasons to refute something.

3.3. Inference Indicator

The inference aspect consists of several parts, such as Performing deduction considering the results of deduction, Performing induction and considering the results of induction, and Making and reviewing consideration values. Three items containing aspects of inference indicator have been developed in the test instrument. These items are question numbers 6,7 and 8. The result of average critcal thinking skill of students is shown as figure 4.
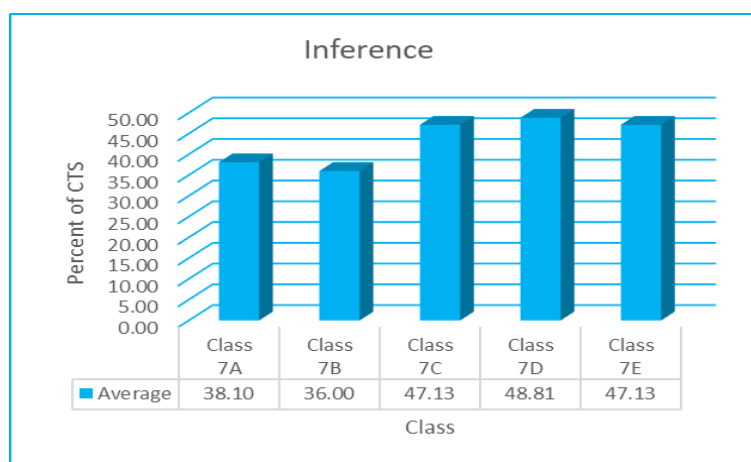

Figure 4. Inference Diagram

In Figure 4 the critical thinking skills indicator shows the results, like Class 7A shows an average percentage score of 38.10% with a low critical thinking skills level category, then class 7B shows an average percentage score of 36.00% with a low critical thinking skills level category. The increase in the critical thinking skills level category, shown by several classes, namely class 7C showed an average percentage score of 47.13% with a sufficient critical thinking skills level category, class 7D showed an average percentage score of 48.81% with a sufficient critical thinking skills level category and class 7E showed an average percentage score of 47.13% with a low critical thinking skills level category. This shows that of the 5 classes studied, there are 2 classes that have an average percentage score of low critical thinking skills, while the other 3 classes have an average percentage score of critical thinking skills in the sufficient category.

Student activities that encourage students to develop their ability to make a conclusion or consider the results of their induction need to be improved. For this reason, in learning, teachers accustom students to infer information or describe various aspects gradually in order to produce information or formulations as a conclusion [39].

3.4. Advanced Clarification Indicator

The advanced clarification aspect consists of defining a term and considering a definition. One item containing the Advanced Clarification Indicator aspect has been developed in the test instrument. The question item is question number 9. The result shown in figure 5.
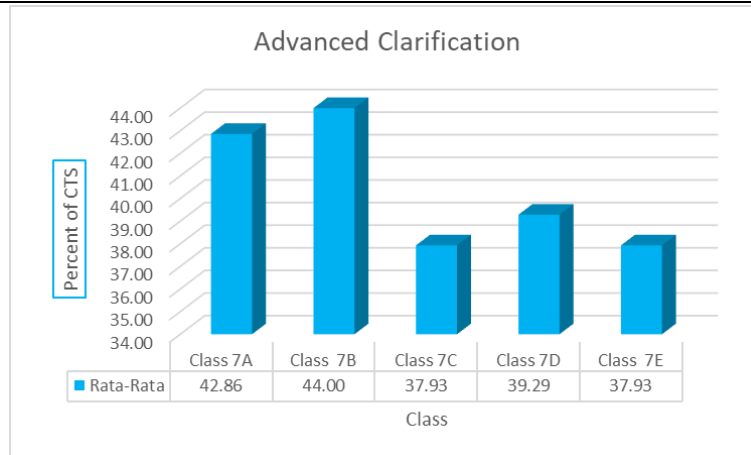
Figure 5. Advanced clarification Diagram

In Figure 5 indicators of critical thinking skills 5 classes at Junior High School 1 Air Kumbang showed the results, like class 7A showed an average percentage score of 42.86% with the category of Sufficient critical thinking skills level, class 7B showed an average percentage score of 44.00% with the category of Sufficient critical thinking skills level. Class 7C shows an average percentage score of 37.93% with a low critical thinking skill level category, class 7D shows an average percentage score of 39.29% with a low critical thinking skill level category and class 7E shows an average percentage score of 37.93% with a low critical thinking skill level category. It is inversely proportional to the inference aspect that of the 5 schools studied, there are 2 classes with low Sufficient critical thinking skills level categories while the other 3 classes have an average percentage score of low critical thinking skills.

This indicates that students' ability to define terms and consider them needs to be improved. A critical thinker needs to really understand an idea and realise the need for new information to be considered and studied so as to define it [40].

3.5. Strategy and Tactics Indicator

The Strategy and Tactics aspect consist of several parts, such as focusing question, analyzing arguments, dan ask and answer questions that require an explanation. Twelve items containing aspects of elementary clarification have been developed in the test instrument. These items are question numbers 1, 2 and 3.

Figure 6. Strategy and Tactics Diagram

Figure 6 shows the results, like Class 7A shows an average percentage score of 29.76% with a low critical thinking skills level category, class 7B shows an average percentage score of 30.67% with a low critical thinking skills level category. Class 7C shows an average percentage score of 33.33% with a low critical thinking skills level category, class 7D shows an average percentage score of 34.52% with a low critical thinking skills level category and class 7E shows an average percentage score of 33.33% with a low critical thinking skills level category. This shows from the 5 schools studied all classes with low critical thinking skills level category. This is due to the lack of students' ability to take action by making their own decisions, using their logic to solve problems, or finding alternative solutions and cooperating with others.

Average of Every Indicator of Critical Thinking Skill for Five Classes in Junior High School 1 Air Kumbang is shown in Figure 7.
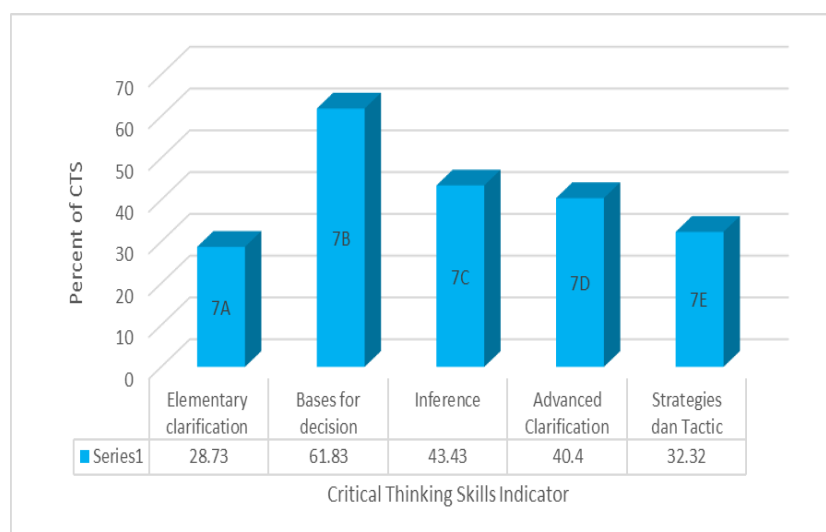

Figure 7. Average of Critical Thinking Skill Indicator

The level category of critical thinking skill in All Class Junior High School 1 Air Kumbang is shown by Table 2

Table 2. Average of critical thinking skill and Level category of critical thinking skill

No	Class	Average of Percent CTS	Category
1	7A	28.73	Low
2	7B	61.83	High
3	7C	43.43	Sufficient
4	7D	40.40	Sufficient
5	7E	32.32	Low

In terms of the subject matter of Matter and their changes, Phase D students of class VII at Junior High School 1 Air Kumbang showed the level of critical thinking skills, namely Class 7A had an average percentage of 28.73% in the low category, class 7B had an average percentage of 61.83% in the high category, class 7C had an average percentage of 43.43% in the sufficient category, 7D had an average percentage of 40.40% in sufficient category and class 7E had an average percentage of 32.32% in the low category. Overall, the average critical thinking skills of students was 41.34% in the sufficient category. The process of improving the quality of education must continue to be carried out dynamically to improve the quality of education and its related components [41].

This study shows the level of critical thinking skills for junior high school students. For future research, researchers suggest developing and implementing interactive learning media such as online learning and games [42]-[44]. They can also apply learning approaches such as STEM [45], Project Based Learning (PjBL) [46], [17], [47] and Problem Based Learning (PBL) [48]. Development of teaching materials [23], [49] that can support students' critical thinking skills to improve.

4.   CONCLUSION

In this study, the researcher wanted to know the initial description of the research on the needs analysis of the level of critical thinking skills of junior high school students on subject matter and their changes at Junior High School 1 Air Kumbang. The implication of subject matter and their changes in junior high school grade 7, phase D emancipated curriculum, using descriptive qualitative research methods and questionnaires. Based on the findings and analysis of the level of critical thinking skills there are different results for each indicator from each class. Learners have different abilities in each indicator, such as in the fifth indicator of strategy and tactics; learners have low critical thinking skills. In the fourth indicator, the advanced clarification indicator has a sufficient level of critical thinking skills, the reference indicator has a sufficient level of critical thinking skills, the bases for decision indicator has a high level of critical thinking skills, and the first indicator, namely the elementary clarification indicator is low. Therefore, it is necessary to conduct development research to improve the quality of learning and critical thinking skills.

ACKNOWLEDGEMENTS

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