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Analysis of Students' Science Process Skills Profile: Case Study in Pekanbaru

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Abstract

The skills of the science process are crucial in science learning, yet they have not been fully maximized in science learning activities. The research aimed to analyze the profile of students' science process skills in Pekanbaru. The study used a descriptive method with a survey technique of students in class VII of SMPN 23 Pekanbaru for the 2023/2024 academic year. The sample was selected using a simple random sampling technique of 70 students, consisting of 33 students from VII Hang Tuah and 37 students from VII Hang Jebat. The instrument used a sheet of science process skills test consisting of 10 multiple-choice questions covering indicators observing, classifying, measuring and using numbers, inferring, communicating, formulating problems, formulating hypotheses, controlling variables, planning experiments, and interpreting data. The data collection technique involved distributing the science process skills test to students. The data analysis technique was done quantitatively by calculating the percentage score of students' science process skills per indicator based on students' test answers. The results showed that the percentage of students' science process skills overall is 54%, categorized as sufficient. The highest percentage is in the observation skill at 91%, while the lowest percentage is in the variable control skill at 10%. The poor science process skills are communication, variable control, experimental planning, and data interpretation. The research recommends further research as an initial stage in analyzing the profile of junior high school students' science process skill levels.

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INTRODUCTION

The essence of science education involves engaging students in scientific investigation, like experimental activities (Umiliya *et al.*, 2023; Safaah *et al.*, 2017). Scientific investigation includes the process of formulating problems, and hypotheses, designing experiments, collecting data, analyzing data, and drawing conclusions (Pertiwi, 2019). Students should be able to integrate knowledge, attitudes, and skills to develop a better understanding of concepts (Yamin *et al.*, 2022). One of the most important basic skills in scientific inquiry is the science process skills (Darmaji *et al.*, 2019; Kramer *et al.*, 2018; Zulirfan *et al.*, 2018). Science process skills are considered to provide meaningful learning experiences for students and can enhance students' higher-order thinking skills (Tilakaratne & Ekanayake, 2017).

Science process skills are crucial in science learning because science learning integrates the fields of physics, biology, and chemistry, which contain many abstract concepts (Hadiprayitno, 2019). Abstracts of scientific concepts are often encountered by students in their surroundings. So, with abstract knowledge and assisted by training in science process skills, students will find it easier to understand the learning material as a whole (Dewi & Manuaba, 2021). Training in science process skills aims to familiarize students with discovering knowledge themselves in line with the increasing development of science and technology, train students in critical thinking, and develop cognitive abilities through scientific inquiry activities, especially in science learning (Chotimah *et al.*, 2023; Nasution, 2018).

Science process skills in science learning are divided into basic and integrated science process skills. Basic science process skills include observing, classifying, communicating, measuring,

concluding, and predicting. Meanwhile, integrated science process skills are more complex, which include identifying variables, making tables, creating graphs, describing variable relationships, processing data, analyzing data, making hypotheses, defining operational variables, designing experiments, and conducting experiments (Darmaji *et al*., 2019; Zulirfan *et al*., 2018).

Based on the field observations, science learning has not fully trained students' science process skills. Based on Fitriana *et al*. (2019), students' science process skills are still categorized as sufficient at 58%. The minimum level of student involvement in learning means insufficiently trained science process skills (Aryanti *et al*., 2018). As a result, the average student's thinking ability only reaches the low-order thinking skills stage (Murnawianto *et al*., 2017). It is also supported by the results of the PISA and TIMSS 2018 studies showing that students' abilities in science are still low, which is evident from the average scores of Indonesian students far below the average scores set by the Organization for Economic Co-operation and Development (OECD). The average score of Indonesian students in science is 389, while the average score for OECD is 489 (OECD, 2019).

The existing science learning process is still teacher-centered. Moreover, student activities during learning are still dominated by the teacher who explains the material/concepts through lecture methods. Here, students do not have the opportunity to develop their potential (Adnyani *et al*., 2020). Learning is not directed towards discovering scientific concepts by the essence of science, which is process-product. Teachers who act as central figures in education can make several efforts to train students to discover scientific concepts (Yunimuninggar & Fardhani, 2024). As a result, students still have difficulty solving science learning material problems based on everyday life issues that require students to reason or analyze the problems before answering (Nasution, 2018).

Science teachers need to train students' science process skills, not just through lectures or discussions. It must analyze the profile of students' science process skills to serve as an initial reference for teachers and researchers to see the level of skills that are trained in schools. The research is important because it must first know which skill indicators are still low or already high. It aims to train students' science process skills.

Based on the problems encountered from several previous relevant studies, students' science process skills have not been maximally trained in schools, even the science process skills are crucially important to training in science learning. This research aimed to analyze the profile of students' science process skills at SMPN 23 Pekanbaru for preliminary data analysis to find the right solutions for the future. Therefore, the research questions are:

1. What is the profile of students' science process skills at SMPN 23 Pekanbaru?
2. What science process skills are still in the low category and need to be improved?

RESEARCH METHOD

The study used quantitative methods. The research design used a cross-sectional survey design, namely the collection of data obtained from a sample that is carried out at one time and does not require a long time. The research design is presented in Figure 1.

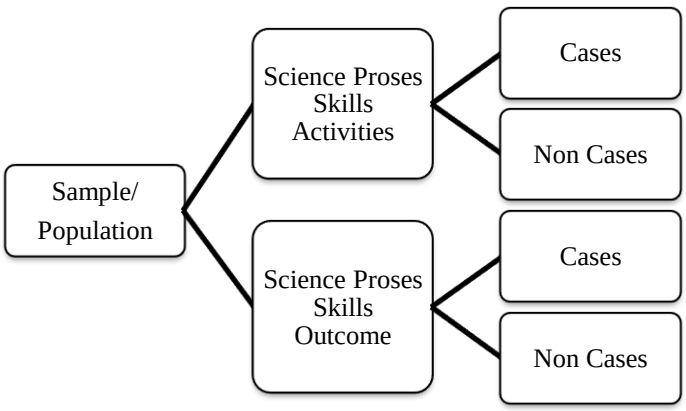

Figure 1. Cross Sectional Study Design

The population were all class VII students at SMPN 23 Pekanbaru in the odd semester of the 2023/2024 academic year. Sampling was selected using a simple random sampling technique of 70 students, consisting of 33 students from class VII Hang Tuah and 37 students from class VII Hang Jebat.

The implementation of the study started from the preparation stage, namely the permission process from the head of SMPN 23 Pekanbaru to conduct the research. Next, it determined the research sample. The next stage is conducting research. The science process skills tests distributed to samples in August 2023. The final stage was evaluation. All data obtained will be processed and analyzed.

The instrument was a science process skills test sheet, adapted from Zulirfan *et al.* (2019) with a reliability test value of 0.69 of high level. The science process skills test sheet includes 10 multiple-choice questions with 10 indicators of science process skills. The profile of the science process skills test instrument is presented in Table 1.

Table 1. Science Process Skills Test Instrument Profile

Science Process Skills	Indicators of Science Process Skills	Question Number
Basic Science Process Skills	Observe	1
	Classify	2
	Measure and use numbers	3
	Inference	4
	Communicate	5
Integrated Science Process Skills	Formulate the problem	6
	Formulate a hypothesis	7
	Control variables	8
	Plan an experiment	9
	Interpret data	10
Number of Questions		**10**

The data collection technique was distributing science process skills tests to students. Quantitative data was obtained by calculating scores based on test answers given to students. Next, data analysis techniques are carried out quantitatively and describe the results. The percentage of students' science process skills scores per indicator is calculated with the formula by Sudijono (2008).

$$P = \frac{f}{n} \times 100\%$$

Description:
P = Percentage obtained
f = Frequency of questionnaire answers
n = Number of samples

The results of calculating the percentage of students' science process skills scores are categorized based on Table 2.

Table 2. Student Science Process Skills Profile Category

No.	Percentage	Category
1.	81% – 100%	Very High
2.	61% – 80%	High
3.	41% – 60%	Sufficient
4.	21% – 40%	Poor
5.	0% – 20%	Very Poor

Source: Riduwan (2015) & Yunarti (2021)

RESULT AND DISCUSSION

The profile of students' science process skills is seen from the results of the science process skills test given to 70 class VII students at SMPN 23 Pekanbaru. The research results are based on indicators of basic and integrated science process skills. The profile of students' basic science process skills is presented in Figure 2.

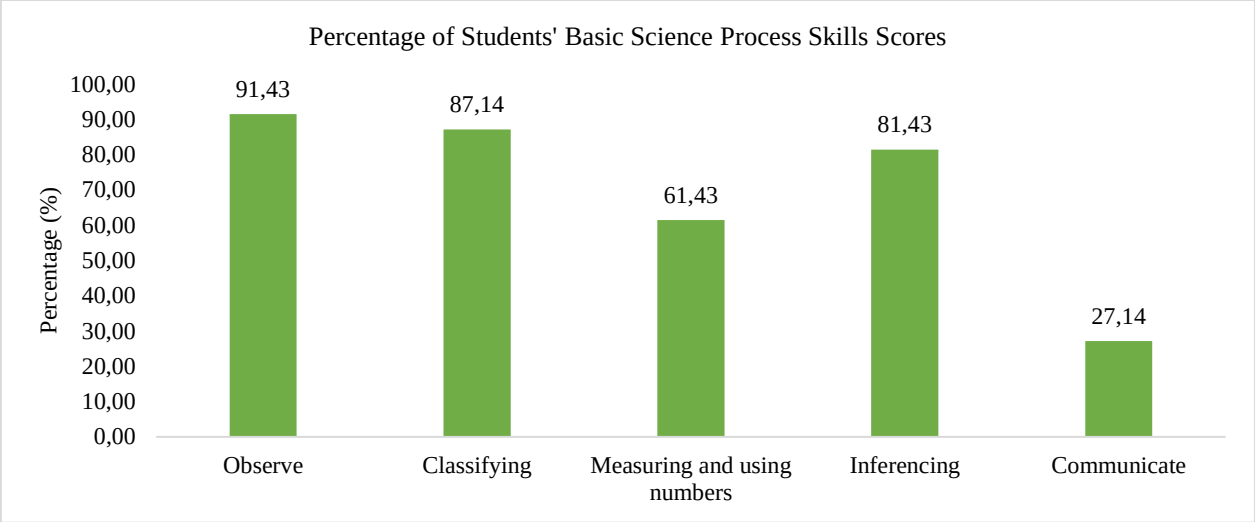

Figure 2. Profile of Basic Science Process Skills of Students at SMPN 23 Pekanbaru

Based on Figure 2, the highest indicator of basic science process skills is the observing at 91.43% in the very high category. The lowest indicator is the communicating at 27.14% in the poor category.

The integrated science process skills profile consisting of indicators of formulating problems, formulating hypotheses, controlling variables, planning experiments, and interpreting data is presented in Figure 3.

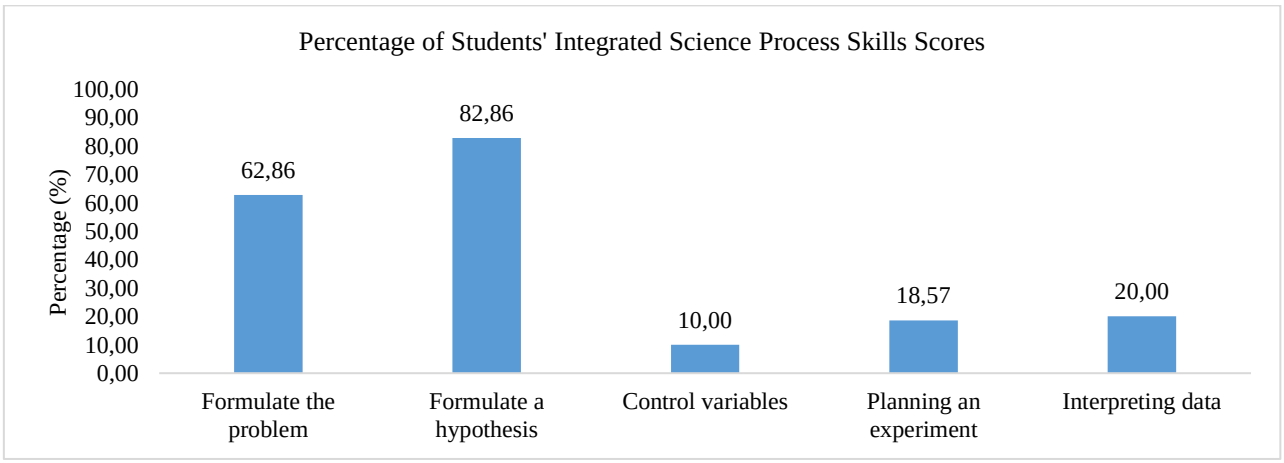

Figure 3. Profile of Integrated Science Process Skills of Students at SMPN 23 Pekanbaru

Based on Figure 3, the highest indicator of integrated science process skills is the indicator of formulating a hypothesis at 82.86% in the very high category. The lowest indicator is in the indicator controlling variables at 10% in the very poor category. Furthermore, the indicators for planning experiments and interpreting data are also in the very poor category at 18.57% and 20% respectively. It means that students' science process skills in the indicators of controlling variables, planning experiments, and interpreting data still need attention and improvement because they are still relatively low compared to other indicators.

Based on the findings, the science process skills of SMPN 23 Pekanbaru students had different score percentages and ability categories in each indicator. The highest indicator of science process skills is the observing indicator of 91.43% in the very high category. Meanwhile, the lowest indicator of science process skills is variables at 10% in the very poor category.

The first indicator of science process skills analyzed is the observing indicator. In this research, students' observation skills were in the very high category. Observation skills are tested through question number 1 where students are asked to observe two pictures of animals where picture 1 is a scorpion and picture 2 is a spider. After observing the two pictures, students are asked to determine the two animals based on observation. In question number 1, 64 students answered correctly and only 6 students answered incorrectly. This means that students' skills in observing an object are good.

Observation skills are basic skills individuals must have in scientific investigation activities. Students easily solve questions related to

observation skills because students are often asked by teachers to observe the material being studied themselves. Things observed in the learning process can be direct or in pictures or videos (Suansah, 2016). The process of observing can be practiced using the senses, but if the object cannot be observed using the senses, it can be observed using tools. This is supported by the fact that observing skills do not experience problems because students are used to making observations (Saleh *et al*., 2020). Observing skills can develop other skills, such as inferring, communicating, and predicting (Darmaji *et al*., 2019).

The next indicator of science process skills is the classifying indicator. In this research, students' classification skills were in the very high category, namely 87.14%. Classification skills are tested through question number 2 where students are asked to group an image of a bone fragment into an image of a bone fragment with the same characteristics. In question number 2, 61 students answered correctly. And, only 9 students answered incorrectly. It means that students' skills in classifying are good. This is per the results of Yunita & Nurita (2021) study, which found that student classification skills were in the high category because these skills are still basic skills and are already familiar to students.

In a study by Elvanisi *et al.* (2018), classification skills have the highest percentage because students have experienced classifying activities in everyday life, such as grouping things based on similarities and differences. Classification skills can be obtained when students interpret experiences related to the surrounding environment (Rifqiawati *et al*., 2017). Also, it is supported when teachers often give assignments to students to classify things based on existing characteristics in learning activities. So, students' classification skills become high (Yunita & Nurita, 2021).

The skill of measuring and using numbers is the third indicator of science process skills. In this research, the skill of measuring and using numbers was in the high category, namely 61.43%. Measuring skills and using numbers are tested through question number 3 where students are asked to measure how far an ant moves in a specific time using a ruler. In question number 3, 43 students answered correctly, and 27 students answered incorrectly. This means that many students still have difficulty answering questions related to measuring skills and using numbers. This is following the results of a study by Firdaus & Subekti (2021) who obtained poor results on measuring skills indicators due to students' lack of practice in measuring science learning activities.

The skill of measuring and using numbers is a very important skill for students to have. Demonstrated by the activity of measuring each existing quantity. In terms of measuring skill indicators, some students still answered questions incorrectly due to students' lack of accuracy in measuring activities and incorrect measurement readings. Thus, students' measuring skills are in the poor category (Darmaji *et al*., 2020).

The fourth indicator of science process skills is inferencing. In this research, inferencing skills were in the very high category, namely 81.43%. Inferencing skills are tested through question number 4 where students first read a table of observation results to investigate the effect of the number of batteries installed in a simple electrical circuit on the flame of the lamp. Then, students are asked to explain the observation results based on the table given. In question number 4, 57 students answered correctly, and 13 students answered incorrectly. It means students who have difficulty answering questions related to inferencing skills. This is by the results of a study by Rahayu *et al*. (2021) showing that inferencing skills can be achieved by students. So, they can solve the questions given, but there are still some students who cannot answer the questions.

Based on the results of Yunita & Nurita's (2021) study, low inferencing skills indicate that students still have difficulty predicting everything. In questions, students are required to predict, but most students are still incorrect in giving answers. It is supported by the studies that inferencing skills are more abstract compared to other skills, so students still have difficulty answering questions related to inferencing skills (Karamustafaoğlu, 2011).

The final skill in the basic science process skills indicators analyzed is communication skills. In this research, communication skills were in the low category, namely 27.14%. Communication skills are tested through question number 5, which describes of the results of an investigation into the electrical energy content of 3 types of fruit. Students are asked to choose which graph is most appropriate based on the description of the results of the investigation. In question number 5, only 19 students answered correctly, and 51 students answered incorrectly. This means many students have difficulty answering questions related to communication skills. Following the results of a study by Darmaji *et al.* (2020), indicators of communication skills were in the very poor category, shown by students who were still less skilled in describing empirical data from experimental results.

Communicating can be defined as the activity of expressing concepts or views orally or in writing in various formats, such as tables, graphs, diagrams, or pictures (Firdaus & Mirawati, 2017). Students' communication skills are still low because, in the science learning process, students are not used to explaining material through pictures, graphs, or tables (Yunita & Nurita, 2021). Supported by the results of a study by Elvanisi *et al.* (2018), which found indicators of communication skills had the lowest percentage compared to other skills. This is reading or converting experimental results into picture, graph, or table format.

Teachers can train problem formulation skills by inviting students to carry out practical activities. Because, if someone obtains knowledge from discovery, a person can improve their ability to formulate problems, including solving the problems. The skill of formulating problems is the first integration skill that is important for students to have to support other integrated skills.

The next indicator is the skill of formulating a hypothesis. In this research, the skill of formulating a hypothesis is in the very high category by 82.86%. The skill of formulating a hypothesis is tested through question number 7 where students are asked to formulate suspected answers based on the investigation questions. In question number 7, 58 students answered correctly, and 12 students answered incorrectly. This means students have difficulty answering questions related to hypothesis formulating skills. This is in line with the results of a study by Yunita & Nurita (2021), in which some students can answer questions related to the skill of formulating hypotheses, while other students were not able to answer the questions correctly.

Formulating a hypothesis is a skill that students must have to solve various scientific problems using scientific methods (Liandari *et al*., 2017). Students' hypothesis formulating skills at SMPN 23 Pekanbaru have shown good results, because, during the learning process, the teacher often asks students to express opinions about the problems given by the teacher, apart from that the teacher quite often does practicum during science learning. However, there are still students who cannot answer questions about skills in formulating hypotheses. This is in line with the results of a study by Elvanisi *et al.* (2018) that students' hypothesis formulating skills were still low. One reason is that science teachers rarely train students to formulate hypotheses in learning (Rifqiawati *et al*., 2017). Hypothesis-formulating skills can be trained by inviting students to formulate hypotheses before carrying out practical activities.

Variable control skills are the third indicator of integrated science process skills. In this research, variable control skills are in the very low category by 10%. Variable control skills are tested through question number 8 where students are asked to choose which variable is appropriate to the investigation, namely an investigation to determine the ability of several types of soil to absorb water. In question number 8, only 7 students answered correctly and 63 students answered incorrectly. This means that only a few students can answer questions related to indicators of science process skills to control variables. So, it can be concluded that students' skills in controlling variables are still very low and need to be paid attention to in the science learning process. This is in accordance with the results of a study by Yulianingsih & Paidi (2018) who found that the skill of identifying variables is the science process skill with the lowest mastery.

Yunita & Nurita's (2021) study shows that variable control skills are in the very low category. Based on a percentage of 8.33%, there are still too many students who answer incorrectly because they have difficulty distinguishing between control variables, dependent variables, and independent variables. The skill of controlling variables in the science learning process is still rarely trained by teachers, so it is difficult to improve it to become better. Apart from that, the skill of controlling variables is an integrated skill that requires students to think broadly and critically.

The next indicator is the skill of planning experiments. In this research, experimental planning skills were in the very low category of 18.57%. Experiment planning skills are tested through question number 9 where students are asked to choose 3 pictures that should be carried out in connection with an experiment to determine the effect of an object's weight on its speed down an inclined plane. In question number 9, only 13 students answered correctly, and 57 students answered incorrectly. This means that only a few students can answer questions related to indicators of science process skills in planning experiments. So, it concluded that students' skills in planning experiments are still very low and need to be paid attention to in the science learning process. However, the results of this study are quite different from the results of previous relevant research, which found that indicators of experimental planning skills were in the medium category (Elvanisi *et al*., 2018; Yulianingsih & Paidi, 2018; Rahayu *et al*., 2021).

Experiment planning skills are skills in determining objectives, tools, materials, and appropriate experimental procedures. The results of this research show poor levels of students' skills in planning experiments due to teachers rarely training students to determine the tools, materials, and experimental procedures. In carrying out a practicum, the teacher usually tells students the tools, materials, and steps in the experiment activities. One way to improve experimental planning skills is to allow students to plan experiments according to what they know with the guidance of a science teacher.

The last skill in the integrated science process skills indicator is interpreting data. In this research, data interpretation skills were in the very low category of 20%. Data interpretation skills are tested through question number 10 where a table of observation results is displayed regarding what objects can be attracted by a magnet. Students are asked to interpret the appropriate data based on the table of observation results displayed. In question number 10, only 14 students answered correctly, and 56 students answered incorrectly. This means that only a few students can answer questions related to indicators of science process skills in interpreting data. So, it concluded that students' skills in interpreting data are still very low and need to be paid attention to in the science learning process. According to Yunita & Nurita (2021), data interpretation skills are in the very low category by 16.67%. This is supported by the results of a study by Rahayu *et al.* (2021) showing that indicators of data interpretation skills are relatively low and difficult for students to achieve.

Interpreting data is a skill for connecting the results of observations and data. Students still have difficulty answering questions related to interpreting data. This is partly due to students' lack of mastery of the material. Then, when students are tested to analyze data, students are still confused about choosing the correct answer. Apart from that, data interpretation skills are still rarely trained among students (Yunita & Nurita, 2021).

Based on the percentage results for each tested indicator of basic and integrated science process skills, the overall average percentage is 54.29% in the sufficient category. Supported by Yunita & Nurita's (2021) study, the overall average of students' science process skills was in the medium category. So, it concluded that some students cannot answer correctly the science process skills questions. Factors of students' poor science process skills are that poor students' backgrounds and laboratory infrastructure, the school administration has not initiated contextual learning, the emphasis on teacher teaching is still on the conceptual scope, and learning does not extend to process skill abilities. Students' science (Khaeroningtyas *et al*., 2016), and if a conclusion is drawn, the main factor causing students' poor science process skills is that optimization in learning still does not encourage students to play an active role.

One way to improve students' basic and integrated science process skills is, by carrying out a learning process that can grow and develop students' science process skills. In this learning process, the teacher must play an active role, either in designing or creating the science learning process. Supported by the results of Rahayu & Anggraeni (2017), that science process skills need to be trained through activities directly as learning experiences, such as practical activities. Moreover, developing science learning media can improve science process skills to support inquiry learning activities (Kaleka & Ika, 2018).

Science process skills can be trained with inquiry learning and learning media. Therefore, it is important for teachers and researchers to know the profile of students' science process skills at school. With this analysis, it can design and create better science learning solutions for their future.

CONCLUSION

Based on data analysis and discussion, it was found that students' science process skills at SMPN 23 Pekanbaru were in the sufficient category. The highest science process skill most mastered by students is observation skills. Meanwhile, the lowest science process skill that is most difficult for students to master is the skill of controlling variables. Indicators with a low percentage consist of communication skills, controlling variables, planning experiments, and interpreting data. It shows that students' science process skills still need to be improved through practicing science process skills with students in science learning activities, such as carrying out practical activities or developing science learning media that can improve students' science process skills. This research is recommended for further research in the future as an initial stage in analyzing the profile of junior high school students' science process skill levels. So, the next researcher obtains an idea to create appropriate learning media to improve students' science process skills.

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