Analysis of HOTS content in the science process skills Students' and Teachers' Handbook of the Merdeka Curriculum

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Abstract. This research aims to analyze science process skills (SPS) and higher order thinking skills (HOTS) questions in Natural Science textbooks for elementary school students in Indonesia. Using a qualitative approach, data was collected from independent curriculum student and teacher handbooks for grade IV science subjects. Analysis of question items was carried out through the stages of unitizing, sampling, recording/coding, reducing, inferring, and narrating. The results of the analysis show that the values of science process skills and HOTS are distributed in each learning activity, although the distribution is not evenly distributed. Observational indicators are the ones that appear most frequently, followed by interpretation, classification, and prediction. There is no significant contribution from communication and hypothesis. The analysis also revealed that learning activities present various activities, such as essential questions, do it together, and let's reflect, which support the development of students' critical and creative thinking skills. The results of this research can provide valuable input for developing a curriculum that is more effective and relevant to the demands of the times.

Keywords: Science Process Skills, Higher Order Thinking Skills, Science Textbooks, Independent Curriculum, Elementary School.

1 Introduction

High-level thinking abilities (HOTs) are the main key in this era and are essential skills for future generations to face future challenges [1]. Students need to master the skills of analyzing, interpreting, reasoning, synthesizing, evaluating, and creating meaning according to their individual abilities [2]. Students who have high-level thinking abilities can make decisions independently, logically and precisely, as well as create new knowledge in accordance with environmental conditions due to developments in technology and information. Students who learn with assessments based on higher order thinking skills gain better memory for information [3]. Students who have HOTS skills are able to face various problems and will help them prepare themselves to answer

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future challenges. In addition, high level thinking skills are very necessary for students to compete and face challenges because they can help them make appropriate, logical and careful decisions, and can consider things from various points of view [4]. Higher order thinking skills can be used to predict student success and students who have these abilities are expected to be successful in their further studies [5].

Science process skills (SPS) are thinking skills that scientists use to construct knowledge to solve problems and formulate results [6]. In the past two decades, the term "science process skills" has become more commonly used to describe scientific and critical thinking skills. These skills involve constructing knowledge to solve problems and formulate results. Science education aims to teach effective thinking, including hypothesis generation, manipulation of nature, and data-based reasoning. Educational reform holds great promise for integrating science process skills into the curriculum [7]. Educators recognize the value of these skills in personal, intellectual, and social development, with some emphasizing the importance of teaching more abstractly, involving the mental and physical skills of gathering, organizing, and utilizing information for prediction, explanation, and problem solving. Students can develop these skills through science education that emphasizes science process skills.

The results of PISA 2022 show an increase in Indonesia's learning literacy ranking by 5 to 6 positions when compared to PISA 2018. This achievement records the highest achievement in the history of Indonesia's participation in PISA, showing the success of the Indonesian education system in overcoming learning loss due to the pandemic. This increase in ranking can be seen in reading literacy, with Indonesia rising 5 positions, mathematics literacy rising 5 positions, and scientific literacy rising 6 positions in PISA 2022. This increase reflects Indonesia's resilience in facing the challenges of the Covid-19 pandemic. Even though the international reading literacy score in PISA 2022 decreased by 18 points, Indonesia only experienced a decrease of 12 points, which is a decrease in the low category compared to other countries. Overall, Indonesian students succeeded in maintaining the quality of learning outcomes in their PISA scores [8].

These findings indicate that Indonesian students' higher order thinking skills are still lacking. They are not used to the difficulties of critical and high-level thinking. Students are still used to common things, so their cognitive processes are slower than in other countries. Indonesia created an independent curriculum to overcome this problem. This curriculum seeks to improve Indonesian education. Improving the quality of schools creates a generation that is able to compete, answer future problems, and have international standard education. Implementation of the independent curriculum will run well if all parts work together.

UU no. 20 of 2003 regulates the analysis of test items in education. Article 35 (2) states that questions must be analyzed to identify the competencies, skills, concepts and skills being tested. Question developers need to pay attention to construction, word choice, validity and reliability. Article 50 (1) emphasizes that educational institutions must have a good examination system, including the construction, validity and reliability of questions. Article 50 (2) also requires educational institutions to evaluate the relevance of the test items [9]. Thus, this Law stipulates that all educational institutions must have appropriate mechanisms to review and evaluate the question items used in

exams. This mechanism must include analysis of aspects of question construction, performance and validity. At a certain level, analysis of test items must also pay attention to conformity with curriculum standards and relevant competencies. Analysis of test items must also follow the standards set by the local education regulatory body [10].

HOTS questions have several important elements that must be considered [11]. First, HOTS questions must have a high level of complexity that is able to evaluate students' critical thinking abilities. Second, questions should require students to use more complex thinking strategies than just remembering existing information. Third, the questions should focus on assessing higher competencies, such as solving problems, connecting facts and theories, analyzing and evaluating information, and concluding results from the various information presented. Fourth, the questions must be designed to stimulate student creativity and develop critical thinking skills. HOTS items should challenge students to think outside the box, analyze information, solve problems, create and confirm hypotheses, draw conclusions, and reflect. This will help students to build critical and creative thinking skills that can be applied in real situations.

Ideally, science process skills questions are items designed to measure students' ability to understand, interpret and use important concepts and principles in the science process [12]. Items should investigate students' ability to create hypotheses, run experiments, analyze data, and summarize results. In addition, the questions must be able to measure students' communication skills through clear reports. Written in language that is easy to understand, questions must cover all stages of the scientific process such as observations, hypotheses, experiments, analysis and conclusions. Question styles can vary, including multiple choice, true/false, and open-ended, and may use graphs or pictures. Overall, the goal of the questions is to test skills relevant to the material, encourage critical thinking, and make learning fun for students.

The Independent Curriculum Policy for learning Natural and Social Sciences in Elementary Schools aims to improve students' skills and knowledge about the natural and social world around them [13]. This curriculum focuses on developing students' abilities to explore, analyze and organize information from the physical and social environment. With an emphasis on critical thinking skills, speaking, and mastery of abstract concepts, this curriculum also encourages the use of technology to enhance science learning. Students will understand and apply science concepts through exploration, contextual activities, and the use of various learning resources. The curriculum also promotes collaborative and communication skills through a variety of comprehensive and fun learning activities.

Elementary students today are faced with various realities in learning science. The material provided covers aspects of natural, social and cultural sciences, with school standards that must be met. Students need to master identifying, explaining, and applying science concepts in everyday life. The questions also require them to analyze natural and social phenomena and convert information into useful actions. This research aims to analyze science process skills and HOTS questions in elementary school science textbooks, to identify the level of competency that students must achieve. This analysis allows evaluating the skills contained in the book, as well as assessing its contribution to improving student learning and understanding of basic science concepts and HOTS.

The problem to be solved in this research is evaluating and improving the quality of SPS and HOTS questions in Natural Science textbooks for elementary school students in Indonesia. The specific problem is the need to understand and improve the quality of questions in elementary school science textbooks so that they comply with competency standards and students' needs in developing critical, analytical thinking skills and scientific process abilities. This research is needed because the findings show that Indonesian students' high-level thinking skills are still lacking, and they are not yet accustomed to the difficulties of critical and high-level thinking. The independent curriculum has been implemented to improve the quality of education in Indonesia, but evaluation of science textbooks, especially in relation to question items that reflect science process skills and HOTS, needs to be carried out to ensure that these books truly support the development of the skills needed by students.

By analyzing the science process skills and HOTS questions in elementary school science textbooks, this research will help identify the level of competency that students must achieve. This evaluation will also make it possible to assess the contribution of textbooks in improving students' understanding of basic science concepts and higher-order thinking abilities. Thus, this research is needed to ensure that the learning material presented in science textbooks can support the development of elementary students' critical thinking, analytical and science process skills in accordance with future needs.

2 Method

This research uses qualitative methods with the aim of comprehensively understanding the phenomena experienced by the subject through descriptions in natural situations. This study includes content analysis, focusing on science process skills and HOTS in the Merdeka Curriculum science teacher and student books. Data was collected through documentation techniques, reading and taking careful notes from the fourth-grade elementary school student handbook from the Curriculum and Book Center. Findings are recorded and analyzed objectively to support repeatable conclusions. The process used in this research includes data analysis consisting of unitizing, sampling, recording/coding, reducing, inferring, and narrating.

In the unit selection stage, the researcher collected relevant books, namely the Student and Teacher Handbook for grade IV elementary school science subjects from the Merdeka Curriculum. The units to be observed are selected from the questions contained in the book. This was done to ensure that the data units selected reflect content relevant to science process skills and allow in-depth observation of HOTS aspects. By using student and teacher handbooks as the main data source, this research can provide a more comprehensive understanding of the extent to which HOTS content has been implemented in the fourth-grade elementary school science curriculum. The analysis carried out at the unit selection stage will help researchers to identify patterns in the content that enable the development of higher order thinking skills in students. Overall, the unit selection stage in this research played an important role in directing a systematic and focused data collection process, thereby enabling researchers to conduct in-depth analysis of HOTS content in science process skills contained in the Independent

Curriculum Student and Teacher Handbook for subjects Science class IV elementary school.

The sampling stage in this research was used to simplify the observation process by selecting several handbook units that have characteristics that are representative of the entire content. The samples in this research can be excerpts or concrete examples from the handbook that support the statements made in the analysis. For example, researchers could select several chapters or sections from a handbook that are considered to represent different types of science process skills and HOTS. This research will identify and analyze how science process skills and HOTS are integrated in the content of teacher and student handbooks. This includes analysis of questions, assignments, or activities that encourage students to think critically, analyze, evaluate, and make conclusions in the context of natural science. In addition, this research will also consider the extent to which the handbook supports the development of students' higher-order thinking skills in accordance with the principles of the Independent Curriculum which emphasizes strengthening 21st century skills, including critical and creative thinking abilities. This analysis will provide a deeper understanding of the extent to which teacher and student handbooks in the Independent Curriculum science subjects encourage the development of higher order thinking skills in fourth grade elementary school students. The conclusions from this research can provide valuable input for educators and policy makers in developing curricula that are more effective and relevant to the demands of the times.

The recording/coding stage was carried out to provide narrative explanations and supporting images for the units found in the student and teacher handbooks. The goal of this stage is to create a bridge that connects the findings in the unit with the reader, so that the findings can be understood and used repeatedly without changing their meaning. During the recording/coding stage, the researchers will examine each section of the fourth-grade elementary school science student and teacher handbook in the Merdeka curriculum. They will record every content related to SPS and HOTS, and analyze in depth every related aspect. This recording/coding involves the process of identifying SPS and HOTS content in the handbook. Then, the content will be recorded and coded according to predetermined criteria. For example, does the content require higher-level thinking, such as analysis, synthesis, or evaluation, or does it only focus on more basic conceptual understanding. Apart from that, the researchers will also describe narratively the SPS and HOTS content they found, including concrete examples. This will help readers to better understand and interpret research findings better. Thus, the recording/coding stage in this research aims to provide a comprehensive understanding of the extent to which SPS and HOTS content is integrated in the fourth-grade elementary school science teacher and student handbooks in the Merdeka curriculum. It is hoped that the results of this stage will provide valuable insights for future curriculum and learning development.

The reduction stage in this research was carried out to simplify and focus the data obtained from the Guidebook. This activity is important to obtain more structured and effective data, so that the analysis results can produce more concise, shorter and clearer conclusions. During this stage, researchers will filter information or data that is irrelevant or not related to the research problem, so that only information that is relevant to a high cognitive level in science process skills is retained. Researchers will identify and

delete parts of the Handbook that are not related to the development of higher-order thinking skills, as well as filter out material that is more basic or rote knowledge. Researchers will focus on simplifying the data so that they can analyze the high cognitive level in science process skills as stated in the Independent Curriculum Guidebook. By carrying out the reduction stage carefully, researchers can ensure that the data analyzed is the most relevant and contributes to an understanding of the extent to which higher cognitive levels have been integrated in the curriculum. This stage allows researchers to gain sharper insight into the potential of the Merdeka Curriculum in developing students' higher-order thinking skills in the context of science process skills.

The concluding stage is carried out by drawing conclusions from the findings obtained. Researchers want to reveal the meaning of the various units that have been discovered. This stage is designed as a bridge between descriptive data and the meaning of the book which can illustrate the content with analytical construction. This aims to create a model of the relationship between context and conclusion objectives. The conception used in this research has validity in the academic sphere. The depiction adapted to textbook analysis is carried out by grouping the reduction results and looking for solutions that can produce conclusions from the analysis results.

3 Results and Discussion

The independent curriculum teacher and student handbooks are two books used in implementing the independent curriculum where the two books are interconnected and complement each other. Student books are used by students to understand the material contained in them; essential questions, do it together, let's try, let's reflect, learn more, and choose challenges and various information or activities that students can do. The teacher's book is used as a teacher's guide in carrying out learning which contains; information on material coverage, learning objectives, skills being trained, teaching schemes, and apperception activities that teachers can use as learning references.

The independent curriculum handbook in this research is the first printed 2021 class IV science student book published by the Center for Curriculum and Bookkeeping, Research and Development and Bookkeeping Agency of the Ministry of Education, Culture, Research and Technology, Jalan Gunung Sahari Raya No. 4 Central Jakarta. This book has 8 chapters in it, namely Chapters 1 to Chapter 4 on science material and Chapters 5 to Chapter 8 on social studies material. Each chapter consists of topics A, B, and C which contain different competencies. This research focuses on Chapter 1 Plants are the Source of Life on Earth Topic A: Plant Body Parts, Topic: B. Photosynthesis, the Most Important Process on Earth, and Topic: C. Plant Reproduction

In the results and discussion, the research results will be presented as well as a description of the data based on a previously determined analysis scheme. The following is an explanation related to the analysis of items on science process skills and higher order thinking skills in the science student book for class IV Chapter 1 Plants as the Source of Life. The following results were obtained.

3.1 Content of Science Process Skills Values in Class IV Science Subject Books in Elementary Schools.

Based on data analysis and descriptions that have been carried out in the science student book for class IV Chapter 1. Plants as the Source of Life as a whole, it was found that the values of science process skills are distributed in every learning activity. Indicators of science process skills include observation, inter research, classification, prediction, communication and hypothesis.

Science Process Skills Values Topic A. Plant Body Parts. Science process skills include several key values, including observation, interpretation, classification, prediction, communication, and hypothesis. The review process includes three activities outlined in the student book, including; essential questions, do them together, and let's reflect. These actions are explained in Table 1 according to the number of questions asked.

Table 1. Content of science process skills in student books

Indicator	Essential question		Do it together				Let's reflect				Amount
	1	2	1	2	3	4	1	2	3	4	
Observation	1	1	1	1	1	1	1	1	1	1	**10**
Interoretation	1	1					1	1	1	1	**6**
Classification							1	1	1	1	**4**
Prediction							1	1		1	**3**
Communication											**0**
Hypothesis											**0**

Information:
$\sum$ = number of occurrence frequencies

Based on the data in Table 1, it can be concluded that not all learning contains everything indications relating to parts of the scientific process capabilities. Observation indicators are the indicators that appear most frequently, with a total of 10. Next, interpretation indicators are seen with a total of 6, while classification indicators are represented with a total of 4. Finally, predictions are the ones that appear least frequently. indications, with a total of 3.

If expressed as a percentage, observation indicators account for 100% of the total, while interpretation indicators account for 60%. Classification indicators represent 40% of the total, followed by predictions at 30%. However, communication and hypothesis indicators do not contribute to the overall percentage. Based on existing data, it can be concluded that the distribution is uneven due to the presence of prominent indicators, namely observation.

Existing research shows that the distribution of indicators of science process ability in learning is not always even, with some indicators perhaps appearing more frequently than others. For example, in research conducted by Mahmudah (2017)it was found that observational indicators are often the main focus in learning, while other indicators

such as interpretation, classification, and prediction may appear less frequently[14]. This opinion is supported by findings from researcher, which states that observational indicators tend to dominate in science learning, while other indicators such as interpretation and prediction may not receive enough attention [15].

In the context of indicator topic A plant body parts are carried out through three activities, namely practicing essential questions, doing it together, and let's reflect. The frequency distribution of activities varies. Essential questions are carried out twice, do it together four times, and let's reflect four times in a certain context. The essential question consists of two interpretive indicators, namely do it together with a frequency of 0 occurrences, and let's reflect with a frequency of 4 occurrences. essential questions don't produce a single classification indicator, don't do it together at all, and let's reflect four times. In the analysis of essential questions, no examples of predictive indicators were identified, no examples of do it together, and three examples of let's reflect were noted. There are no communication activities and hypotheses identified in the essential question, do it together, and let's think about it. The Science Student Book contains examples of essential question exercises, do them together, and let's reflect.

In this essential question, students are asked to identify the body parts of plants, understand the function of each part of the plant body, and relate the function of body parts to the needs of plants to grow, defend themselves and reproduce [16]. Based on these joint activities, students were asked to carry out literacy activities, take their test glasses and make observations, asking them to compare with the results of their group friends. Directing students for group discussions withencourage students to mention other functions of the rods that they know [17].

3.2 Content of Higher Order Thinking Skills (HOTS) Values in Class IV Science Subject Student Books in Elementary Schools

Higher Order Thinking Skills (HOTS) includes several key values, including analyzing, evaluating and creating. The review process includes three activities outlined in the student book, including; essential questions, do it together, and let's reflect. These actions are explained in Table 2 according to the number of questions asked.

Table 2. HOTS content in student books

Indicator	Essential question		Do it together				Let's reflect				Amount
	1	2	1	2	3	4	1	2	3	4	
Analyze	1	1	1	1	1	1	1	1	1	1	**10**
Evaluate							1	1	1	1	**4**
Create							1	1	1	1	**4**

Note: ∑ = number of occurrence frequencies

Based on the data in Table 2, it can be concluded that not all learning contains all the indications related to the Higher Order Thinking Skills (HOTS) sections. The ana-

lyzing indicator is the indicator that appears most frequently, with a total of 10. Furthermore, the evaluating indicator is seen with a total of 4, while the creating indicator is represented with a total of 4.

If expressed in percentages, analyzing indicators account for 100% of the total, while evaluating indicators account for 40%. The create indicator represents 40% of the total. Based on existing data, it can be concluded that the distribution is uneven due to the presence of prominent indicators, namely observation.

In the context of indicator topic A, plant body parts are carried out through three activities, namely practicing essential questions, doing it together, and let's reflect. The frequency distribution of analyzing the activities varies, the essential questions are carried out twice, do it together four times, and let's reflect four times. The indicator evaluates the essential question and does it together with a frequency of 0 occurrences, and let's reflect it with a frequency of 4 occurrences. The indicator creates an essential question and does it with a frequency of 0, and let's reflect four times. The Science Student Book contains examples of essential question exercises, do them together, and let's reflect.

This book is about creating indications that inspire children to be creative or produce solutions to solve a problem. This book encourages children to be creative, innovate and solve problems. Students must be able to innovate, predict, and solve problems to apply higher order thinking skills. Creative interactions between teachers and students and the curriculum can increase self-confidence, ability, creativity and curiosity [18]. Students can also explain the events in this book. This is in accordance with previous research. Developing higher-order thinking skills helps students analyze, justify, and make judgments [19]. Students can gain confidence, voice their perspective, and analyze a phenomenon by having the opportunity to defend their beliefs [20]. Students can work together and critically examine their ideas by modifying learning techniques to allow for interaction.

Additionally, students are given the opportunity to analyze and interpret the material. Previous research suggests that analysis requires examining material in detail to discover meaning [21]. The processing of this information influences their task performance. Students need information processing skills to learn. Literacy is needed to help people solve difficulties with these abilities. This is also consistent with the idea that the cognitive process of evaluation involves providing judgments as a reference for decision making [22]. Assessment prevents rote practice, fosters critical thinking, and enhances learning. Students can improve their work by evaluating it [23].

This book also helps students overcome challenges. Examples of reports or products that they will create to solve problems and use as references can be provided. According to previous research, this creation component involves creating something new or adapting something that already exists to methodically solve a problem [21].Based on the data above, creation, analysis, and assessment are the most common HOT components in this book. Additionally, others believe HOT is a series of scientific techniques to solve its difficulties. By giving students a place to analyze, assess and solve their future problems. Previous research suggests that students use higher-order thinking skills including analysis, synthesis, and evaluation to complete the scientific process[24]. In addition to remembering and understanding, students now know how to

integrate the skills of analyzing, evaluating, and creating. HOT activities can be started by asking or telling stories about real problems or conditions in the student's environment that require thinking to solve them. All subjects must include thinking exercises.

4 Conclusion

Based on the research results, it can be concluded that the student books for class IV science subjects in the Merdeka Curriculum contain science process skills (SPS) and higher order thinking skills (HOTS) which are integrated in every learning activity. However, there are several findings that need attention. SPS distribution is uneven in student books. Observation indicators appear most frequently, followed by interpretation and classification, while predictions, communication and hypotheses rarely or do not appear. This shows that learning tends to focus more on observation than other science process skills. SPS is reflected in learning activities such as essential questions, do it together, and let's reflect. However, some activities may dominate certain indicators more than others, such as dominant observations in essential questions. The content of HOTS in student books is also visible, especially in activities that require students to think critically, analyze and make conclusions. However, there is no clear continuity in the integration of HOTS across student books. Nonetheless, student books generally provide opportunities for students to develop higher-order thinking skills through challenging questions and assignments that encourage reflection. This research provides a deeper understanding of the extent to which science process skills and HOTS content are integrated in the fourth-grade elementary school science curriculum. These findings can be the basis for developing a curriculum that is more effective and relevant to the demands of the times. Thus, evaluation of science textbooks needs to continue to be carried out to ensure that these books support the development of students' critical thinking, analytical and science process skills in accordance with future needs.

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