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Data inventory of students' research skills to support SDGs goals at the junior high school level in Bandung

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ABSTRACT

This research is aimed at gathering data on students' research skills in supporting the SDGs (Sustainable Development Goals) at the secondary school level. This study is a quantitative descriptive research using a survey method to map students' research skills in one of the schools in Bandung city. The population of this research consists of 7th-grade students who have studied the subject of The Nature of Science and the Scientific Method (n=52). The results of this study describe students' knowledge of SDGs and their research skills related to SDG-oriented issues. The data indicates that while many students are aware of the SDGs, their implementation in daily life still needs improvement. Furthermore, the results regarding research skills show that many students understand how to conduct research. However, for each indicator, there is still a data spread or unequal distribution of scores between high and low groups in research skills. Therefore, efforts are still needed to improve students' research skills so they can actively contribute to solving problems.

INTRODUCTION

One way to prepare the younger generation to be aware of global issues is by providing real-world stimuli. This aligns with the skills aimed at achieving 21st-century competency, such as communication skills, creativity, collaboration, critical thinking, and problem-solving (Yokhebed, 2019). Looking at the competencies aimed at achieving 21st-century skills, students, who are the future generation, are expected to actively contribute to global issues and problem-solving. Problem-solving skills can be honed through education and learning at school. As mentioned in previous research, it was found that students' problem-solving skills are crucial in improving the quality of learning (Jayadi et al., 2020). There are several things that can be done, one of which is providing learning experiences that directly involve students. The goal is to make the learning more meaningful and impactful for students, so they can experience the real-life effects of what they have learned, making the learning process more significant (Widodo, 2021).

School learning is the most tangible way to provide real-world stimuli for understanding concepts (Engeström & Käyhkö, 2021; Jurdak, 2016). Therefore, it is essential to have a type of learning that can offer such stimuli, enabling students to take real action and directly engage with a problem. In several studies, one of them mentions that providing real stimuli for students to take action gives them a different experience of what they have learned (Kartini et al., 2021). This requires equipping students with research skills to ensure that the learning experience stimulates them to actively solve real-world problems.

Several studies have shown that there is still a gap in the learning process when it comes to equipping students with research skills. This is an important aspect that needs to be improved, especially considering that the demands of 21st-century skills require students to possess problem-solving abilities. In research skills, the output gained by students is the ability to solve real-world problems (Chu, 2001). Equipping students with research skills provides an opportunity to learn and build knowledge. In addition, providing opportunities for students can be done through an assessment approach, which can serve as a guide for students in conducting research (Sari et al., 2019).

Based on these points, research aimed at equipping students with research skills will support 21st-century skills to create students who are aware of problems, capable of making real contributions in problem-solving, and informed about global issues. These global issues are outlined in the current development goals, which are encapsulated in the 17 points of the Sustainable Development Goals (SDGs). The SDGs are a sustainable development program that includes 17 measurable goals with set timeframes for achievement. The main goal of sustainable development or the SDGs is to achieve a universal common goal that can maintain three essential elements in order to create a balance, which refers to three dimensions: environmental, social, and economic (Chen et al., 2022). These three dimensions in the SDGs are interconnected and related to achieving harmony and balance in development (Berglund & Gericke, 2022; Pham-Truffert et al., 2020). The SDGs in Indonesia have become one of the frequently discussed programs among the public, including in the education sector (Safitri et al., 2022).

One of the points in the SDGs is quality education. Sustainable development can be achieved through education (Stevani & Nugraheni, 2024). Through education, it is possible to change human perceptions, attitudes, and behaviors (Siahaan et al., 2023). Quality education is related to the development of individuals who possess abilities, skills, and a broad understanding of various matters (Stevani & Nugraheni, 2024). Education is defined as a methodical and controlled process that seeks to instill knowledge, skills, values, and attitudes in members of society (Sihaloho et al., 2023; Spector et al., 2014) . The education sector enhances students' skills for in-depth SDG research and empowers them to actively contribute as change agents in solving real environmental problems.

Student involvement in real problem-solving is essential for contributing to development. Engaging students directly in school-based learning makes the learning process more meaningful

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and enhances their understanding of concepts (Widodo, 2021). Therefore, the involvement of the younger generation in understanding and addressing problems, as well as being active in global issues, can have a significant impact on the progress of a nation (Rachman et al., 2024). Based on the issues identified, an inventory of students' research skills will be conducted to support the SDGs targets at the junior high school level. This will provide a foundational understanding of how students' research skills can have a positive impact on their problem-solving abilities in supporting the SDGs targets. This is intended to be initial data that can be used as a reference to be a reference in improving problem-solving skills through students' research skills.

METHODS

The type of research conducted to assess students' research skills is quantitative descriptive research, with data collection using a survey method. In its implementation, the survey is used to describe the data quantitatively (in numbers) regarding trends, behaviors, or opinions of a population by studying a sample of that population (Creswell, 2014). The techniques used to collect data in this study involved several methods, namely: 1) Google Form: used to collect data in the form of questionnaires about SDGs knowledge and research skills students, and Data were measured on a 1-4 point Likert scale; 2) Semi-structured interviews: used to gather additional qualitative data about students' knowledge of the SDGs and research skills, such as: "have you ever heard of sustainable development?" or “have you ever conducted research on sustainable development before?”. The interview data was then processed descriptively qualitatively.

The population in this study consisted of 7th-grade students from a private junior high school in Bandung. The selection of this population was based on certain considerations, namely that the students had already studied on the Nature of Science and the Scientific Method concept. This material is grade 7 junior high school material studied in the odd semester. This material is material related to the SDGs because it will provide students with skills to be able to play an active role in solving problems both locally and globally This was intended to assess students' scientific method skills, which are indirectly related to research skills.

The sample (n-52) for this study was selected using convenience sampling, which took into account the ease and availability of classes that could be studied (Creswell, 2014). The study sample included two 7th-grade classes, totaling 52 students, who had previously studied the Nature of Science and the Scientific Method. The instrument used in this study was a questionnaire to measure SDGs knowledge (Nusrat Afroz & Zul Ilham, 2020) and students' research skills in learning (Anderson, 2015; Prahmana et al., 2016).

RESULTS AND DISCUSSION

From the data that has been collected on students' knowledge of sustainable development and students' research skills, it has provided an overview of students' knowledge of sustainable development and students' skills in researching a problem. This can be an initial overview of how students can play an active role in influencing sustainable development, and problem-solving skills through research activities. Given that problem-solving skills are important things that students must have as provisions in life and 21st century skills (Jayadi et al., 2020). Therefore, students' research skills are provisions that need to be given to students to support sustainable development. The results of the research that has been conducted are discussed based on the collected data. The data were processed based on the instruments used in the study, including students' knowledge about the SDGs (Nusrat Afroz & Zul Ilham, 2020) and students' research skills (Prahmana et al., 2016). The discussion is as follows:

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Students' knowledge about SDGS descriptive statistical data processing

Based on the descriptive statistical analysis of students' knowledge about the SDGs, it will provide information about the overall processed data. This data includes information about the comparison of each indicator related to students' knowledge of the SDGs. The results of the descriptive statistical analysis are as follows.

Table 1. Descriptive data of students' knowledge about SDGs

	N	Range	Minimum	Maximum	Mean		Std. Deviation
						Std. Error	Statistic
Indicator 1 score: General Knowledge	52	62	38	100	77.83	2.226	16.055
Indicator 2 score: SDGs Goals	52	62	38	100	74.54	1.971	14.215
Indicator 3 score: Perception about SDGs	52	56	38	94	73.92	1.425	10.276

Based on the data in Table 1, it was found that, in general, each indicator has a relatively high average score (>70). The highest average score in the displayed data is for the General Knowledge indicator (77.83), while the lowest average score is for the SDGs Perception indicator (73.92). This means that, in general, students are familiar with and have heard of the SDGs, but their perception of the SDGs still needs improvement. Several assumptions that could explain the overall high average score are that students already have a general understanding of the SDGs. This aligns with previous research, which indicated that students' knowledge of the SDGs is already high (Nusrat Afroz & Zul Ilham, 2020). In addition, data from interviews with several students revealed that they are aware of the SDGs, recognizing that SDGs are related to sustainable development and that they have heard about the SDGs and its targets, specifically mentioning one of the SDG targets, namely target number 13 on Climate Change. One of the students when asked about: "*have you ever heard of sustainable development and its targets?*", the student answered "*Yes, I know.*" Furthermore, from the data obtained, students have demonstrated a good level of knowledge about the goals of the SDGs (74.54). This is a positive step, suggesting that further development can be made to empower students to collectively contribute to achieving sustainable development in Indonesia. This is in accordance with previous research which states that students have an important role in achieving sustainable development (Abowardah et al., 2024; Pauw et al., 2015; Zwolińska et al., 2022).

In addition to the general data on students' knowledge, data processing was also conducted based on the individual items answered by the students. The purpose of processing data per item is to measure which items received the highest scores from students. The results of this data processing are as follows.

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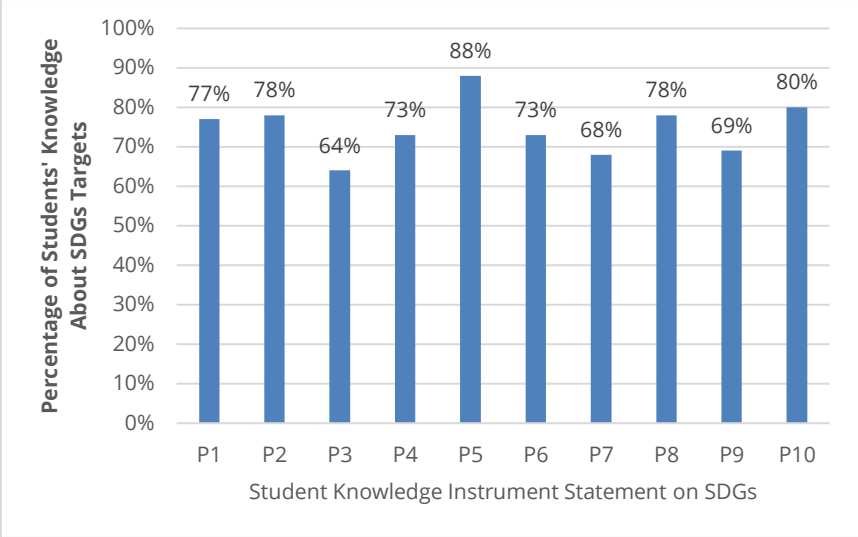

Figure 1. Percentage of students' scores per item statement

Based on Figure 1, it was found that several statements about the SDGs were answered correctly by students and received fairly high scores (specifically, in statement 5 (P5), with 88%). Statement 5 is part of the indicator for the SDG goals, and the average student understanding of the SDG objectives is quite high (specifically, 88%). In statement 5 (P5), students were presented with a statement about sustainable development achievements. The wording of this statement is: "To achieve sustainable development, everyone in the world must have access to quality education." From this statement, 88% of students strongly agreed. For the SDG goals indicator (see Table 1), the SDG goals indicator also has a good average score (74.54), which is a positive sign of students' knowledge about the SDG objectives. However, in statement 3, based on the research instrument, which is part of the SDG goals indicator, the percentage score was the lowest (specifically, 64%). The wording of statement 3 is: "I am aware that the sustainable development goals are intended to be achieved by 2030." This is a point of concern in both the research indicator and the research statement. The instrument used by (Nusrat Afroz & Zul Ilham, 2020), statement 3 also has the lowest score. In statement 3 (P3) about students' awareness of sustainable development goals aimed to be achieved in 2030, students still have low scores. Students still only know, but have not realized that sustainable development goals are aimed to be achieved in 2030. This is in accordance with research by (Nusrat Afroz & Zul Ilham, 2020) which found that students' awareness of sustainable development goals is still low.

Data processing: Frequency analysis

Frequency analysis is used to obtain a summary of an individual variable (Trihendradi, 2005). This means that in this analysis, the occurrence of a value or category within a data set will be presented. Based on Table 2, it was found that each indicator has a relatively high average score (>70). This indicates that, on average, students' knowledge about SDGs is quite good. However, when looking at the standard deviation values, there is a notably high standard deviation (specifically in Indicator 1), which suggests that students' knowledge varies greatly. It is possible that some students have a very high understanding, while others have a low understanding. In general, data on students' knowledge of sustainable development has a diverse data distribution. Data on the indicator of students' general knowledge of SDGs can be seen as follows. The data from the frequency analysis results are as follows.

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Table 2. Descriptive frequencies data of students' knowledge about SDGs

	Indicator 1 Score (General Knowledge)	Indicator 2 Score (SDGs Goals)	Indicator 3 Score (Perception about SDGs)
N		52	
Mean	77.83	74.54	73.92
Median	75.00	75.00	75.00
Modus	75	69	81
Std. deviasi	16.055	14.215	10.276
Skewness	-.245	-.285	-.728
Std. Error of Skewness	.330	.330	.330
Kurtosis	-.494	.021	1.586
Std. Error of Kurtosis	.650	.650	.650
Minimum	38	38	38
Maximum	100	100	94

In Figure 2, it was found that the most common score achieved by students was 75 (exactly 18 students). The information gathered from Figure 2 indicates that most students have a moderate level of general knowledge about SDGs (75), which means their understanding is neither too high nor too low. The average value of students' general knowledge is at 75 (18 students). This aligns with the standard deviation for Indicator 1 on general knowledge, which had the highest standard deviation. Additionally, Figure 2 shows that there are some students who already have a high level of general knowledge about SDGs, with a score of 100 (exactly 11 students). Furthermore, Figure 2 also reveals that there is a group of students who have a very low score (38), with 1 student in this category. From this data, it is evident that students' scores on the general knowledge indicator show considerable variation. This is also in accordance with previously conducted research that students tend to know about sustainable development (Nusrat Afroz & Zul Ilham, 2020).

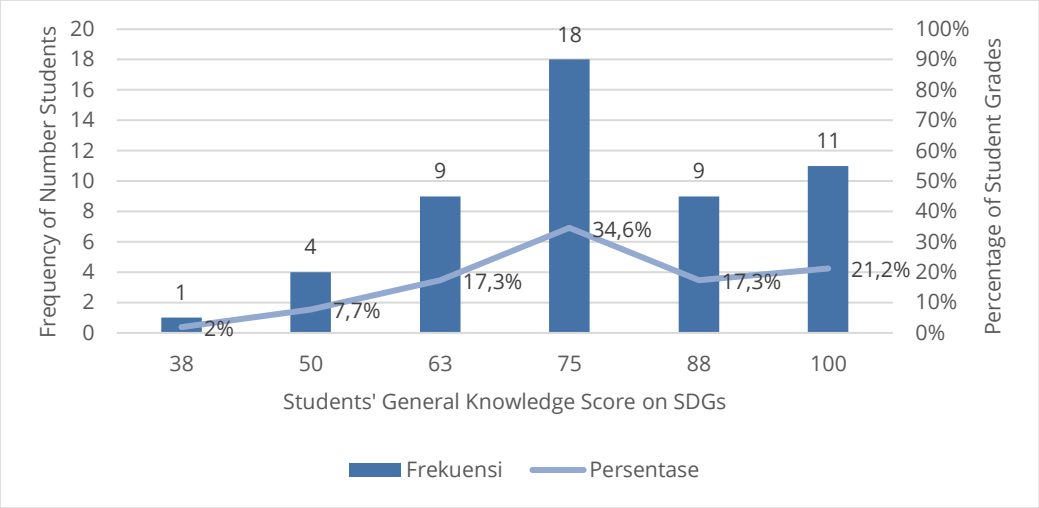

Figure 2. Frequency distribution of students' scores on the general knowledge indicator

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As for Indicator 2, which pertains to students' knowledge of SDGs' goals, the data is as follows.

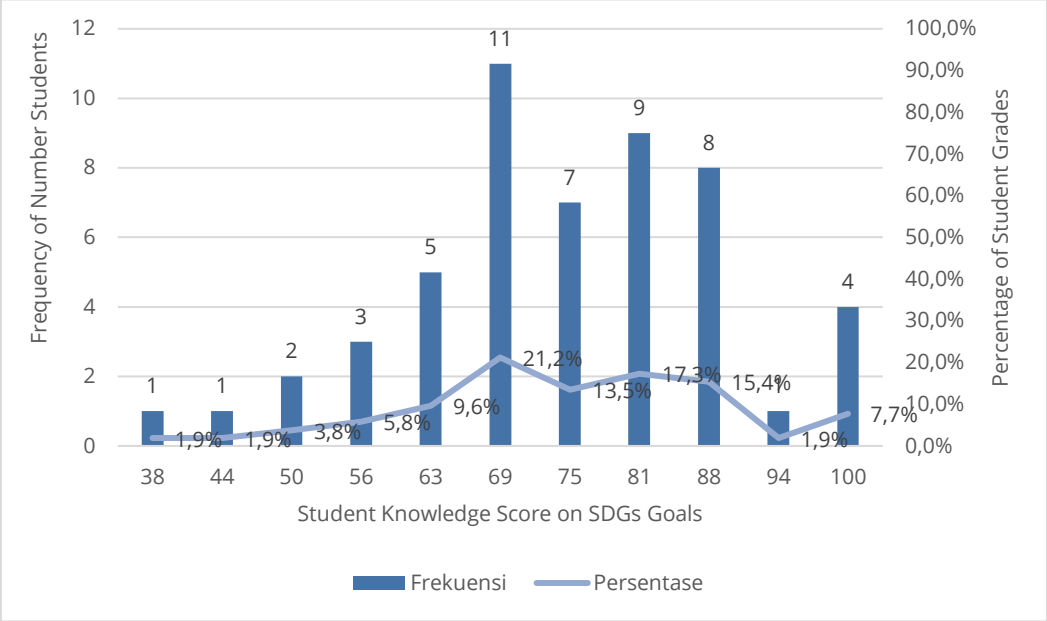

Figure 3. Frequency distribution of students' score on the SDGS goals indicator

Based on Figure 3, it was found that the data distribution is not very even. This means that not all students have the same knowledge about the SDGs. from the data collected, it was found that the average student got a score of 69 (11 students), while the lowest scores were 38 and 44, each of which had one student getting the lowest score. The highest score with 100 points was obtained by 4 students. The tendency of the scores is centered around the number 69 (specifically, 11 students), which was the most frequent score obtained by students. This highlights the need to improve students' knowledge of the SDGs. Given that the scores obtained are quite extreme, with an uneven data distribution, although most students fall within the >75 range, many still have scores <75. The large number of students who scored 69 (specifically 11 students) indicates that the SDG objectives have not been effectively communicated among students. This aligns with previous research, which mentioned that while students generally understand the SDGs and have a good view of them, their awareness of the SDGs remains low (Novieastari et al., 2022). One way to increase student awareness is to involve students directly in the problem (Saragih et al., 2021). This is in accordance with previous research that has been done using STEM-ESD project learning which can increase student awareness of the problem (Solihat et al., 2024). Additionally, the percentage line also shows an unstable trend. This indicates that students' knowledge about the SDG objectives still needs to be improved. The values for indicator 3, regarding students' perceptions of the SDGs, are as follows.

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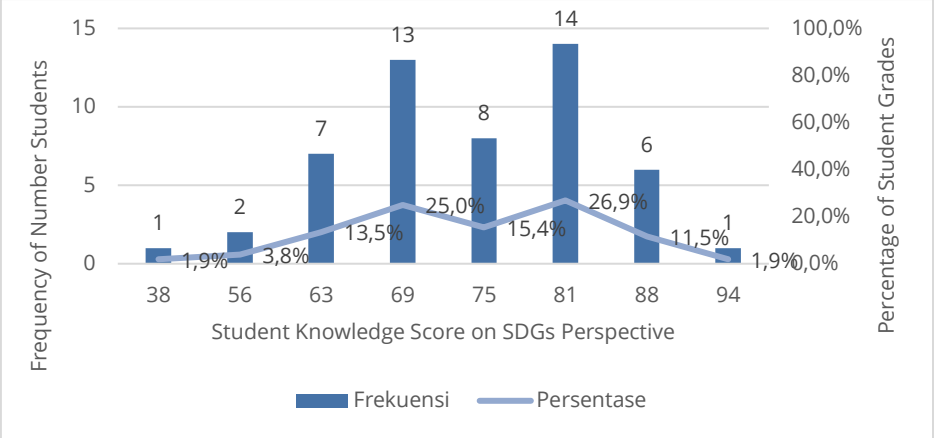

Figure 4. Frequency distribution of students' score on the perception about SDGS indicator

Based on Figure 4, it was found that the data distribution is uneven, and there is a significant variation in the students' scores. From the obtained data, it was found that students do not share the same perception of the SDGs. This can be seen from the tendency of the scores shown in Figure 5, where the highest score achieved by students was 81 (specifically by 14 students). However, there was also the most frequent score obtained by students, which was 69 (specifically by 13 students). This is noteworthy as the scores of the high and low-performing groups tend to be balanced. Therefore, the data is uneven due to the tendency of scores being spread across both groups. This presents a rather extreme condition, indicating a significant difference in students' perceptions of the SDGs. Additionally, the percentage of students regarding the SDGs shows an unstable trend. This can be seen from the trend that fluctuates up and down. This differs from previous research, which indicated that students' perceptions of the SDGs were already good (Novieastari et al., 2022).

Student research skills on the SDGS descriptive statistical data processing

In this study, students' research skills on the SDGs were processed using descriptive statistics to illustrate the extent of students' research skills related to the SDGs. The data is presented in table form to display the overall results of the students' scores. The test conducted was a frequency analysis test. This test is used to present the count or frequency and the proportion in percentage of a categorical data variable (Trihendradi, 2005). However, before being analysed using frequency analysis, the data was first tested using descriptive analysis to provide an overview of the entire dataset. The results of the descriptive analysis test on students' research skills are as follows.

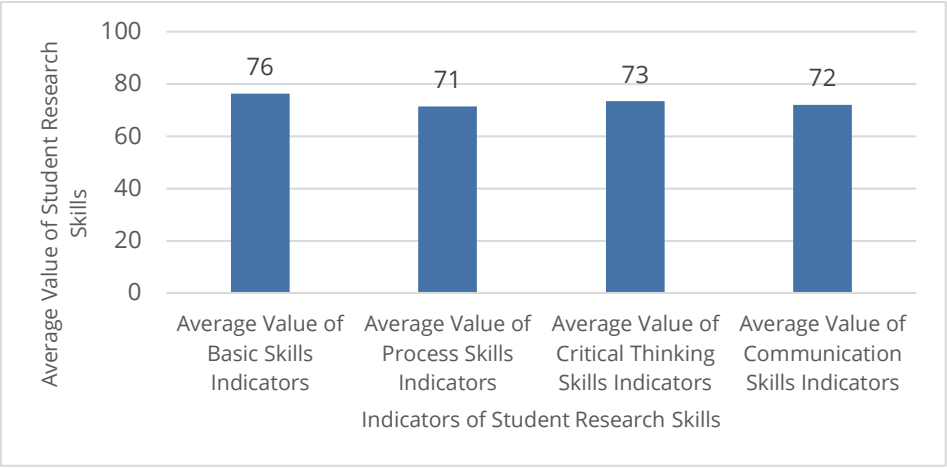

Figure 5. Average value of student research skills

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Based on Figure 5, in general, students' research skills show relatively good scores. Each research skill indicator has an average score above 70. The results of this study are consistent with previous research, which mentioned that students' research skills are quite good. In previous studies, it was stated that one of the learning methods that influences research skills is providing research-based learning (Prahmana et al., 2016). In the data from Table 3, overall, the highest average score of students is found in the basic skills indicator (76.27), while the lowest average score is found in the process skills indicator (71.33). This suggests that in the implementation of the research process, students still face difficulties in conducting research. This is consistent with previous studies, which indicated that students' skills in conducting research are still low (Maknun et al., 2020). The skill of conducting research is included in the process skills category (Prahmana et al., 2016). This raises several assumptions, one of which is that research skills training provided in lessons is still scarce. Previous research also shows that only 43.8% of students receive research skills training (Maknun et al., 2020).

In addition to the general data on students' research skills, data processing was also conducted on the students' scores per item statement. The results are as follows.

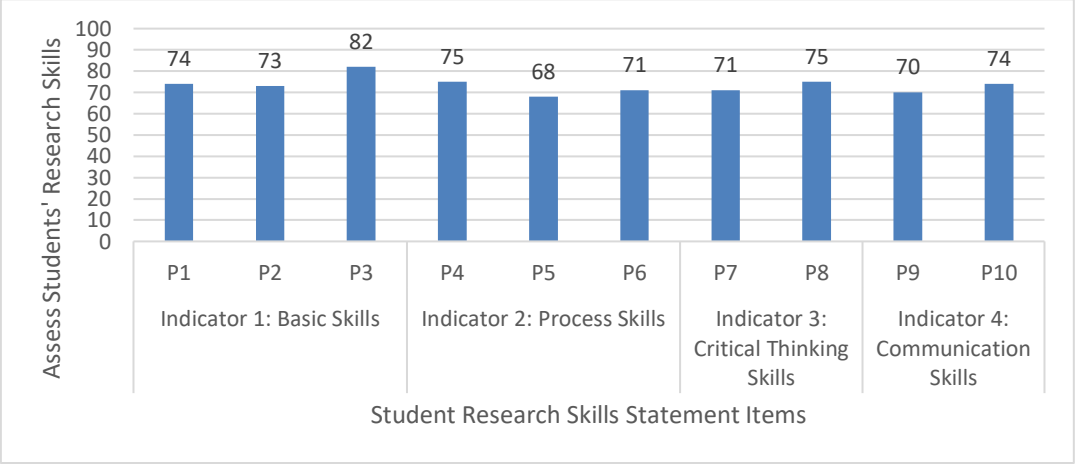

Figure 6. Students' research skills scores based on statement items

Based on Figure 6, it was found that there is a variation in research skills when viewed from the scores obtained. Each statement has a different value. The highest score for each item was obtained on statement item P3, under the basic skills indicator (82). This can be interpreted to mean that students tend to already possess fairly good research skills in basic skills. The wording of statement 3 is: "Skills in categorizing information are important in conducting research." From this statement, the students' scores are quite good. Thus, it can be seen that students are aware that basic research skills must be possessed first in order to conduct research. The lowest score for a statement item was found in item P5, under the process skills indicator (68). This indicates that students' process skills are still low, so development is needed to improve their process skills in research. Statement 5 reads: "I often confuse facts and opinions when designing a research project." Many students scored low on this statement. Therefore, students still need training to differentiate between facts and opinions when conducting research.

Data processing of frequency analysis

Frequency analysis is used to obtain a summary of an individual variable (Trihendradi, 2005). In other words, in this analysis, the occurrence of a value or category within a dataset will be presented. The data from the frequency analysis is as follows.

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Table 4. Descriptive Frequency Data of Student Research Skills

	Indicator 1 Score (Basic Skills)	**Indicator 2 Score (Process Skills)**	**Indicator 3 Score (Critical Thinking Skills)**	**Indicator 4 Score (Communication Skills)**
N	52			
Mean	76.27	71.33	73.37	72.08
Median	75.00	75.00	75.00	75.00
Modus	75	75	75	75
Std. deviation	14.024	14.241	14.042	16.937
Skewness	-.342	-.474	-.276	-.461
Std. Error of Skewness	.330	.330.	.330	.330
Kurtosis	-.005	.047	.202	.225
Std. Error of Kurtosis	.650	.650	.650	.650
Minimum	42	33	38	25
Maximum	100	100	100	100

Based on Table 4, it was found that each indicator has a relatively high average score (>70). This indicates that the average student research skills are quite good. However, when looking at the standard deviation, there is a relatively high value (specifically for indicator 4). This suggests that students' research skills in the communication skills indicator show significant variation. It is possible that some students have very high research skills in communication, while others still have low skills. The distribution data for each indicator is as follows.

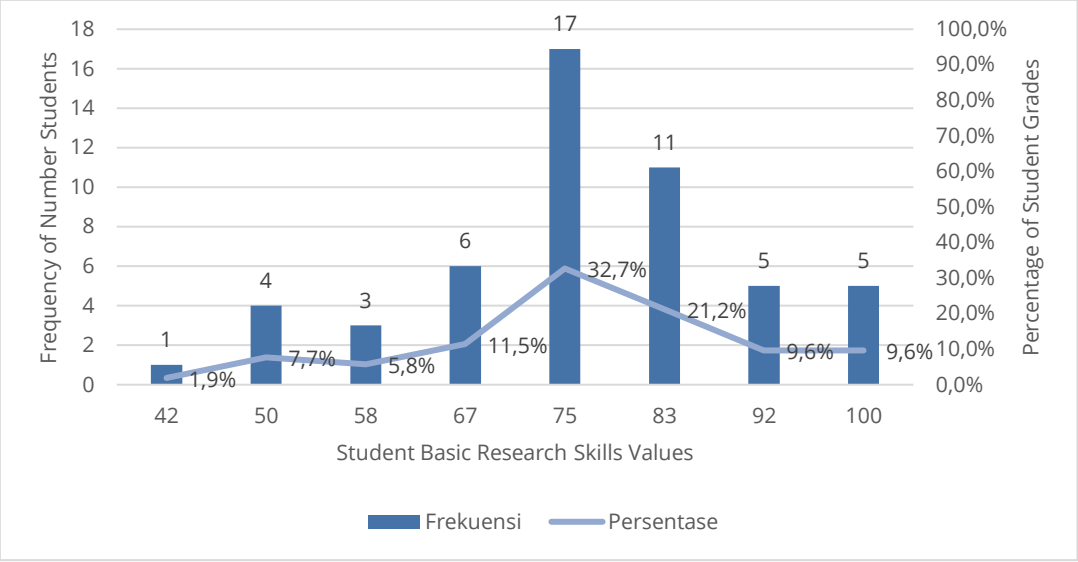

Figure 7. Frequency data of the emergence of students' research skills values on basic skills indicators

Based on Figure 7, it is found that the students' scores show that the scores are centered in one group (to be precise, the frequency of scores is mostly at 75). This suggests that students' research skills scores on the basic skills indicators are quite good. The distribution of the data also illustrates that many groups of students tend to score high (>75) rather than low (<75). In addition, there are also groups of students who get a score of 100 (5 students to be exact) which shows that

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students' basic skills in conducting research are quite good and students understand the importance of understanding basic skills to conduct research.

As for the data on indicator 2 of research skills regarding process skills, the data processing results can be seen as follows.

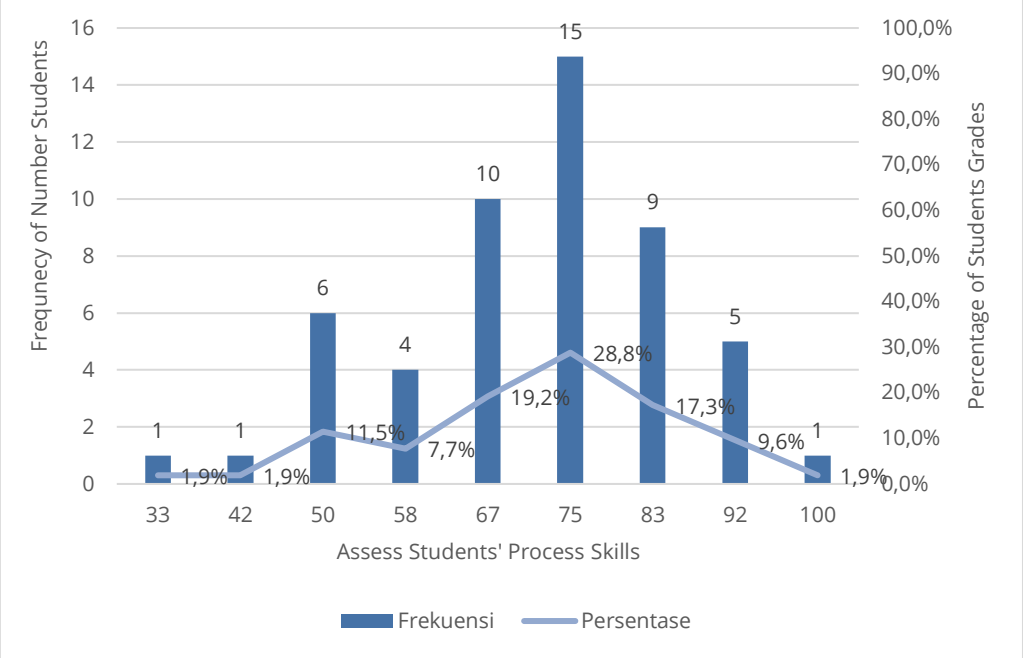

Figure 8. Frequency data of the emergence of student research skills values on process skills indicators

Based on Figure 8, it is found that students' scores show most of them centered on the score of 75 (15 students to be exact). This provides a temporary picture that the value of students' research skills on process skills indicators has a fairly good value. However, there are still many students who score <75. The distribution of data shows that the scores of high and low group students tend to be in the low group. From the increase in the graph, it can also be seen that the graph has a decreasing curve along with the high scores obtained by students. This indicates that most students have not mastered the process skills in student research skills. The data shown is sufficient to illustrate the criteria for students' process skills. Basically, from the total number of students (n=52), 15 students have a process skills score >75. This is good enough, but the trend of the data obtained shows that there are still many students who have low process skills (22 students scored <75).

One of the other data obtained is about research skills in indicator 3, namely critical thinking skills. The data that has been processed is as follows.

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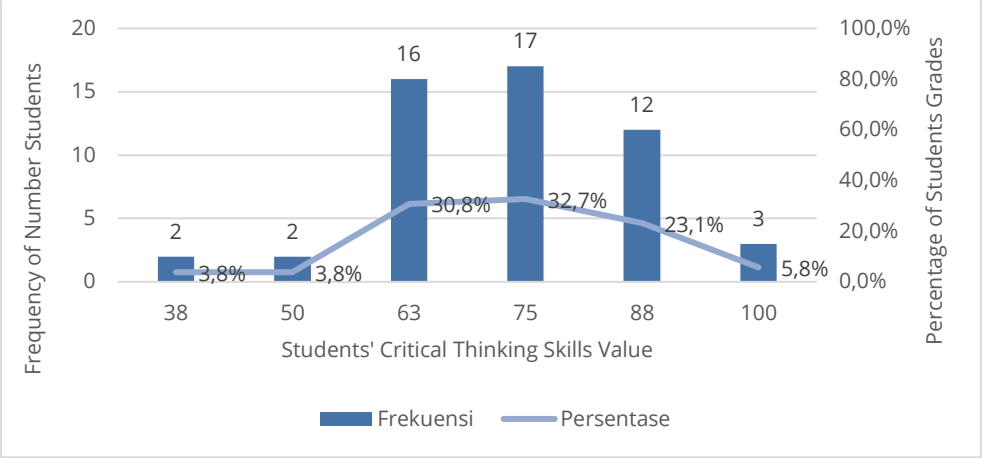

Figure 9. Frequency data of the emergence of student research skills values on critical thinking skills indicators.

Based on Figure 9, it is found that the value of students' research skills on the critical thinking skills indicator is mostly at the value of 75 (17 students to be precise) which is the middle value. However, the data shows that there are still many students who have scores <75 (20 students to be exact). This indicates that students still have not mastered critical thinking skills in their research skills. Comparison between high and low groups in the data found, shows that the most data distribution is in the category below 75. This means that there are still many students who have not mastered critical thinking skills compared to students who have mastered critical thinking skills (15 people from n = 52 to be precise). This needs to be a concern for efforts to improve students' critical thinking skills, especially for groups of students who are still in the <75 category.

The last value in the data processing process on student research skills, namely research skills on communication skills indicators. The results of the data processing can be seen as follows.

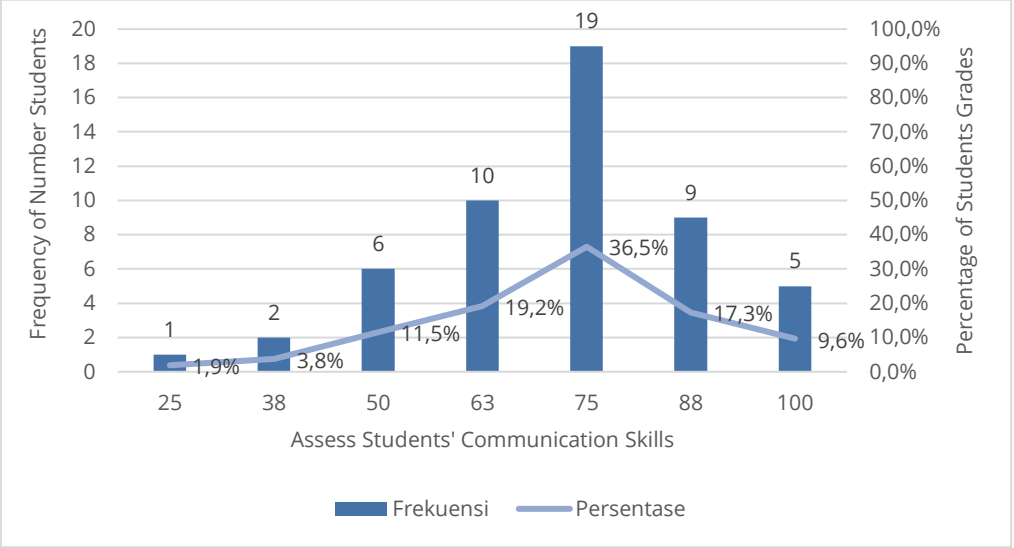

Figure 10. Frequency data of the emergence of student research skills values on communication skills indicators

Based on Figure 10, it is found that students' communication skills scores are centered on the score of 75 (19 students to be exact). However, in the distribution of data that appears, many students' scores are still <75. This indicates that there are still many students who are less skilled in research skills on communication skills indicators. From the data obtained, there are 19 students who still have scores below 75. This is an important concern and finding to be able to make efforts to improve student communication skills, especially for students who still have scores

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below 75. As for other results, namely there are also students who have scores above 75 (14 students to be precise). Given the importance of communication skills in supporting 21st century skills, this must be a special concern. Students are not only equipped with cognitive abilities, but are able to play an active role in development and communication skills are one of the supporters of 21st century skills (Kennedy & Sundberg, 2020).

CONCLUSION

The research on inventing data on student research skills to support SDGs goals has provided a sufficient picture of research skills. The data obtained can be used as initial data for innovation and efforts to re-improve student research skills in supporting SDGs. This inventory report provides an overview of students' research skills and knowledge of the SDGs, presenting a positive outlook for their development and awareness of SDGs programs in Indonesia. The data collected illustrates that some students have heard a lot about SDGs but still need to be improved to be able to provide knowledge about the goals of SDGs itself in order to improve students' perceptions in supporting SDGs goals. In addition, data on students' research skills show that overall the value of research skills, many students already understand and understand how to carry out research. However, in each indicator, there is still an uneven pattern of data between research skills in high and low groups. Therefore, efforts still need to be made to improve students' research skills so that students can actively contribute to solving problems.

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