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Profile of Research Skills of Class X High School Students on Environmental Change Material

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ABSTRACT

This study aims to (1) observe biology learning activities on environmental change and (2) analyze the level of research skills of high school students on the concept of environmental change. This research used a descriptive qualitative method with a case study approach to understand an issue or problem using a case within a certain period by collecting data from various sources such as observation, interviews, and documents. The data collection technique used was non-participant. The instrument used in this study was an observation sheet to observe learning activities carried out by the teacher. In addition, interviews were conducted with teachers, and questionnaires were given to students to obtain information on the extent to which teachers and students know research skills and to see the level of research skills possessed by students. The research results show that the teacher's learning process has not directed students to develop research skills, so the research skills profile in the sample studied is still lacking and not optimal.

Keywords: 21st century, Research skills, Biology learning, Environmental change

Introduction

Indonesia's education development is one of the biggest challenges today. The challenge that must be faced is how the world of education can prepare young people with quality human resources who can compete in the current era of globalization and revolution 4.0. According to Sutia (2019), research skills are one of the 21st-century skills students must have. This aligns with the opinion of Trilling & Fadel (2009), who state that research skills are the most needed jobs in the 21st century in developed and developing countries. Therefore, developing research skills at the high school level has an important context and background (Sagita, 2024), and the results of international conventions agree that acquiring research skills is an important goal of secondary education (Maddens et al., 2021).

Government support in improving the quality of education and preparing students to face an increasingly complex world of work by including research skills in the Graduate Competency Standards at the General Secondary Education level based on the Regulation of the Minister of Education, Culture, Research and Technology of the Republic of Indonesia Number 5 of 2022 Article 9 points 3 (e), 3 (c), and 3 (f) which describes the competencies of graduates who master research skills such as the ability to collaborate, respect cooperation, have creativity with the ability to convey original ideas, create creative actions and works, and be proactive in finding alternative solutions to daily problems. In addition, the demands for developing research skills are also found in the Merdeka Curriculum. In the learning outcomes of the natural science (IPA) family in the process skills element, there are research skills that must be mastered by students, such as the ability to observe, question, plan and conduct investigations, process, analyze data, evaluate, reflect, and communicate results (Ministry of Education, Culture, Research, and Technology, 2022).

According to Widodo (2021), in studying science, we should learn the essence of science. The nature of science consists of scientific knowledge, processes, and scientific attitudes. Scientific knowledge is the product of the work of scientists. Meanwhile, the way to obtain knowledge can be referred to as a process, and the attitude to obtain knowledge is called a scientific attitude. Products, processes, and attitudes are not three different things but are a unity so that when someone studies science, he must study the product, process, and attitude. This is Sagita's (2024) opinion, which is that science learning is not only oriented towards conceptual knowledge alone but also encourages the development of critical thinking skills, inquiry, and research. This approach not only aims to provide an understanding of concepts but also helps students apply science in the context of everyday life.

The Research Skill Development (RSD) framework was introduced by Willison (2007; 2018). Based on this framework, research skills can be explained as essential abilities required in the research process. These skills include six research skill facets identified as observable indicators of achievement. The indicators within each facet are: (1) Embark and clarify, including problem identification skills, problem formulation skills, determining research variables, developing hypotheses, and identifying safety, ethical, cultural, and social issues. (2) Find and generate, determine research subjects, develop research instruments, and identify research designs. (3) Evaluate and reflect, including skills to evaluate research methods and information sources. (4) Organize and manage, including the skills of creating, reading, and interpreting graphical representations of data. (5) Analyze and synthesize, including the skills to construct scientific arguments on data, use quantitative skills, including probability and simple statistics, and be able to reason or make inferences, predictions, and conclusions based on quantitative data. (6) Communicate and apply, including the skills to compile research reports and present findings.

The right learning strategy is needed to develop research skills, especially in biology concepts. Research skills can be developed through an integrated curriculum that can facilitate students' development of thinking skills and research processes (Torres, 2018; Wisker, 2018). Some proven successful methods include inquiry methods, project-based learning, practicum, experiments, virtual laboratories, and research-based learning (Aripin et al., 2021). In addition, Roito et al. (2019) used a step-by-step experimental model to develop research skills with the

help of LKPD. In the field, research related to research development has not been carried out much, including in the implementation of biology learning in schools; not many teachers have developed research skills in the learning they do in class.

Based on this background, the author conducted a study by observing the biology learning process and analyzing students' research skills that refer to the research skill development (RSD) framework introduced by Willison (2007; 2018) in one of the schools in West Bandung Regency, West Java Province. The objectives of this study are (1) to determine whether the biology learning carried out has directed students to develop research skills, (2) to determine the research skills profile of students in Biology learning.

Methods

This research uses a descriptive qualitative method with a case study approach to understand an issue or problem using a case within a certain period by collecting data from various sources such as observation, interviews, and documents (Creswell, 2007). This research aims to explore and investigate more deeply the implementation of the learning process on environmental change material carried out by teachers and whether it can develop students' research skills. The researcher wants to get an understanding and description of how the research skills profile of class X students on environmental change material is good or needs to be improved. This case study was conducted in natural conditions without any treatment from researchers. The results of the research are described with in-depth explanations and descriptive statistics. Learning activities in the school under study, in terms of implementation, were fully submitted to the teacher following the lesson plan that had been designed without any intervention from the researcher. The population of this study was class X students in one of the schools in West Bandung Regency, West Java Province. The purposive sampling technique is a sampling technique with certain considerations (Sugiyono, 2009).

The sample taken comprised class X-9 students, totaling 36 students. Data collection is done through observation with non-participant techniques, interviews with teachers, and distributing questionnaires (questionnaires) to students. In observation with non-participant techniques, researchers are not directly involved with the observed activities (Sugiyono, 2009). The instruments used in this research are observation guidelines, interview guidelines, and student questionnaires.

Observation is carried out using an observation guideline sheet, which aims to see the learning process carried out by the teacher on the concept of environmental change and to get an idea of the extent to which the teacher has directed the development of students' research skills in learning activities carried out as they are without any intervention from the researcher. In addition, during the observation, the researcher also observed students' answers on the students' worksheets (LKPD). The students' answers on the LKPD were analyzed to see whether they had led to the indicators of research skills. Interviews were conducted with teachers using an interview guideline sheet containing several questions to get teacher responses about research skills and an overview of students' level of research skills. Data collection through questionnaires was carried out by distributing questionnaires through Google Forms to students, which aims to obtain information about the extent to which students know research skills and what research skills indicators they feel have been mastered by students.

The research skills used in this study refer to the Research Skill Development (RSD) framework introduced by Willison (2007; 2018), which consists of six research skill facets, and each facet has observable research skill indicators. Each observed indicator is given a check mark (√) in the applicability column in the "Yes" column, and the unobserved indicator is given a check mark (√) in the applicability column in the "No" column in the observation guideline sheet. The research skills indicators used in this study are shown in Table 1.

Table 1. Research skills indicators

Facets	Indicator
1. Embark and clarify	Identify the problem. Formulate the problem. Determine the research variables. Develop a hypothesis. Identify safety, ethical, cultural, and social issues.
2. Find and generate	Determine the research subject. Develop research instruments. Identify the research design.
3. Evaluate and reflect	Evaluate research methods. Evaluate information sources.
4. Organize and manage	Create, read, and interpret graphical representations of data.
5. Analyze and synthesize	Construct scientific arguments on the data. Using quantitative skills, including probability and simple statistics. Reasoning or making inferences, predictions, and conclusions based on quantitative data.
6. Communicate and apply	compile a research report presenting the research findings.

The research data were analyzed quantitatively and qualitatively. According to Sugiyono (2013), the research data on the observation guideline sheet for the implementation of research skills is presented as a percentage and categorized using a rating scale. Table 2 shows the category of achievement of the value of the observed and unobserved indicators.

Table 2. Percentage of DKI achievement

Value Interval (%)	Criteria
81 – 100	Excellent
61 – 80	Good
41 – 60	Simply
21 – 40	Less
0 – 20	Less than once

Results and Discussion

This research begins with observing the teacher's learning process on environmental change material. The learning activities that were observed and the implementation process occurred naturally to the lesson plan that the teacher had designed without any intervention from the researcher. The aspects observed when observing the learning process consisted of (1) learning approaches, (2) learning models, (3) learning methods, and (4) learning media. The four aspects observed were adjusted to the teaching module the teacher had designed. Implementing the learning process will run optimally and can achieve the expected learning objectives if carried out by the lesson plan that has been designed.

The first aspect observed is the learning approach. According to Abdullah (2018), the approach can be interpreted as a starting point or our point of view on the learning process. This agrees with Widodo (2021), who states that the approach is a strategy to achieve the desired goals when designing learning. The second aspect observed is the learning model used by the teacher. A learning model is a logical sequence for teaching students through clear

stages or sequences; if the approach is more related to the strategy in designing a lesson, while the model is already talking about how the steps are in achieving learning objectives, the learning model is a basic framework for implementing learning (Widodo, 2021).

The third aspect is learning methods. Learning methods are techniques or ways to teach students. This means that students get lessons through the implementation of learning methods. So, if the learning model is the basic learning framework, then the technical implementation is the method. Therefore, the selection methods should consider the learning model used (Widodo, 2021). The fourth aspect is learning media. Learning media is anything that can convey messages through various channels, such as stimulating the thoughts and feelings of students so that it can encourage the creation of an effective learning process to add new information to students so that learning objectives can be achieved properly (Daniyati et al., 2023). Therefore, the media is a tool to help deliver learning materials designed with a unity of approaches, models, and learning media.

Based on the observation results, the teacher's learning process on the material of environmental change in the subchapter of water pollution was conducted in a face-to-face meeting for 3 lesson hours (135 minutes). The results of the observations of the learning process can be seen in Table 3.

Table 3. Results of observations of the learning process

Aspects Observed	Observation Results
Learning Approach	Scientific
Learning Model	Problem Based Learning
Learning Methods	Stand to stand presentation
Learning Media	YouTube video, presentation paper

Based on Table 1, the observation results show that in teaching the material of environmental change and water pollution, the teacher uses a scientific approach, Problem-Based Learning (PBL) learning model, learning method with a stand-to-stand presentations, and the learning media used are YouTube videos as learning resources and presentation paper used when making stand to stand presentations. The observation results were adjusted to the teaching module that the teacher had designed. It was found that the approach and learning model did not appear in the learning steps in the core activities. Each learning activity described in the teaching module is not grouped based on the PBL syntax, and the scientific approach consists of 5M (observing, questioning, gathering information, processing information, and communicating). Information on the use of the PBL model and the scientific approach can only be found on the identity sheet of the teaching module. In its implementation, the syntax of PBL and the scientific approach have not been implemented optimally. Problems about water pollution are given by the teacher through a student worksheet (LKPD) in the form of pictures. As many as three questions, then students are asked to gather information and find solutions to these problems. The results of students' work in the form of solutions to problems given by the teacher are written on LKPD, along with students' answers, and poured on presentation paper as interestingly as possible. Learners visit each other at each group stand and get an explanation from the group being visited. The stand-to-stand presentation method is a method made by the teacher.

The teacher's learning has actually been able to involve students actively in the learning process. However, the teacher has not directed the activities that are indicators of the development of research skills. Table 4 shows the following observation results related to the implementation of research skills development during the teacher's learning process.

Table 4. Observation results of implementation of research skills indicators

Research Skills Indicator	Applicability	
	Yes	No
1. Embark and clarify		
a. identify the problem.	√	
b. formulate the problem.		√
c. determine the research variables.		√
d. develop a hypothesis.	√	√
e. identify safety, ethical, cultural and social issues.		
2. Find and generate		
a. determine the research subject.		√
b. develop the research instrument.		√
c. identify the research design.		√
3. Evaluate and reflect		
a. evaluating research methods.		√
b. evaluate information sources.		√
4. Organize and manage		
a. create, read and interpret graphical representations of data.		√
5. Analyze and synthesize		
a. construct scientific arguments on the data.	√	
b. using quantitative skills, including probability and simple statistics.		√
c. reasoning or making inferences, predictions and conclusions based on quantitative data.		√
6. Communicate and apply		
a. compile a research report	√	
b. presenting the research findings.	√	
Total	**5**	**11**
Percentage (%)	**31**	**69**

Based on the observation data shown in Table 4, the percentage of research skills implementation in the learning process carried out by teachers is 31% with a poor category. There are only five indicators of research skills that appear and can be observed, including (1) identifying problems, (2) identifying security, ethical, cultural, and social issues, (3) compiling scientific arguments on data, (4) compiling research reports, and (5) presenting research results. The indicators of research skills that appear in the learning process can be seen in the questions and answers of students on the LKPD (Figure 1).

In Figure 1, the indicator of identifying problems can be observed in the first question. The teacher displays two pictures of environmental changes as a source of problems; then, students are asked to identify problems according to the picture by providing scientific explanations. Learners' answers have identified the problems that occur in the observed images. Learning that connects students with the context of a situation can help develop students' research skills (Nurlaelah et al., 2021). The second indicator observed, identifying security, ethical, cultural, and social issues, can be seen in the third question. The teacher asks students to pay attention to the surrounding environment. Whether pollution occurs, the teacher asks for students' opinions regarding how community members' awareness can

overcome it. According to the researcher, this part is based on indicators of ethics, culture, and society. Students' answers show that there is still a low public awareness of the environment.

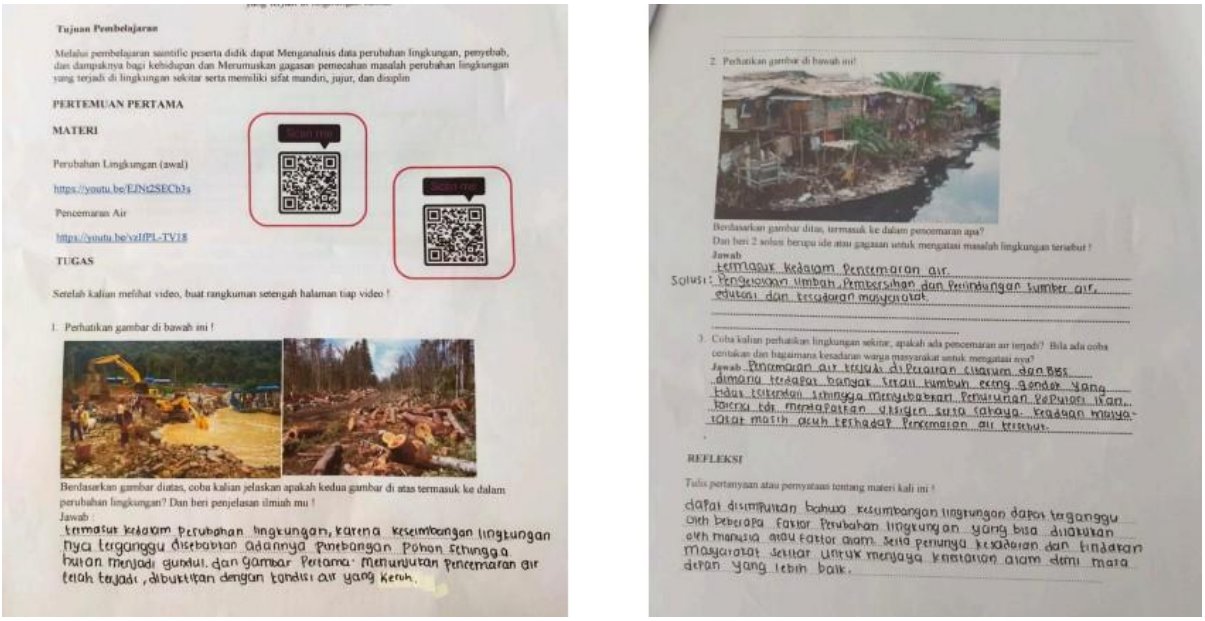

Figure 1. Example of LKPD that has been done by students

In the indicator of compiling scientific arguments on data, the teacher has directed the indicator through the second question. In the LKPD, students are presented with a picture of water pollution. Then, learners are asked to provide two solutions in the form of ideas to overcome these environmental problems. However, students' answers in expressing solutions to ideas and ideas have not been maximized. This is because the teacher does not free students to find various credible reference sources to get ideas. However, the teacher only directs students to get information or learning resources from YouTube videos made by the teacher himself. This is not in accordance with the indicators for evaluating information sources. The RSD framework is in line with the demands of 21st-century research, which requires students to not only answer questions from a problem but also be able to design investigations to find and evaluate problem formulations. Through RSD, students are expected to be able to create a solution to a problem through a scientific process (Trilling & Fadel, 2009).

The indicator of compiling a research report can be observed in making a presentation paper displayed on the wall when students make a stand-to-stand presentation. Although the report is not a research report, according to the researchers, the presentation paper has shown the product of the students' work. Finally, the indicator of presenting research findings can be observed when students present to students who visit their stand. One thing that needs to be explained in Figure 1 is that students fill in the reflection section with a conclusion sentence. Researchers did not include these answers in the research skills indicators that emerged because there were no questions or commands from the teacher that asked students to make conclusions.

Meanwhile, the research skills indicators did not appear and could not be observed in the teacher's learning process by 69%. This means that the teacher's learning process has not fully directed students to develop research skills. Indicators that do not appear include (1) formulating problems (2) determining research variables, (3) formulating hypotheses, (4) determining research subjects, (5) preparing research instruments, (6) identifying research designs, (7) evaluating research methods, (8) evaluating information sources, (9) creating, reading and interpreting graphical representations of data, (10) using quantitative skills, including probability and simple statistics, (11) reasoning or making inferences, predictions, and conclusions based on quantitative data. The learning process is simple, not research activities, inquiry, or project-based activities, so there are not many issues discussed about environmental change. The results of Aripin et al. (2021)'s research show that the inquiry

method and project-based learning are the two most widely used methods in developing students' research skills. In addition, in learning activities carried out by teachers, there are no data quantification activities in numerical form. Therefore, many indicators of research skills cannot be observed. In fact, according to Yayuk et al. (in Saputra & Supriatno, 2024), in the Merdeka curriculum, several demands must be considered, one of which is quantitative literacy. Quantitative literacy refers to an individual's ability to understand, use, and think critically about mathematical concepts in everyday life. Therefore, biological research activities should be directed to develop a certain ability or skill: quantitative literacy (Riyaldi et al., 2021).

Interviews with teachers were also conducted to complement the observation data. The results of the interview obtained information that; (1) the teacher already knows enough about the indicators of research skills, according to the teacher research skills are skills where students can research to become researchers through the steps of the scientific method, (2) according to the teacher research skills need to be owned by students because it can familiarize students with critical and analytical thinking about problems that exist in real life so that they can find the right solution, (3) the teacher has conducted learning activities that develop research skills through germination project activities in grade 12 but it is not optimal, (4) according to the teacher, the model that can develop research skills is project-based learning (PjBL), (5) according to the teacher, the condition of research skills possessed by students at school still has to be improved even though there are some students who already have good research skills, but there are still many students who do not have good research skills and must continue to be trained and developed.

To make the research data obtained more comprehensive, a questionnaire is also used to collect information about the extent to which students know research skills and what indicators of research skills they feel have been mastered. Table 5 shows the following types of statements in the questionnaire about research skills.

The questionnaire contains 20 statements about research skills, and learners responded to them as strongly agree (SS), agree (S), disagree (TS), and strongly disagree (STS). Questionnaires were distributed to students using the Google Forms application. The data from the questionnaire analysis is presented in the form of a graph, which can be seen in Figure 2.

Based on Figure 2, the graph of the analysis of students' questionnaires on research skills shows that 42% of students disagree that they already know a lot about research skills. As many as 42% of learners disagree that they have had lessons that improve research skills. This means that many learners still do not know about research skills because they rarely get lessons that develop research skills. A total of 58% agreed that learners can find phenomena as a source of problems. This means that students can identify problems according to the results of analyzing students' LKPD answers.

However, many students gave disagreeing responses to the ability to formulate problems, create variables, formulate hypotheses, design a study, create and interpret graphs, compile scientific arguments, and draw conclusions with a percentage of 50%, 50%, 56%, 56%, 58%, 61%. This means that students have not mastered the indicators of research skills. In statements related to being able to solve problems given by the teacher, 78% of students agreed. Students can develop solutions because they have been trained to work on LKPD. Learners could make research reports and present research results, and as much as 81% and 58% agreed. This is because learners have been able to make reports in the form of presentation papers and present them stand to stand. Stand to stand. The results of the last analysis show that students agree that research skills are very important and that students need learning strategies to improve their research skills. Students believe research skills can help solve problems in everyday life, with a percentage of 56%, 64%, and 53%. This is in accordance with the opinion of Nurlaelah et al. (2021) that scientific work skills are very important to be supplied to students in learning science. Research experience is important because it can build students' confidence in their research skills, give them experience with applied research practices, and broaden their understanding of research. In addition, learners who participate in research experiences show gains in their ability to think analytically and learn

independently. Engaging learners in research has been shown to provide learners with meaningful learning opportunities in several contexts. Essentially, through research experiences, learners can better understand the research process, improve their writing and communication skills, and gain experience working effectively with a team (Nurlaelah et al., 2021).

Table 5. Types of statements in the learner questionnaire on research skills

	Statement
1.	I already know a lot about research skills.
2.	I have had lessons that improved my research skills.
3.	I have learned about the steps of the scientific method.
4.	I can perform the steps of the scientific method in a study.
5.	I have done research project activities on biology materials.
6.	I was able to find phenomena or facts that could be considered as the source of the problem in the problem (in the form of a picture) given by the teacher.
7.	I can formulate a problem based on a problem that has been given by the teacher.
8.	I can create independent and dependent variables in scientific research.
9.	I can formulate a hypothesis or temporary conjecture based on the problems given by the teacher.
10.	I was able to design research based on the steps of the scientific method.
11.	I am able to come up with solutions to problems given by the teacher.
12.	I believe the sources of information that I use as references in finding solutions to problems given by the teacher are valid.
13.	I can create, read, and interpret data in graphical form.
14.	I am able to construct scientific arguments on data, using quantitative skills including probability and simple statistics.
15.	I am able to make conclusions based on quantitative data regarding problems that have been given by the teacher.
16.	I can make a report on the results of the research that I have done.
17.	I am able to present the results of problem-solving (research findings) that have been given by the teacher.
18.	I think research skills are very important for students to have.
19.	I really need a learning strategy that can improve my research skills.
20.	I believe research skills can help in solving problems in daily life.

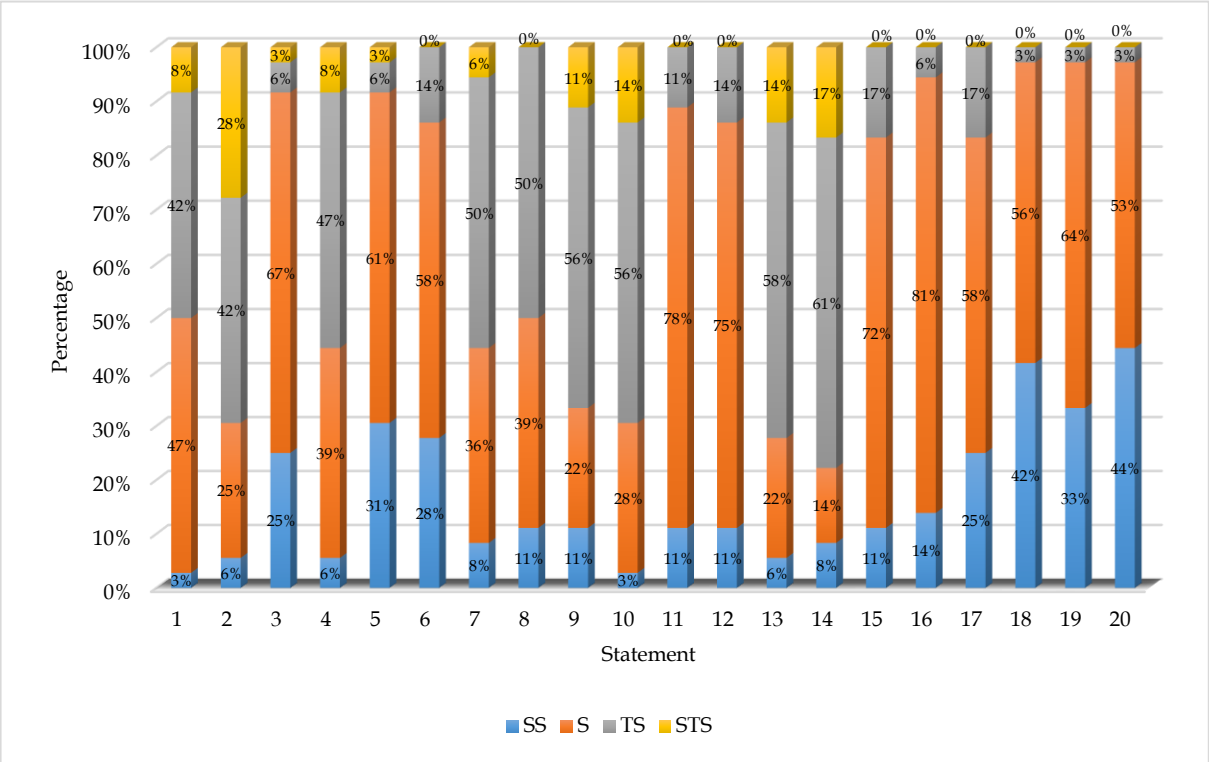

Figure 2. Graph of student questionnaire results

From the observation of the learning process, analysis of students' answers on the LKPD, the results of interviews with teachers, and the results of questionnaire analysis, it can be said that the profile of students' research skills is still lacking and must still be developed. Teachers have not directed learning to develop research skills. This is evidenced by only a few indicators that appear and can be observed in the learning process that the teacher has carried out. By having research skills, it is expected that students will be able to compete in the current era of globalization, where research skills are the number one most sought-after ability in the world of work in the 21st century, as explained by Trilling & Fadel (2009).

Conclusion

Based on the results of observations and the analysis that has been done, it can be concluded that the learning process carried out has not directed students to develop research skills, so the research skills profile in the sample studied is still lacking and not optimal. The results of this study can be used as a basis for further research in improving students' research skills through innovations in the biology learning process, both in terms of learning models, student worksheets, and learning media.

References

Abdullah, A. (2018). Approaches and Learning Models that Activate Students. *Edureligia; Journal of Islamic Religious Education*, *1*(2), 45-62. https://doi.org/10.33650/edureligia.v1i2.45

Aripin, I., Hidayat, T., Rustaman, N., & Riandi, R. (2021). The Effectiveness of Science Learning Research Skills: A Meta-Analysis Study. *Science Educatia, 10*(1), 40-47. http://dx.doi.org/10.24235/sc.educatia.v10i1.8486

Creswell, J. W. (2007). *Qualitative Inquiry & Research Design: Choosing Among Five Approaches (2nd Ed.)*. Thousand Oaks, California: Sage Publications, Inc. https://revistapsicologia.org/public/formato/cuali2.pdf

Daniyati, A., Bulqis Saputri, I., Wijaya, R., Aqila Septiyani, S., & Setiawan, U. (2023). Basic Concepts of Learning Media. *Journal of Student Research (JSR)*, *1*(1), 282-294. https://doi.org/10.55606/jsr.v1i1.993

Indonesia. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi [Ministry of Education, Culture, Research, and Technology]. (2022). *Keputusan Kepala Badan Standar, Kurikulum, dan Asesmen Pendidikan Nomor 033/H/KR/2022 tentang Perubahan atas Keputusan Kepala Badan Standar, Kurikulum, dan Asesmen Pendidikan Nomor 008/H/KR/2022 tentang Capaian Pembelajaran pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah pada Kurikulum Merdeka [Decree of the Head of the Education Curriculum Assessment Standards Agency (BSKAP) Number 033/H/KR/2022 Revised Decree of the Head of BSKAP Number 008/H/KR/2022 on Learning Outcomes for Early Childhood Education, Elementary School, Junior High School and Senior High School]*. https://kurikulum.kemdikbud.go.id/wp-content/uploads/2022/06/033_H_KR_2022-Salinan-SK-Kabadan-tentang-Perubahan-SK-008-tentang-Capaian-Pembelajaran.pdf

Nurlaelah, I., Widodo, A., Redjeki, S. & Rahman, T. (2021). Instrument Development Testing of Research Skills in Authentic Research Programs. *Quagga: Journal of Education and Biology*, *13*(2), 37-44. https://doi.org/10.25134/quagga.v13i2.4232.Received

Riyaldi, A. S., Supriatno, B., & Anggraeni, S. (2021). Alternative Laboratory Activity Design: Facilitating Students' Quantitative Literacy Skills Through Anaerobic Respiration Practicum. *Bioedusiana: Journal of Biology Education*, *6*(1), 104-120. https://doi.org/10.37058/bioed.V6i1.3103

Sagita, S. (2024). *Development of a Project-Based Research Learning Model Supported by Self-Regulated Learning (PjBR-SRL) to Improve Research Skills* [Doctoral Dissertation]. University of Education Indonesia. https://repository.upi.edu/116910/

Saputra, A. D., & Supriatno, B. (2024). Revolutionizing Learning: Enhancing Student Worksheets on Plant Tissue Structure Through Vee Diagrams in Alignment With The Merdeka Curriculum. *Assimilation: Indonesian Journal of Biology Education*, *7*(1), 25-38. https://doi.org/10.17509/aijbe.v7i1.66426

Sugiyono. (2009). *Educational Research Methods Quantitative, Qualitative and R&D Approaches*. Bandung: Alfabeta.

Sugiyono. (2013). *Quantitative, Qualitative and R&D Research Methods*. Bandung: Alfabeta.

Sutia, C. (2019). Building Students' 21st Century Research Skills Through Google Classroom-Based Learning Management System in Biology Project Learning. *Journal of Physics: Conf. Series*, *1557*(2), 1-5. http://dx.doi.org/10.1088/1742-6596/1157/2/022093

Torres, L. (2018). Research Skills in The First-Year Biology Practical - Are They There? *Journal of University Teaching and Learning Practice*, *15*(4), 1-25. https://doi.org/10.53761/1.15.4.3

Widodo, A. (2021). *Natural Science Learning Basics for Practice* (M. Iriany, Ed.). Bandung: UPI Press.

Wisker, G. (2018). Frameworks and Freedoms: Supervising Research Learning and The Undergraduate Dissertation. *Journal of University Teaching and Learning Practice, 15*(4), 1-16. https://doi.org/10.53761/1.15.4.2