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Development of Practical Instructions Based on Scientific Approach on Blood Circulation System Material to Improve Students' Science Process Skills

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Abstract

The purpose of this study was to develop practical instructions based on a scientific approach to the material of the blood circulation system that were feasible and effective to improve students' science process skills. The research design used was development research or R&D (Research and Development) using the 4D (Four-D) model stages, including: Define, Design, Development, and Dissemination. This study did not reach Dissemination. These practical instructions were developed through feasibility and effectiveness tests. Data collection tools include questionnaire instruments and observation sheets. The questionnaire instrument was made using a Likert scale which is used to measure the feasibility of practical instructions in learning. The observation sheet used is to create indicators of science process skills to measure students' science process skills. Based on the results of the study, the practical instructions were declared very feasible with a percentage value of 98.33% by media experts and by material experts getting a percentage value of 92.18%. In the effectiveness test, it was declared effective in improving science process skills with a percentage gain at the 1 st meeting of 58,14% with medium criteria increasing to the 4 st meeting of 97,04% with high criteria. Based on the results of data analysis in this study, it was concluded that the product of practical instructions based on a scientific approach was very feasible and effective in improving students' science process skills in the blood circulation system material.

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INTRODUCTION

The development of science and technology encourages all countries to fully utilize the potential of resources to gain equal opportunities in various aspects of life. Education is one aspect of life that is very fundamental to national development in a country and has a role in producing quality future generations (UNESCO, 2006). Quality education is required to produce graduates who have skills in various fields and master knowledge and are able to compete globally.

Schools are one of the places to obtain education and as a place to produce quality human resources (Jirana & Damayanti, 2016). Quality human resources are produced by quality education, one of which is through improving the quality of education (Shanti et al., 2015). The quality of education in schools must be improved by providing sufficient space for initiative, creativity, and independence to students. Students must have broad knowledge, skills in various things such as critical thinking skills and creativity which are part of 21st century skills (Matten & Moon, 2008). With 21st century skills, a person will improve their quality, especially in their thinking and learning processes.

Science learning, especially biology, encourages students to develop skills that are important in producing quality graduates. Science learning consists of chemistry, physics and biology. One of them is biology, the material in biology is the human circulatory system. This circulatory system is an organ system that functions to move substances and nutrients to body cells. This system is very important for maintaining the survival of organisms, supporting the metabolism of body cells, and maintaining the chemical and physiological stability of body fluids (Tawil, M., & Liliasari, 2020). In addition, this material also includes an analysis of the relationship between the structure of the tissue that makes up the organs in the circulatory system and its relationship to the bioprocesses that occur, so that it can explain the mechanism of blood circulation and disorders that may occur in the human circulatory system through literature studies, observations, experiments, and simulations. Therefore, this material should be accompanied by practical activities, which can provide direct experience, make learning more meaningful, increase interest in learning, and provide evidence that supports the truth of the theories that have been learned by students.

Based on the results of observations at SMA Teuku Umar, the material on the human circulatory system, students' science process skills are low due to the lack of supporting tools such as practical instructions. The lack of practical instructions makes students confused and not serious in doing the practical. In addition, students have not carried out the correct steps in the practical. So from the results of the observation, when the practical was carried out, it finally showed that the process skills possessed by students in the school were not good. Practical instructions as one of the learning resources in practical activities should be a guide for students in developing science process skills.

Science process skills are very important for students because they help them to act carefully, think critically, and process the information they have. This allows students to better understand the material being taught, because they can play an active role in learning, so that the indicators of science process skills can be achieved (Fadilah et al., 2023). However, in reality in many schools, science process skills are still low. Based on the results of pre-research conducted in the Teuku Umar High School class, which used science process skills questions with indicators such as grouping, hypothesizing, interpreting observations, planning experiments, observing, and communicating, the results showed that students' science process skills were still very low. The results of the pre-study showed an average value for the KPS indicators, such as predicting (60%), concluding (50%), classifying (65%), communicating (55%), and interpreting data (58%), all of which were classified as low according to the criteria of science process skills.

The results of the analysis of these teaching materials were also reinforced by data from interviews with a biology educator, Mrs. Arina Kusuma, S.Pd., Gr. obtained information that active attitudes, interest, and direct experiences as learning experiences for students were still low, this was because students' science process skills did not develop and the teaching materials used by educators had not invited students to do activities that could improve science process skills. In order to overcome the problems in learning at SMA Teuku Umar, a solution is needed to improve learning that makes students active in the learning process, understand the learning material and are able to develop students' science process skills, one of which is by

developing practical instructions.

Practical instructions based on a scientific approach are designed to provide clear direction to students in carrying out practical work, so that they can expand scientific knowledge, increase productivity, and help students become skilled in obtaining and analyzing information that can improve their science process skills. The development of practical instructions based on a scientific approach is expected to encourage students to express creative ideas through individual or group activities, and strengthen cooperation among group members to develop their science process skills. Based on this background, the researcher decided to conduct a study entitled "Development of Practical Instructions Based on a Scientific Approach on the Material of the Human Circulation System to Improve Students' Science Process Skills".

RESEARCH METHOD

This research was conducted at SMA Teuku Umar in the odd semester of the 2024/2025 academic year. The population in this study were all students of class XI SMA Teuku Umar consisting of 5 classes, namely class XI-1 to class XI-5. The sampling technique used Purposive Sampling. The samples used were 3 classes, namely class XI-2, XI-3 and XI-4 with the consideration of the number of students as many as 107 students and teachers who teach in the same class. The data in this study include the percentage of science process skills which were analyzed quantitatively.

RESULTS AND DISCUSSION

The assessment stage aims to produce valid and effective scientific approach-based practical instructions. The assessment consists of several aspects, namely:

1) Validity of Scientific Approach-Based Practical Instructions

4.1. Media Expert Data Validation

Total Item Score Obtaineg (TSi)	59%
MaximumScore (TSm)	60%
Validity of Practical Instructions (V)	98,33%
Criteria	Very Valid

Based on the scores from the media validator related to the technical aspects of the scientific approach-based practicum instructions, namely, the suitability of the composition of the practicum instruction cover, the use of writing layout, the presentation of images and the suitability of the design, it can be concluded that the practicum instructions are suitable for use. The score obtained from the validator for the technical aspect is 96.42%. In the construction aspect, there are five assessment indicators, namely the suitability of syntax, the suitability of the material with the practicum, ease of maintenance, the use of clear instructions and the clarity of the instructions getting a score of 100% from the validator. So it can be concluded that the scientific approach-based practicum instructions by the validator are included in the criteria very suitable for use in learning.

4.2. Material Expert Validation Data

Total Item Score Obtaineg (TSi)	59%
MaximumScore (TSm)	64%
Validity of Practical Instructions (V)	92.18%
Criteria	Very Valid

Based on the score from the material validator related to the material validity indicators consisting of aspects of content/material validity, language validity and presentation validity, the score obtained from the validator for the content/material validity aspect with a score of 91.66%, the language validity aspect

with a score of 95% and the presentation validity aspect with a score of 87.5%. It is concluded that the feasibility test of the practical instructions based on the scientific approach by the validator is said to be very feasible for use in learning.

2) Effectiveness of Practical Instructions Based on the Scientific Approach

Based on the data analysis, the results obtained show that the average science process skills of students in Class XI-2, XI-3 and XI-4 are in the moderate category and need to be improved further. Data analysis of students' science process skills was obtained from the results of observations that had been assessed by observers. The results of students' science process skills consisted of 5 indicators consisting of predicting, concluding, classifying, communicating and interpreting data. Each student's science process skills were analyzed with the material of the blood circulation system during the practicum activities. In analyzing students' science process skills, it was carried out in eight meetings conducted during practicum activities with different practicum topics. The results of the N-Gain test of students using practicum instructions based on a scientific approach to the material of the blood circulation system are presented in Table 4.3.

Table 4.3. Results of Students' Science Process Skills Improvement After Using Scientific Approach-Based Practical Instructions on Blood Circulation System Material

Meeting	**Average**	**Category**
Meeting 1	58,14%	Medium
Meeting 2	70,21%	Medium
Meeting 3	84,78%	High
Meeting 4	97,02%	High

Aspects Of Science Process Skills	**% of Students' Science Process Skills in the Meeting**			
	1	2	3	4
Predicting	59,57	65,88	80,37	96,72
Concluding	51,17	62,26	82,78	96,93
Classifiying	66,12	70,09	80,14	96,49
Communicating	56,42	66,97	77,72	96,32
Interpreting Data	55,60	69,39	81,77	96,02
Average	57,77	66,91	80,55	96,49
Category	Medium	Medium	High	High

Based on Table 4.3, overall it shows that there was an increase in the percentage of students' science process skills at the 1st meeting of 58.14% with moderate criteria increasing to the 4th meeting of 97.02% with high criteria. The increase in science process skills is also strengthened by the average achievement in each aspect of science process skills which shows results with a moderate category of 57.77% at the 1st meeting and at the 4th meeting with a high category of 96.49% so that it can be concluded that practical learning using a scientific approach-based practical manual can improve students' science process skills on the material of the blood circulation system. blood circulation system.

The increase in students' science process skills indicates that the assessment of the fourth meeting obtained was higher than the assessment of the first meeting so that in this case it can be said that the application of scientific approach-based practicum instructions on the blood circulation system material that has been developed has proven effective in improving students' science process skills. The effectiveness of scientific approach-based practicum instructions products on each aspect of science process skills has also been proven to improve students' science process skills. The assessment of science process skills is adjusted to assessment standards that include various indicators of science process skills, such as observing, classifying, predicting, interpreting data, and concluding. Each aspect is evaluated through instruments that have been designed in accordance with the scientific approach, so that they are able to measure the

development of students' abilities as a whole.

The effectiveness of the scientific approach-based practicum instruction product can be seen from the increase in the science process skill score at each meeting. The scientific process that involves students in observing phenomena, formulating problems, making hypotheses, conducting experiments, and analyzing data, indirectly trains them to think critically and logically. The systematically and structured practicum instructions help students follow these steps well, so that they can understand science concepts more deeply. In addition, the science skills assessment process is not only carried out based on the final results, but also the process during the practicum. This includes observations of student involvement in practicum activities, the ability to complete practicum tasks, and their participation in group discussions or practicum result reports. With this approach, students' science process skills can be monitored more comprehensively, covering cognitive, affective, and psychomotor aspects.

Adjusting the assessment with a scientific approach also ensures that the learning carried out is relevant to the needs of students in the 21st century, where the ability to think critically, communicate, and collaborate are important skills. Thus, the product of the scientific approach-based practical instructions not only improves science process skills but also provides competency provisions for students to face challenges in the world of education and real life. To further increase effectiveness, teachers can conduct evaluations and continuous improvements to the product of practical instructions, based on feedback from students and the results of the analysis of the assessment of science process skills. Thus, the scientific approach can be applied consistently and continue to have a positive impact on the quality of learning.

CONCLUSION

Based on the research results, it can be seen that the scientific approach-based practical instructions were declared very feasible by media experts and material experts as biology teaching materials on the blood circulation system material in Class XI SMA and the scientific approach-based practical instructions on the blood circulation system material in Class XI SMA were declared effective for improving the process of students' science skills.

REFERENCES

Fadilah, A., Nurzakiyah, K. R., Kanya, N. A., Hidayat, S. P., & Setiawan, U. (2023). Pengertian media, tujuan, fungsi, manfaat dan urgensi media pembelajaran. *Journal of Student Research*, *1*(2), 01-17.

Jirana, J. J., Irfan, M., & Damayanti, M. (2022). The Effect of The Use of Social Media (Whatsapp) towards The Biological Cognitive Learning Outcomes of Class XII MIA Students at SMA Negeri 1 Tinambung. *Journal of Biological Science and Education*, *4*(1), 23-30.

Kusmiati, R., & Suhada, I. (2023). Pengembangan Lembar Kerja Peserta Didik Berbasis Search, Solve, Create, and Share pada Materi Sistem Indera. In *Gunung Djati Conference Series* (Vol. 30, No. 25-34).

Larasati, A. D., Lepiyanto, A., Sutanto, A., & Asih, T. (2020). Pengembangan e-modul terintegrasi nilai-nilai islam pada materi sistem respirasi. Didaktika Biologi: *Jurnal Penelitian Pendidikan Biologi*, 4(1), 1-9.

Lisa, F. Y. (2019). Analisis Ketrampilan Proses Sains Peserta Didik Pada Materi Laju Reaksi Melalui Model Inquiry Labolatory. *Jurnal Tadris Kimiya*, *2*(12), 226-236.

Maiyanti, A. A., Imtiyaza, M. I., Laili, U. F., & Panse, V. R. (2024). Development of A Project Based Learning Hybrid Mode Module to Train Science Skills for Phase D Students. *Islamic Journal of Integrated Science Education (IJISE)*, *3*(2), 105-118.

Matsna, F. U., Rokhimawan, M. A., & Rahmawan, S. (2023). Analisis Keterampilan Proses Sains Siswa Melalui Pembelajaran Berbasis Praktikum Pada Materi Titrasi Asam-Basa Kelas XI

SMA/MA. *Dalton: Jurnal Pendidikan Kimia dan Ilmu Kimia*, *6*(1), 21-30.

Matten, D., & Moon, J. (2008). "Implicit" and "explicit" CSR: A conceptual framework for a comparative understanding of corporate social responsibility. *Academy of management Review*, *33*(2), 404-424.

Matten, D., & Moon, J. (2008). "Implicit" and "explicit" CSR: A conceptual framework for a comparative understanding of corporate social responsibility. *Academy of management Review*, *33*(2), 404-424.

Meliyani, M. (2022). *Pengembangan penuntun praktikum biologi umum terintegrasi keislaman menggunakan aplikasi flip pdf Professional* (Doctoral dissertation, IAIN Palangka Raya).

Mohd Nurazzi, N., Khalina, A., Sapuan, S. M., Dayang Laila, A. H. A. M., Rahmah, M., & Hanafee, Z. (2017). A review: fibres, polymer matrices and composites. *Pertanika Journal of Science & Technology*, *25*(4), 3-30.

Moi, M. Y., & Masing, F. A. (2023). Pengembangan E-Modul Praktikum Mikrobiologi Menggunakan Aplikasi Kvisoft Flipbook Maker bagi Mahasiswa Pendidikan Biologi. *Jurnal Basicedu*, *7*(6), 3683-3691.

Muhammad, M., & Nurdyansyah, N. (2015). Pendekatan pembelajaran saintifik.

Shanti, P., Tantiani, F. F., & Dwiastuti, I. (2017). Pengembangan Permainan untuk Meningkatkan Keterampilan Kerjasama pada Anak. Psikologi Universitas Negeri Malang, *34*(2), 1-11.

Tawil, M., & Liliasari, L. (2020). Keterampilan-keterampilan sains dan implementasinya dalam pembelajaran IPA. *Makasar: Badan Penerbit Unm*.

UNESCO. (2006). *Education for all global monitoring report 2006*. Paris: UNESCO

Wahab, A., & Sartika, R. P. (2021). Pengembangan petunjuk praktikum titrasi asam basa berbasis inquiri terbimbing. *Jurnal Education and Development*, *9*(3), 75-80.