



Development Of LKPD Using Scientific Approach To Improve High School Student's Understanding Of Concepts And Scientific Thinking Abilities On Excretion System

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Article Info

Article History:

Received : April 2024

Accepted : August 2024

Published : April 2025

Keywords:

*LKPD, Scientific approach,
Scientific thinking abilities,
Understanding concept*

Abstract

The purpose of this study is to analyze validity, readability, and effectiveness of the student worksheet using scientific approach to improve understanding concepts and scientific thinking on excretory system material. The research was conducted at SMA N 2 Kebumen with a sample of 70 students of class XI-A and XI-B. The type of this study is Research & Development. This development was limited to the large scale test. The data collection technique used in this study is the questionnaire method and the pretest and posttest test methods. The result showed that the validity by material expert obtained high validity criteria with an average score of 92,5% and an average score by material expert of 88,75% obtained a high valid criterion. The readability test of student's worksheet was tested on limited students with 9 students of class XI-C Senior High School 2 Kebumen and 1 biology teacher. The result of the response of student obtained 87,03% with very good criteria. The result of teacher response obtained 97,72% with very good criteria. Then the results of the N-Gain data pretest and posttest are included in the high category. Classical completion is 90%. Based on these results, it can be concluded that the student worksheet using scientific approach on excretory system materials is very valid and readability very well and effective in improving understanding concepts and scientific thinking.

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p-ISSN 2252-6579
e-ISSN 2540-833X

INTRODUCTION

21st century learning places more emphasis on students' abilities to can find and transform information independently. Part Most of the current learning process is only concerned with obtaining final grades, no focuses on understanding concepts related to the material. Apart from that, quality learning in the field of science in Indonesia is currently still low. This matter based on the results of the Program for International Student Assessment (PISA) 2022 in the field of science, Indonesia will still be in 67th position out of 81 countries (OECD, 2023). The low academic abilities of students in the field of science include biology is partly due to the lack of active involvement of students in the process learning. This results in only one lesson taking place direction. Teachers who teach more subject matter concepts only through the transfer of knowledge and the provision of examples tend to be memorized, resulting in students' skills becoming less trained and students being mistaken in understanding a concept. Therefore, it is in progress Teaching and learning activities are expected to allow students to understand the concept of the material that has been studied. Students' understanding of material concepts can be achieved supported by creating learning that makes students active in finding and understanding material concepts.

On the other hand, the process of teaching and learning activities in the classroom needs to be carried out actively, creatively, and interactively so that students are motivated to improve learning outcomes and develop their potential (Rosdiana & Ulya, 2021). This requires students to be able to think scientifically in order to develop a critical mindset in overcoming various problems (Ahli, 2017). Scientific thinking skills are very important for students in the context of science learning, but in reality scientific thinking skills are rarely trained in the learning process (Anggraini et al., 2018). So far, teachers' attention has been more focused on cognitive aspects alone, so they have not been able to create students who have the ability to think scientifically (scientific thinking) or think at a higher level (Zahro et al., 2019).

During the learning process, students are required to be able to participate actively by making observations, formulating questions, collecting data or conducting experiments, associating and communicating (Rizki & Ranu, 2019). Therefore, teachers need to use a strategy to support student activity, namely a scientific approach. This approach refers to the 5M stages regulated in Minister of Education and Culture Regulation No. 13 of 2014, namely observing, asking, collecting information, reasoning and communicating. Research shows that learning based on a scientific approach is more effective than traditional approaches. The study revealed that in traditional learning, only about 10% of the information could be retained by students after 15 minutes, and contextual understanding only reached 25%. Meanwhile, in learning based on a scientific approach, students' information retention rate is more than 90% after two days, and contextual understanding can reach 50 - 70% (Musfiqon & Nurdyansyah, 2015).

In the learning context, achieving learning objectives is very dependent on the use of teaching materials. These teaching materials have a crucial role in ensuring the effectiveness and efficiency of the learning process in the classroom. One type of teaching material that is commonly used in learning activities in schools is LKPD. Based on the identification results, the LKPD in circulation generally contains practice questions or summaries of material sourced from teaching materials. This is in line with the results of interviews conducted with Mrs. Wahyu as a Biology teacher. She stated that in some materials the teacher had already used LKPD. However, these LKPD tend to make students less interested because the activities presented in the LKPD used are still lacking variative. The LKPD used is dominated by practice questions and students asked to answer without carrying out a series of investigative activities so students do not get direct experience of the learning process. Apart from that, the material on the LKPD has not been able to encourage students to do it discover concepts independently and improve their abilities in scientific thinking, so that the learning process becomes less meaningful. Teachers more often use lecture and question and answer methods with PPT so that learning is not student centered. Therefore, It is necessary to develop LKPD with a scientific approach that can provide guidance students to be actively involved in the learning process so that can be student centered learning.

In the learning process, students often experience difficulties in understanding certain material,

especially those that have high complexity and are difficult to visualize, such as material regarding the Excretory System. This material requires students to have a deep understanding of the concepts contained in it. The excretory system is an abstract part of the body, so many students think that this material is less interesting and difficult to understand. Common difficulties faced by students in the Excretory System material include understanding the structure and function of the human excretory organs and the processes that occur in them. Based on the background of the study, it needs to be studied in depth about development of LKPD using scientific approach to improve understanding of concepts and thinking ability on excretory system material.

RESEARCH METHOD

This type of this study is Research and Development or R&D by (Sugiyono, 2019) with the following steps: (1) potential and problems; (2) data collection; (3) product design; (4) design validation; (5) design revision; (6) product trial; (7) product revision; (8) trial use. The research design applied at the large-scale trial stage is one group pretest-posttest design. The research was conducted at Senior High School 2 Kebumen with a sample of 70 students of class XI-A and XI-B. The data collection technique used is the questionnaire method, and the pretest and posttest test methods with the respondents of this study divided into 4 groups, that is: media experts, material experts, teachers, and students. The data analysis techniques used are percentage descriptive and N-gain analysis.

RESULTS AND DISCUSSION

Problems and potentials

Before conducting research, it is necessary to conduct an analysis of the problems and potentials that primary the development of student worksheet using scientific approach on excretory system material with the resource person the biology teacher. Based on the results of interviews, it was found that students tended to be less active during learning. The method used in learning still uses the lecture method with the help of PPT and printed books facilitated by the school. However, according to the biology teacher, the printed book had very little material and was incomplete so it was considered difficult for students to understand. Therefore, students tend to get bored quickly in learning. In the previous material, LKPD was used. However, the LKPD used tends not to be varied. This makes students experience difficulties in understanding the concepts of the material so that the understanding of the concepts obtained is not optimal. In addition, students' scientific thinking abilities have never been measured. The potential that can be utilized to support learning is that SMA Negeri 2 Kebumen has used the Kurikulum Merdeka so that students are required to be active in the learning process. Apart from that, students are happier if learning is carried out in groups.

Problem analysis shows that the use of teaching materials at SMA Negeri 2 Kebumen is still rarely used. Teachers tend to use lecture methods assisted by PPT and printed books facilitated by the school. This is considered less innovative and causes learning to focus only on the teacher so that students tend to get bored quickly. Apart from that, students have difficulty understanding the concept of the material because the teaching materials used are inadequate. Therefore, it can be concluded

Validity Test Results by Material Experts and Media Experts

After the student worksheet using scientific approach on excretory system material product has been developed, the product is tested for validity by material expert validator and media expert validator. The results of the validity test by material expert's validator are presented in the Table. 1

Table 1 Result validity of material

No	Aspect	Score	Max Score	Precentage	Criteria
1.	Worksheet component	15	16	93,75%	Very valid
2.	Presentation	14	16	87,5%	Very valid
3.	Scientific approach	15	16	93,75%	Very valid
4.	Understanding concept and scientific thinking	18	20	90%	Very valid
5.	Language	12	12	100%	Very valid
	Total	74	80	92,5%	Very valid

Based on the data from the Table. 1, the student worksheet developed was declared very valid to use with percentage by material expert's validator is 92,5%. All aspects of the assessment on the results of the material expert validity test are declared very valid.

The content aspect includes the suitability of activities with learning outcomes Excretory System material, suitability of activities on the LKPD with objectives learning, suitability of illustrations and pictures on the LKPD with the material learning, examples of questions and problems given on the LKPD are in accordance with learning objectives. Learning activities on LKPD have a scientific approach which is developed in accordance with the learning achievements in Phase F students can analyze the relationship between organ structures in organ systems and their functions as well as abnormalities or disorders that arise in these organ systems. Contents which includes student activities in the LKPD is presented completely and arranged to achieve learning outcomes. This is in line with Wahyuningsih et al. (2014) which states that the validation assessment in the content aspect will get good validity results if the material presented according to learning outcomes.

This presentation aspect includes the presentation of learning activities and presentations Excretory System material. Presentation of LKPD learning activities using scientific approach that has been developed has been presented logically, systematically, and sequentially complete in accordance with the Excretory System material in class XI. This is appropriate with previous research by Diella et al. (2019) which states that material arranged in a clear and relevant structure can help students to understand the material independently according to their level of knowledge, without requires external guidance so that student learning outcomes will improve and students' understanding of material concepts. Learning activities in LKPD using scientific approach is presented in a coherent according to the stages of the scientific approach 5M. Apart from that, the presentation of learning activities and the depth of the material on the LKPD according to the student's level of development and the LKPD developed to be interesting and help students understand the material especially Excretory System material.

Developing LKPD using a scientific approach obtains validity results products based on the scientific approach aspect with very valid criteria. This matter because the LKPD has a scientific approach which is developed and includes stages 5M are observing, asking, collecting data, associating, and communicate. This is appropriate opinion Daryanto (2014) states that the application of a scientific approach in student-centered learning to actively construct knowledge through a series of scientific activities.

In the language aspect of the LKPD, a scientific approach is obtained to obtain product validity results with very valid criteria. This is because the LKPD with a scientific approach developed by LKPD already uses Indonesian in accordance with EYD, the sentence structure is clear and systematic so that it is easy for students to understand. Apart from that, the language used in the LKPD is appropriate to student

development. The use of appropriate language is an important factor in learning activities, because language functions as a medium for students to understand the information contained in teaching materials and to minimize errors in interpretation (Sihafudin & Trimulyono, 2020). Effective use of language makes it easy for students to understand and understand the material in teaching materials (Rosa & Susantini, 2020).

Student worksheet product is also assessed for validity by media expert's validator. The results of the validity test by media expert validator are presented in the Table. 2

Table 2 Result validity of media

No	Aspect	Score	Max score	Presentage	Criteria
1	Grafic performance	21	24	87,5%	Very valid
2	Presentation	14	16	87,5%	Very valid
3	language	7	8	87,5%	Very valid
4	The use of media	11	12	91,6%	Very valid
5	Scientific approach	8	8	100%	Very valid
6	Understanding concept and scientific thinking	10	12	83,3%	Very valid
Total		71	80	88,75%	Very valid

Based on the data in Table. 2, the student worksheet that was developed was also declared valid and suitable to use. Several aspects of the results of the media expert validity test were stated to be very valid and with percentage is 88,75%.

Graphic aspects generally consist of the size of the LKPD, cover design, and content design. Overall, the graphic aspect assesses the suitability of the display, layout, and fonts used. In this aspect, LKPD using scientific approach get product validity results with very valid criteria. This matter because in general the LKPD using scientific approach meets the standards. The size of the LKPD uses the custom size B5 which is in accordance with its designation. The cover design is in harmony with the content design in terms of typography, elements graphics, and also the colors used. Apart from that, the LKPD cover design The scientific approach describes the content or material to be studied. Attractive illustrations and visuals can increase students' interest in learning and help students relate the material to real life (Mispa et al., 2022).

The presentation aspect consists of the illustration and material presentation aspects. On this aspect gives the validity of the LKPD using a scientific approach validity with very valid criteria. The presentation of illustrations in this LKPD is relevant with the material and can help to clarify the material so that you can increase student learning motivation. This is in line with Nurrita (2018) who states that learning resources that are designed to be attractive can improve learning motivation to learn in students. The material on the LKPD is also presented consistently logical, coherent and coherent. Apart from that, the activities in the LKPD are approachable Scientific knowledge can inspire students to want to learn and can encourage them students to be able to think critically and alternatively.

The language aspect consists of the suitability of the language used development of students' thinking and good and correct use of language. In this aspect, the LKPD using a scientific approach validity results with very valid criteria. This is because LKPD using scientific approach has been arranged according to grammar and spelling the good one. Language that is communicative and appropriate to emotional development and intellectually, making it easier for students to understand the material and information available in the LKPD (Trimurnati et al., 2019). Aspects of the use of media include convenience, making

the process easier learning, and flexibility. In this aspect, LKPD takes a scientific approach get product validity results with very valid criteria. That matter because the LKPD with a scientific approach has been prepared well and practically so that it is easy to use, makes the learning process easier, and is flexible.

Results of Student Worksheet Readability Assessment

The readability test is carried out after conducting a validity test and the product is declared valid to use. The readability value of students worksheet is obtained by distributing and checking the questionnaire for the readability of students worksheet to biology teachers and class XI-C students as many as 9 people who have received excretory system material before. The result of readability was shown on Table 3 and Table 4.

Table 3 Result of student worksheet readability by teacher

No	Aspect	Score	Presentage	Criteria
1	Material	16	100%	Very good
2	Display performance	31	96,87%	Very good
3	Scientific approach	12	100%	Very good
4	Understanding concept and scientific thinking	15	93,75%	Very good
5	The use of term	12	100%	Very good
	Total	86	97,72%	Very good

Table 3 shows that the average value of readability of students worksheet based on science literacy by teachers is 97,72 with very good criteria. This shows that the students worksheet can be read very well by teachers.

From the results of the readability LKPD using scientific approach on the material aspect in the very good category. This shows that the material aspects developed in the LKPD have a scientific approach in accordance with learning outcomes in the Excretory System material, activities learning, examples of questions and problems in accordance with learning objectives. This is in line with opinion Diella et al. (2019) which states that the material is arranged in a structured manner and appropriate, it can make it easier for students to understand the material independently according to the level of knowledge without guidance from others. This has a positive impact on student learning outcomes and understanding to the concept of material.

The next aspect, namely the presentation aspect of the LKPD, is categorized as very good based on the average readability assessment score by the teacher. This is because learning activities on LKPD using scientific approach are presented logically, complete, and systematic so that it is easy to understand by teachers and students. This matter in line with the opinion Putri & Marianti (2021) which states that a good LKPD is one where each activity is easy for the teacher to understand and students so that it can facilitate the learning process in class. Furthermore, aspects of the scientific approach as well as aspects of understanding concepts and scientific thinking ability is also categorized as very good. This matter because the LKPD developed is in accordance with the stages of the approach scientific (5M) which contains indicators of scientific thinking and students can find them concept of the material independently so as to increase understanding of the concept and students' scientific thinking abilities.

The readability results of the developed LKPD are also in the benefit aspect get readability results in the very good category by the teacher. This matter because the LKPD developed is easy to use when learning and can broaden students' insight. LKPD can help students in the creating process learning fun and students

are easy to understand the material (Ernawati et al., 2017).

Table 4 Result of student worksheet readability by students

No	Aspect	Average score	Max score	Presentage	Criteria
1	Display performance	21	24	87,5%	Very good
2	Learning activities	21	24	87,5%	Very good
3	The use of term	10,22	12	85,18%	Very good
	Total	52,22	60	87,03%	Very good

Based on table 4, it can be seen that the average value of readability of students worksheet based on science literacy by students is 87,03% with very good criteria. This shows that the developed of students worksheet can be read very well by students.

The readability of the LKPD was obtained from the results of a questionnaire given to 9 class XI-C students of SMA Negeri 2 Kebumen in Table 4 as a whole from all three aspects show readability with very good criteria total percentage 87.03%. This shows that the LKPD has an scientific approach has been developed can be read very well by students. LKPD has very good presentation, learning and benefits so it's easy understood by students. All aspects of student worksheets can interest students and motivate students to read or study using LKPD scientific approach that has been developed. This is in line with Arifuddin & Yulianto (2021) who stated that learning with an approach Scientific knowledge has a significant influence on student learning motivation.

LKPD Effectiveness Test Results on Large-Scale Test

In the LKPD effectiveness test, the research design used is a one-group pretest-posttest design which in this model there is one experimental group then a pretest is given to determine the initial ability of the experimental group, then given learning treatment using student worksheet scientific approach on excretory system material product and at the end of learning is given a posttest to see the effect of treatment. The data collection method used is the pretest and posttest methods using 40 multiple choice. Indicators of understanding concepts and scientific thinking then analyzed the results using an N-gain score. The results of the N-gain score and classical completion from the large-scale test and are presented in the Table. 5, Table 6, and Table 7

Table 5 N-gain test result of understanding concepts

Class	Indicator	Average		Skor Maks	N-gain	Criteria
		Score pretest	Score posttest			
XI-A & XI-B	C1	2,82	8,5	10	0,79	High
	C2	6,75	14,21	15	0,90	High
	C3	6,39	15,03	17,5	0,778	High
	C4	3,07	6,50	7,5	0,774	High
Total		19,03	44,07	50	0,80	High

Based on Table 5, it shows the results of the N-gain analysis on students' conceptual understanding in the high and medium categories. This shows that LKPD with a scientific approach can improve students' understanding of concepts. By applying a scientific approach in the learning process, students play an active role in discovering the concepts of the material being studied (Ardaya, 2016).

Based on the test results that have been carried out, indicator C2 (understanding) has the highest N-gain value compared to other indicators. From the use of LKPD with a scientific approach, students' ability to explain events that occur related to the Excretory System, understand the function of the nephrons in the kidneys, categorize kidney function and factors that influence urine production, and explain the process of urine formation has increased significantly. This can be seen based on the results of the N-gain analysis on the C2 indicator (understanding) which is included in the high category.

Based on the results of the N-gain analysis, indicator C1 is in second place after C2. N-gain in category C1 is included in the high category. In this indicator, students' ability to remember and recognize the concept of Excretory System material that has been taught has increased after using LKPD with a scientific approach in the learning process. This cannot be separated from the cognitive level, C1 is the most basic level which is classified as Lower Order Thinking Skill (LOTS).

C3 indicator, the N-gain analysis is in third place after C1 and C2. Indicator C3, students' ability to apply material concepts has increased after using LKPD with a scientific approach in the learning process. Using LKPD with a scientific approach can help students apply theories regarding the Excretory System. This can be seen based on the N-gain value in the C3 indicator which is in the high category.

Indicator C4, the N-gain analysis results have the lowest value when compared to other indicators. The low student scores in answering analysis questions are caused by the level of difficulty of the questions compared to the other three indicators (Rahmawati et al., 2018). Students' ability to remember, understand, and apply concepts effectively means students can answer these analytical questions. However, the N-gain in the C4 category is still in the high category. In this indicator, students' ability to analyze increases after LKPD users take a scientific approach in the learning process. This is supported by activities on LKPD using scientific approach to train students' analytical skills based on the phenomena and data presented.

These four indicators have N-gain analysis results in the high category. This is supported by the developed scientific approach LKPD. The LKPD was developed in accordance with the 5M stages, namely observing, asking questions, collecting data, associating, and communicating. A scientific approach can increase student involvement in learning, where they actively seek understanding of the concepts of the material being taught (Ardaya, 2016). When students are invited to ask questions and observe, their curiosity arises, which then encourages them to seek answers through discussion, as well as referring to the reading material sources provided in the lesson.

Table 6 N-gain test result of scientific thinking

Class	Indicator	Average		Max score	N-gain	Criteria
		Score pretest	Score posttest			
XI-A & XI-B	Inkuiri	2,10	9,21	10	0,90	High
	Analisis	5,14	12,03	15	0,69	Medium
	Argumentasi	6,21	10,67	12,5	0,71	High
	Inferensi	4,92	11,96	12,5	0,92	High
Total		18,39	43,89	50	0,80	High

Based on the results of the N-gain analysis presented in Table 6, it shows that the results of measuring the scientific thinking ability which have been carried out in class XI of SMA Negeri 2 Kebumen are already in the high or medium category. In accordance with the opinion of (Daryanto, 2014) who stated that the scientific approach in learning activities involves cognitive processes which have the potential to advance intellectual development, especially in improving students' high-level thinking skills.

Based on the results of the tests that have been carried out, it is known that the inference indicator has the highest N-gain value compared to other indicators. The inference indicator has sub-indicators of finding theories or concepts from observations and making conclusions. This inference indicator is included in the high N-gain criteria because this indicator is supported by LKPD with a scientific approach which is in accordance with the scientific approach stages in the last stage, namely concluding. This is in accordance with the opinion of Thitima & Sumalee (2012) who state that basically inference is an activity in concluding data based on the information that has been obtained. As according to Kuhn (2010), inference is closely related to the process of making conclusions based on hypotheses.

The inquiry indicator has N-gain results which are included in the high criteria. This can happen because this inquiry ability is supported in LKPD activities with a scientific approach at the observing and questioning stage. In observing and asking questions, students are asked to identify the results of observations, then create questions as problem formulations and create hypotheses from the questions that have been created. Basically, inquiry is an investigation process that encourages students to be actively involved in learning (Eysink et al., 2015)

Next is the argumentation indicator. Overall the results of the N-gain analysis fall into the medium criteria. This argumentation ability is supported in LKPD activities that take a scientific approach at the data collection stage. This argumentation activity focuses on how to prevent and overcome disorders of the Excretory System. The use of argumentation aims to solve problems by referring to theoretical experimental results, which can then produce a conclusion to solve the problem (Nurya et al., 2021)

The indicator that has the lowest N-gain analysis results among the other indicators is analysis. In this indicator, students' abilities are measured, namely reasoning from literature review results and presenting experimental data. The N-gain results on the analysis indicators are in the medium criteria. However, LKPD with a scientific approach is still considered effective for improving scientific thinking skills on analytical indicators. This is because LKPD has a scientific approach that trains students to have analytical skills which are carried out at the data collection and association stages. This stage of collecting data supports analysis indicators because it allows students to collect various information from various sources, such as the interview process, observations, and reading from various relevant learning sources (Nurrohmi et al., 2017). With the information obtained, students can more easily provide answers to the questions asked.

Table 7 Result of classical completeness

Result	XI-A		XI-B		Total	
	Number of students	Presentage	Number of students	Presentage	Number of students	Presentage
Complete	33	94,29%	30	85,71%	63	90%
Incomplete	2	5,71%	5	14,29%	7	10%

The classical completeness score obtained in Table 4.7 shows that the percentage of classical completeness for classes XI-A and XI-B is $\geq 85\%$. Based on the results of the posttest scores for class XI-A, there were 3 students whose studies were incomplete, while in class XI-B there were 6 students whose studies were incomplete. The completeness of student learning is supported by the development of LKPD with a scientific approach. This is in accordance with research conducted by Kereh & Limba (2017), student learning outcomes can increase significantly after using a scientific approach.

The use of LKPD with a scientific approach in the learning process results in classical completeness of $\geq 85\%$. This is in accordance with the explanation presented by Putra et al. (2019) stated that the use of

LKPD has proven to be effective in learning by showing an increase in understanding of the material, individual achievement, and psychomotor skills learning outcomes. The stages of activities in the scientific approach, from observing to communicating, produce changes in student learning behavior that contribute to increasing understanding their concepts and scientific thinking abilities. At each stage, students' abilities are strengthened, including curiosity, respect for facts or data, critical thinking skills, as well as an open and cooperative attitude (Asrida, 2023).

CONCLUSION

Based on the results and discussion, it can be concluded that the student worksheet using scientific approach on excretory system material is very valid to use in learning according to material experts, media experts and readability very well by teachers and students. The student worksheet using scientific approach on excretory system material is effective for improving understanding concepts and scientific thinking.

REFERENCES

- Ahl, B. (2017). Thinking about digestive system in early childhood: A comparative study about biological knowledge. *Cogent Education*, 4(1), 1–16. <https://doi.org/10.1080/2331186X.2017.1278650>
- Anggraini, A. F., Maridi, M., & Suciati, S. (2018). Analisis kemampuan berpikir ilmiah siswa kelas XI IPA kawasan pegunungan Provinsi Daerah Istimewa Yogyakarta. *JURNAL BIOEDUKATIKA*, 6(2), 102–111. <https://doi.org/10.26555/bioedukatika.v6i2.10944>
- Ardaya, A. D. (2016). Meningkatkan Pemahaman Konsep Materi IPA Siswa Sekolah Dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, 1(1), 72–83.
- Arifuddin, R., & Yulianto, A. (2021). Pengaruh Pendekatan Saintifik terhadap Motivasi Belajar Siswa Kelas IV SD YPK 4 Pniel Kota Sorong. *Jurnal Papeda*, 3(1), 55–61.
- Asrida. (2023). Pendekatan Pembelajaran Saintifik Dapat Meningkatkan Prestasi Belajar Fisika pada Pokok Bahasan Gelombang Bagi Siswa Kelas X ATPH SMK-PP Negeri Bireuen. *Serambi Akademica*, XI(9), 1195–1201.
- Daryanto. (2014). Pendekatan Pembelajaran Saintifik Kurikulum 2013. Gava Media .
- Diella, D., Ardiansyah, R., & Suhendi, H. Y. (2019). Pelatihan Pengembangan LKPD Berbasis Keterampilan Proses Sains (KPS) Dan Penyusunan Instrumen Asesmen KPS Bagi Guru IPA. *Jurnal Publikasi Pendidikan*, 9(1), 7–11. <http://ojs.unm.ac.id/index.php/pubpend>
- Ernawati, A., Ibrahim, M. M., & Afiif, A. (2017). Pengembangan Lembar Kerja Siswa Berbasis Multiple Intelligences Pada Pokok Bahasan Substansi Genetika Kelas XII IPA SMA Negeri 16 Makassar. *Jurnal Biotek*, 5(2), 1–18.
- Eysink, T. H. S., Gersen, L., & Gijlers, H. (2015). Inquiry learning for gifted children. *High Ability Studies*, 26(1), 63–74. <https://doi.org/10.1080/13598139.2015.1038379>
- Kereh, C. T., & Limba, A. (2017). Scientific Approach to Build Students' Scientific Attitudes and Its Effectiveness toward Their Achievement in Physics. 4th ICRIEMS Proceedings, 105–116. <https://www.researchgate.net/publication/319622165>
- Kuhn, D. (2010). What is Scientific Thinking and How Does it Develop?
- Mispa, R., Putra, A. P., & Zaini, M. (2022). Penggunaan Lembar Kerja Peserta Didik Elektronik (E-LKPD) Live Worksheet Pada Konsep Protista Terhadap Hasil Belajar Peserta Didik Kelas X SMAN 7 Banjarmasin. *Jurnal Pendidikan Indonesia (Japendi)*, 3(1), 2134–2145.
- Musfiquon, & Nurdyansyah. (2015). Pendekatan Pembelajaran Saintifik. Nizamia Learning Center.
- Nurrita, T. (2018). Pengembangan Media Pembelajaran Untuk Meningkatkan Hasil Belajar Siswa. *Misykat*, 03(01), 171–187.
- Nurya, S., Arif, S., Sayekti, T., & Ekapti, R. F. (2021). Efektivitas Model Pembelajaran Children Learning In Science (CLIS) Berbasis STEM Education terhadap Kemampuan Berpikir Ilmiah Siswa. *Jurnal Tadris IPA Indonesia*. <http://ejournal.iainponorogo.ac.id/index.php/jtii>
- OEDC. (2023). PISA 2022 Results: The State of Learning and Equity in Education. OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Putra, A. P., Huldani, & Hidayat, A. S. (2019). Learning Devices For Biological Diversity: Examining The Use Of Troubleshooting To Improve Student Learning Outcomes. *Systematic Reviews in Pharmacy*, 10(1), 235–246. <https://doi.org/10.5530/srp.2019.1.40>
- Putri, R. P., & Marianti, A. (2021). Development of Student Worksheets Based Discovery Learning on Excretion System

- Materials to Improve Scientific Literacy Skills for Senior High School Students. *Journal of Biology Education*, 10(3), 326–333. <http://journal.unnes.ac.id/sju/index.php/ujbe>
- Rahmawati, Nurlaili, & Iis intan Widiyowati. (2018). Kemampuan Kognitif Siswa Sma Yang Diajar Menggunakan Model Pembelajaran Arias Pada Pokok Bahasan Kelarutan Dan Hasil Kali Kelarutan. *Bivalen: Chemical Studies Journal*, 1(1), 33–38.
- Rizki, L. A., & Ranu, E. M. (2019). Pengembangan Lembar Kegiatan Peserta Didik (LKPD) Berbasis Konstektual Pada Mata Pelajaran Administrasi Kepegawaian Kelas XII Semester Gasal Di SMK Negeri 2 Tuban. *Jurnal Pendidikan Administrasi Perkantoran*, 07(02), 59–66.
- Rosa, F., & Susantini, E. (2020). Validitas Pengembangan LKS Berbasis CTL Pada Materi Ekosistem Untuk Melatihkan Keterampilan Proses Sains Siswa Kelas X SMA. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 9(3), 397–405.
- Rosdiana, L., & Ulya, R. M. (2021). The Effectiveness of the Animation Video Learning Earth's Layer Media to Improve Students' Concept Understanding. *Journal of Physics: Conference Series*, 1899(1). <https://doi.org/10.1088/1742-6596/1899/1/012172>
- Sihafudin, A., & Trimulyono, G. (2020). Validitas dan Keefktifan LKPD Pembuatan Virgin Coconut Oil Secara Enzimatis Berbasis PBL Untuk Melatihkan Keterampilan Proses Sains Pada Materi Bioteknologi V. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 9(1), 73–79.
- Sugiyono. (2019). Metode Penelitian Kualitatif, Kuantitatif, dan R&D.
- Thitima, G., & Sumalee, C. (2012). Scientific Thinking of the Learners Learning with the Knowledge Construction Model Enhancing Scientific Thinking. *Procedia - Social and Behavioral Sciences*, 46(1), 3771–3775. <https://doi.org/10.1016/j.sbspro.2012.06.144>
- Wahyuningsih, F., Saputro, S., & Mulyani, D. S. (2014). Pengembangan LKS Berbasis Inkuiri Terbimbing Pada Materi Pokok Hidrolis Garam Untuk SMA/MA. *Jurnal Paedagogia*, 17(1), 94–103. <http://jurnal.fkip.uns.ac.id/index.php/paedagogia>
- Zahro, S., Wahyuni Jurusan Fisika, S., & Matematika dan Ilmu Pengetahuan Alam, F. (2019). Pembelajaran Inkuiri Terbimbing untuk Melatih Kreativitas dan Keterampilan Berpikir Ilmiah Siswa. *UPEJ*, 8(1), 1–7. <http://journal.unnes.ac.id/sju/index.php/upej>