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Development of Student Worksheets Based Discovery Learning on Excretion System Materials to Improve Scientific Literacy Skills for Senior High School Students

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Abstract

This study aims to analyze the feasibility, practicality, and effectiveness of the student worksheet based on discovery learning on excretory system material to improve the scientific literacy skills of senior high school students. The research was conducted at Senior High School 1 Banjarnegara with a sample of 70 students of XI MIPA class. The type of this study is Research & Development. The data collection technique used in this study is the interview method, the questionnaire method, and the pretest and posttest test methods. The data analysis techniques used is descriptive, percentage descriptive and quantitative descriptive techniques. The results showed that student worksheet based discovery learning on excretory system materials were very feasible to use with the results of the percentage of material expert validity tests is 94.79% and the percentage of media experts validity tests is 84.72%. Student worksheet based discovery learning on excretory system materials are also categorized as practical to use with an average percentage of practicality test by teachers is 87% and an average percentage of practicality test by students is 93.7%. Then the results of the N-Gain data pretest and posttest as many as 83% of students completed obtaining an increase in moderate to high scale scientific literacy. Based on these results, it can be concluded that the student worksheet based discovery learning on excretory system materials is valid and practical to use in learning and effective in improving scientific literacy of high school students.

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INTRODUCTION

The current era of education requires the new generation to have various skills that must be have according to the 21st century criteria to produce an excellent generation in the future. One of the skills that students must have today is scientific literacy skills where scientific literacy is the ability to apply scientific knowledge to all the daily needs of society (Toharudin et al., 2011).

Although scientific literacy is very important to determine the quality of a country's education, the level of scientific literacy of Indonesian students in the last 12 years has always ranked at fifth from the bottom in the PISA program (Fu'adah, 2017). The Program for International Student Assessment (PISA) which is held every three years by OECD it aims to assess how far students in the final year of primary education (15 years old students) already have the knowledge and skills needed to participate as citizens or members of a constructive and responsible society. The four results of the PISA survey program in 2009, 2012, 2015, and 2018, Indonesia's ranking in scientific literacy is on average at the bottom with a score obtained below the standard score set by the OECD. Then according to data from the Trends in International Mathematics and Science Study (TIMSS) program which is an international program that focuses on the development of mathematics and science which is held every 4 years, it was found that in the TIMSS program which was held in 2015, Indonesia was ranked at 44th of 47 participants (Martin et al., 2016).

Based on the results of interviews with biology teachers related to the implementation of biology learning in schools during the Covid-19 pandemic, it turns out that the biology learning that was carried out was not optimal because there was still a lack of innovation in teaching materials that were able to help students become the center of learning and which helped students in learning find the concept independently in today's online learning. According to Tjiptiany et al., (2016) for the success in learning, besides depending on the method used, it also depends on the learning tools and learning materials used.

And then based on data from the High School National Examination (UN) for the 2017/2018 academic year that obtained from the Kemendikbud, states that the level of mastery of student material on the matter of biology of the excretory system material which is included in the material of the structure and function of living things with indicators to identify organ systems that perform certain functions through pictures, the results show that the percentage of mastery of material on the questions is below 60% which is at 54.64% in the Banjarnegara District level.

Regarding the problems of the low performance of Indonesian students in scientific literacy, the lack of optimal biology learning during the pandemic, and then the low mastery of the excretory system material, then a solution is given by developing student worksheet based discovery learning on excretory system material to improve student's scientific literacy skills. The purpose of this study was to analyze the feasibility, practicality and effectiveness of student worksheet based discovery learning on excretory system material to improve scientific literacy skills of high school students.

RESEARCH METHOD

This type of this study is Research and Development or R&D by Sugiyono (2013) 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. Then the research design used is a one-group pretest-posttest design. The research was conducted at Senir High School 1 Banjarnegara with a sample of 70 students of XI MIPA class. The data collection technique used is the interview method, 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 descriptive, percentage descriptive and quantitative descriptive techniques.

RESULTS AND DISCUSSIONS

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 based discovery learning on excretory system material with the resource person the biology teacher. The data obtained are descriptive data conducted by interview method regarding the conditions of biology learning, especially the excretory system material that is carried out and also about how to use student worksheet in the school. Based on the results of these interviews, learning in schools has not implemented assessments to measure students scientific literacy skills. If we look at the education system in Indonesia, one of the public's responses to education in Indonesia that it still focuses only on the cognitive domain. This will definitely a problem that must be corrected in order to prepare students to conquer the obstacles that exist in the future. Examples of obstacles for the new generation of Indonesia are the flow of globalization, the rapidity of information technology, the concentration of science and technology, the influence and effects of technology, and then understanding of the material in the TIMSS and PISA programs (Kemendikbud, 2014). So, it can be concluded that the main factor that causes the low of scientific literacy performance of Indonesian students in the TIMSS and PISA programs is because learning still focuses on the cognitive domain so that students are not familiar with questions that train or measure students scientific process abilities.

Then based on the results of interviews with biology teachers regarding the implementation of biology learning in schools during the Covid-19 pandemic, biology learning carried out by teachers only provides Power Point material and assignments where students are encouraged to read and study independently, so students tend to be passive and learning does not interactive. Then there is still a lack of innovation in teaching materials that can help students become the center of learning, especially in online learning. Based on this, the learning process is not optimal so that the student's scientific process ability in solving scientific problems is not well trained and students still have many difficulties in understanding the material provided by the teacher. Inappropriate teaching methods and learning tools is another factor that causes student's low scientific literacy. This agrees with Fatmawati (2016) which states that the conventional way of teaching by teachers does not facilitate student's scientific literacy skills. Then besides of teaching methods, teaching materials and learning media are very important in the success of learning which will be able to have a direct impact on student's scientific processes, student's critical thinking activities, and student learning outcomes.

After getting the preliminary research data, student worksheet based discovery learning on excretory system material product was developed as a solution to the problems based on the results of the preliminary research data. Researchers conduct literacy studies and collect materials for activities on student worksheet from various relevant sources that are adapted to the applicable basic competencies. Student worksheet based discovery learning on excretory system material are proven to improve student's scientific literacy skills at each stage of discovery learning because at each stage it trains active students to think scientifically to solve problems in order to construct concepts independently, so that learning activities can be meaningful and enter long-term memory even online learning. This is supported by Syamsu (2020) that the discovery learning stage prioritizes students to be able to organize and build concepts based on their own discoveries so that students are actively involved directly in gaining knowledge, not just passively reading or listening to the teacher's presentation. A further statement was also put forward by Hosnan (2014) that learning using the discovery learning model will develop an active way of learning by discovering and investigating on their own so that the results obtained will be faithful and long-lasting in memory.

Validity Test Results by Material Experts and Media Experts

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

Table 1 The Results of the Validity Test by Material Experts Validator

No.	Aspect	Score	Max Score	Percentage (%)	Criteria
1.	Worksheet component	20	20	100	Very feasible
2.	Content eligibility	15	16	93,75	Very feasible
3.	Presentation	14	16	87,5	Very feasible
4.	Discovery Learning	15	16	93,75	Very feasible
5.	Scientific Literacy	15	16	93,75	Very feasible
6.	Language	16	16	100	Very feasible
Average Percentage				94,79	Very feasible

Based on the data from the Table. 1, the student worksheet developed was declared valid and very feasible to use with an average percentage by material expert’s validator is 94.79%. All aspects of the assessment on the results of the material expert validity test are declared very feasible.

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 below.

Tabel 2 The Results of the Validity Test by Media Experts Validator

No.	Aspect	Score	Max Score	Percentage (%)	Criteria
1.	Worksheet Component	20	20	100	Very feasible
2.	Diktatorial Terms	6	8	75	Feasible
3.	Constructive Terms	16	16	100	Very feasible
4.	Technical Terms	20	24	83,33	Very feasible
5.	Discovery Learning	12	16	75	Feasible
6.	Scientific Literacy	12	16	75	Feasible
Average Percentage				84,72	Very feasible

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 feasible and others were stated to be feasible with average percentage is 84,72%.

Practicality Test Results by Teachers and Students in Small-Scale Test

The student worksheet based discovery learning on excretory system material product was tested for practicality by 3 teachers and 15 students of XII MIPA class who have received excretory system material before with heterogeneous student abilities with sampling of students is doing by purposive sampling technique. The results of the practicality test by the teacher and the results of the practicality test by students are presented in the Table. 3 and Table. 4 below.

Table 3 The Results of the Practicality Test by The Teacher

No.	Aspect	Respondens Score			Max Score
		Teacher 1	Teacher 2	Teacher 3	
1.	Worksheet Material	20	15	20	20
2.	Worksheet Presentation	35	30	30	36
3.	Discovery Learning	15	12	14	16
4.	Scientific Literacy	14	12	12	16
5.	Benefit	11	12	12	12
Total Score		95	78	88	100
Percentage (%)		95	78	88	
Average Percentage (%)		87			
Criteria		Very Practical			

Table 4 The Results of the Practicality Test by Students

No.	Respondent	Total Student	Percentage average (%)	Criteria
1.	High Ability Students	5	96,2	Very Practical
2.	Moderate Ability Students	5	94,4	Very Practical
3.	Low Ability Students	5	90,6	Very Practical
Average Percentage (%)			93,7	Very Practical

Based on the results of the practicality assessment by the teacher in Table. 3, the student worksheet products developed are included in the very practical criteria. According to the teacher's assessment, the average score of the acquisition of material aspects in the student worksheet is categorized as practical because it is in accordance with the Core Competencies and Basic Competencies, indicators, and learning objectives because in the preparation of this student worksheet it refers to the 2013 curriculum so that the resulting product can be used to support learning in schools in order to achieve the expected competence. This is supported by the opinion (Sitepu, 2015) that the curriculum contains learning objectives in the form of competencies that are expected to be achieved by students after carrying out learning activities.

Then the next aspect, the aspect of presenting the student worksheet is also categorized as practical based on the average score of the teacher's practicality assessment. This is because learning activities in student worksheet is presented logically, systematically and completely so that they are easily understood by teachers and students. A good student worksheet is easy to understand for each activity by both teachers and students, so can facilitate the learning process. The next aspect, the discovery learning aspect and the scientific literacy aspect, were also declared practical based on the average score obtained in the teacher's practicality assessment. This is because the activities in the student worksheet is developed in accordance with the discovery learning syntax which includes scientific literacy indicators at each stage so that they are able to train student's scientific process skills.

And then the last one is the benefit aspect as well as the average score obtained from the teacher's practicality assessment which is categorized as practical because the student worksheet are easy to use when learning and useful for adding insight to students. Student worksheet based discovery learning on excretory system material developed makes it easier for teachers to manage the learning process, for example, being able to manage learning conditions from teacher centered learning to student centered learning conditions. Beside to making it easier for teachers, the developed student worksheet also facilitates student learning, especially during the current online learning period. This is supported by the opinion of Ernawati et al. (2017) that student worksheet can help students in learning activities, besides making the atmosphere fun, student worksheet also make it easier for students to understand the material presented.

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 based discovery learning 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 test methods using 10 essay questions, each question includes 1 indicator of scientific literacy on the aspect of scientific knowledge and 1 indicator on the aspect of scientific competence, so each question represents 2 indicators of scientific literacy which then analyzed the results using an average N-gain score. The results of the average N-gain score from the large-scale test class are presented in the Table. 5.

Table 5 N-Gain Acquisition of Students in Scientific Literacy Skill

Class	Total Students	Pretest Average Score	Posttest Average Score	Percentage of Completeness of Students who Get N-gain Medium-High Criteria (%)
XI MIPA 4	35	64,74	84,69	83%
XI MIPA 5	35	58,16	79,05	83%

Based on the table Table. 5 shows an increase in the average posttest score of students with the

percentage of completeness of students who get the N-gain criterion of moderate to high is 83%. This means that the improvement in student's scientific literacy skills is quite good after the implementation of student worksheet based discovery learning on excretory system materials in the learning process. This agrees with Zainia et al. (2016) who confirmed that the use of student worksheet based discovery learning model was able to increase the percentage of achievement of aspects of scientific literacy skills.

In this study, aspects of scientific literacy used are scientific knowledge aspect and scientific competence aspect. The data on the results of improvement aspects of scientific knowledge and aspects of scientific competence by posttest is presented in Figure. 1 and Figure. 2 below.

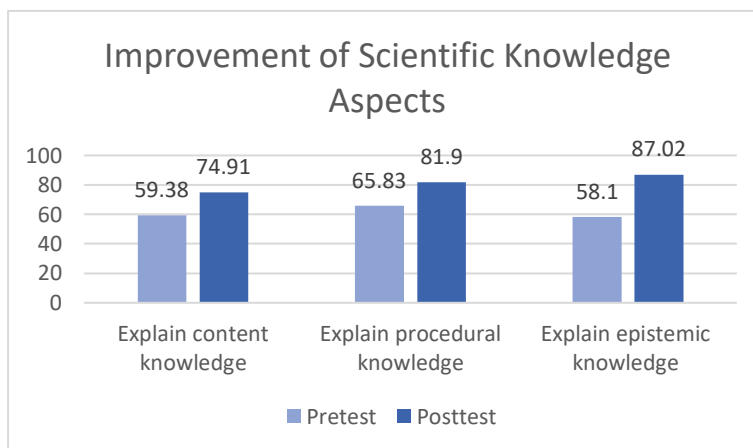


Figure 1 Improvement of Scientific Knowledge Aspects

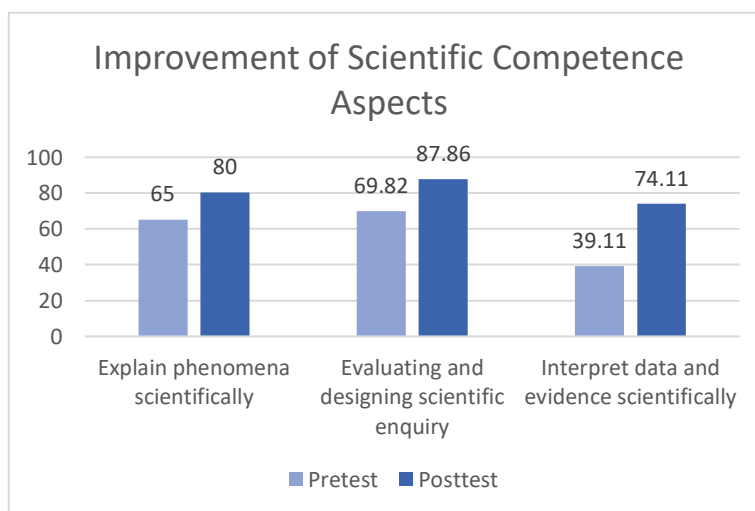


Figure 2 Improvement of Scientific Competence Aspects

Based on Figure 1, in the science knowledge aspect, the three indicators have increased after learning using student worksheet based discovery learning on excretory system materials. Based on Figure 1, it can be seen that the highest indicators of scientific knowledge achieved by students in this study were indicators explaining epistemic knowledge, followed by indicators explaining procedural knowledge, and finally indicators explaining content knowledge. Indicators explaining content knowledge are elaborated on questions number 1, 3, 7 and 9. The increase in this indicator is due to the scientific process ability of students who are trained to explain theories, ideas, information, and facts related to problems that are given scientifically and precisely where these things are presented to the student worksheet in the stimulus, data collection and data processing stages.

The second indicator on the scientific knowledge aspect is explaining procedural knowledge which is elaborated on questions number 2, 4, and 5. The increase in the indicator explaining procedural knowledge is a moderate increase when compared to the other 2 indicators in the aspect of science knowledge, because in the data processing section on the student worksheet is trained student's science process skills in explaining

procedures and mechanisms for constructing concepts based on the given problem so that students are trained in process skills in explaining knowledge that directs to explain a procedure or stage.

And the third indicator on the aspect of scientific knowledge is explaining epistemic knowledge indicator which is elaborated on questions number 6, 8, and 10. The increase in this indicator is the highest when compared to the other indicators in the aspect of science knowledge, because students have been trained to explain, interpret data and answer questions, identify conclusions from a data and explain evidence that supports the hypothesis in the student worksheet contained in the problem statement, verification, and generalizations stage.

Based on Figure 2, in the aspect of science competence, the three indicators have increased after learning using student worksheet based discovery learning on excretory system materials. Based on Figure. 2 it can be seen that the highest indicators of scientific competence achieved by students in this study were indicators of interpreting data and evidence scientifically, followed by indicators of evaluating and designing scientific enquiry, and finally indicators of explaining phenomena scientifically. The first indicator is to explain the phenomenon scientifically which is elaborated on questions number 1, 2,3, 4, 5 and 9. The increase in this indicator is lower when compared to other indicators, because students are not optimal in communicating scientific answers. Although the increase is lower, in learning students are still trained to explain phenomena scientifically in the student worksheet stages of stimulus, data collection and data processing.

The second indicator on the aspect of scientific competence is evaluating and designing scientific enquiry which is elaborated on questions number 6 and 10. In the indicator of evaluating and designing scientific enquiry, the improvement is stated to be moderate when compared to the other indicators in the aspect of scientific competence. The reason for the improvement in this indicator is because students in their learning have the opportunity to carry out in-depth investigation activities based on experimental demands. In connection with the acquisition of an increase in this indicator, it is assumed that students have mastered activities related to investigation.

And the third indicator on the aspect of scientific competence is interpreting data and evidence scientifically which is elaborated on questions number 7 and 8. This indicator experienced the highest increase among the other indicators, because the skills that exist in the indicators interpret data and evidence scientifically such as activities related to transforming data, interpreting data, making conclusions, are often trained in learning using student worksheet based discovery learning on excretory system material. So that when students are given questions that elaborating this indicator, students are used to and trained their abilities.

Based on the results of the study, it can be concluded that there is an improvement in student's scientific literacy skills in aspects of science knowledge and aspects of science competence after learning using discovery learning based worksheets on excretory system materials. Scientific literacy skills must be trained and need to be continuously trained and extended to all learning materials so that student's scientific literacy skills remain good and can be applied by students in everyday life. This is also confirmed by Mirnawati & Rusdiana (2016) that if not guided and directed continuously, the possibility of students' understanding of scientific literacy is very small or even less, so that the previous learning process becomes meaningless. Because essentially the purpose of science education is to be able to train students and make students enthusiastic about scientific topics, then acquire and apply science and technology for personal, social and global interests. In addition, because it gives students various opportunities to understand and discover various applications of science in everyday life, it can foster student's analytical thinking skills in problem solving (Qomaliyah et al., 2017).

CONCLUSION

Based on the results and discussion, it can be concluded that the student worksheet based discovery learning on excretory system material is valid and practical to use in learning according to material experts, media experts, teachers and students. And the student worksheet based discovery learning on excretory system material is effective for improving scientific literacy for senior high school students.

REFERENCE

- Ernawati, A., Ibrahim, M. M., & Afii, 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.
- Fatmawati, I. N. (2016). Penerapan Levels of Inquiry Untuk Meningkatkan Literasi Sains Siswa Smp Tema Limbah Dan Upaya Penanggulangannya. *Edusains*, 7(2), 151–159. <https://doi.org/10.15408/es.v7i2.1750>
- Fu'adah, H. (2017). Pengembangan Alat Evaluasi Literasi Sains untuk Mengukur Kemampuan Literasi Sains Siswa Bertema Perpindahan Kalor dalam Kehidupan. *Lembaran Ilmu Kependidikan*, 46(2), 51–59.
- Hosnan, H. (2014). *Pendekatan Saintifik dan Kontekstual dalam Pembelajaran Abad ke-21*. Bogor: Ghalia Indonesia.
- Kemendikbud. (2014). *Implementasi Kurikulum 2013*. Jakarta: Kementerian Pendidikan Nasional.
- Martin, M. O., Mullis, I. V. S., Foy, P., & Hooper, M. (2016). *TIMSS 2015 International Results in Science*. Boston College TIMSS & PIRLS International Study Center.
- Mirawati, & Rusdiana, D. (2016). Implementasi Model Pembelajaran Discovery untuk Mengembangkan Keterampilan Dasar Bekerja Ilmiah pada Materi Indera Penglihatan dan Alat Optik. *Edusains*, 8(2), 136–144.
- Nurdin, S., & Andriantoni. (2016). *Kurikulum dan Pembelajaran*. Depok: Rajagrafino Persada.
- Qomaliyah, E. N., Sukib, S., & Loka, I. N. (2017). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Literasi Sains Terhadap Hasil Belajar Materi Pokok Larutan Penyangga. *Jurnal Pijar Mipa*, 11(2), 105–109. <https://doi.org/10.29303/jpm.v11i2.111>
- Sitepu, B. P. (2015). *Penulisan Buku Teks Pelajaran*. Bandung: PT Remaja Rosdakarya.
- Sugiyono. (2013). *Metode Penelitian Kualitatif, Kuantitatif dan R&D*. Bandung: Alfabeta.
- Syamsu, F. D. (2020). Pengembangan Lembar Kerja Peserta Didik Berorientasi Pembelajaran Discovery Learning untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Jurnal Genta Mulia*, 11(1), 65–79.
- Tjiptiany, E., As'ari, A., & Muksar, M. (2016). Pengembangan Modul Pembelajaran Matematika Dengan Pendekatan Inkuiri Untuk Membantu Siswa SMA Kelas X Dalam Memahami Materi Peluang. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 1(10), 1938–1942. <https://doi.org/10.17977/jp.v1i10.6973>
- Toharudin, U., Hendrawati, S., & Rustaman, A. (2011). *Membangun Literasi Sains Peserta Didik*. Bandung: Humaniora.
- Zainia, A., Hidayati, N. S., & Faizah, U. (2016). Kelayakan Lembar Kegiatan Siswa (LKS) untuk Melatihkan Literasi Sains pada Materi Sistem Transportasi Manusia. *Jurnal Online Pensa Universitas Negeri Surabaya*, 4(2), 7–10.