Development of Student Worksheets Based on Science Process Skills on Human Excretion System Materials

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Abstract

Development of Student Worksheets (LKPD) based on science process skills on human excretory system material presented in the form of an application on a smartphone which contains human excretion system material, stages of practicum activities and questions adapted to indicators of science process skills, which are expected to be able to train participants' thinking abilities educate. The research aims to find out: (1) the feasibility of developing science process skills-based LKPD (Student Worksheets): (2) the practicality of developing process skills-based LKPD (Student Worksheets); and (3) The effectiveness of developing LKPD (Student Worksheets) based on science process skills on human excretory system material. The development model in this study is 4D which consists of 4 stages, namely define, design, development, and disseminate the research subject of 30 students of class XI IPA MAS 12 Perbaungan. The research instruments are validation sheets for material experts, linguists, and media experts on feasibility testing, practitioner validation sheets to determine practicality, pretest and posttest sheets for effectiveness testing. The results of this study prove that the skill-based LKPD science process developed is declared very feasible with a percentage of 89.39%, very practical with a percentage of 81.94% and very effective with a high category of learning improvement that has been tested with n-gain with a score of 0.73 and excellent student response with a percentage of 81.58%. The results of this study prove that the developed science process skills-based learner worksheets are very feasible, very practical, and very effective to use in the learning process.

Keywords: *LKPD (Student Worksheets), Science Process Skills*

INTRODUCTION

The achievement of learning objectives is not only influenced by the methods or models used by teachers but also by the instructional materials used in the learning process. One of the instructional materials known and widely used in the general learning process by teachers is student activity sheets, also known as student worksheets (Nissa and Yuliati, 2017). Student worksheets, commonly referred to as LKPD, are one of the teaching materials and learning resources that play a supporting role in the learning process and can be used to enhance students' activities in learning. LKPD is a type of

teaching material that functions to help students learn in a structured manner (Trimunanti et al., 2019). Therefore, LKPD is also a tool to guide students' learning activities (Citra Nova et al., 2021).

According to the 2016 Ministerial Regulation, the 2013 curriculum implements a scientific approach. This approach can be marked by the implementation of a scientific or scientific process during the learning process. The scientific process involves direct involvement of students in activities such as observing, questioning, collecting data from available sources, associating the data, drawing conclusions, and communicating. These scientific activities are related to the Science Process Skills (SPS). Student worksheets (LKPD) integrated with SPS can help students improve their cognitive understanding and science skills. The use of SPS-based LKPD is highly effective in the learning process as it can improve learning outcomes, enhance conceptual understanding, and attract students' interest in learning (Muida, 2019). Therefore, the stages of the science learning process can be unique compared to other subjects, and the scientific approach can be implemented effectively (Diella Dea et al., 2019).

One of the skills needed by students to develop their potential is through science process skills. Science Process Skills (SPS) is one of the skills that measure students' thinking abilities, emphasizing a learning approach that focuses on the learning process, applying scientific methods to understand, develop, and acquire knowledge (Trimunarti Etti et al., 2019). The indicators of Science Process Skills according to M. Tawil and Liliasari are Observing, Classifying, Interpreting, Predicting, Asking questions, Formulating hypotheses, Designing experiments, Using tools/materials, Applying concepts, and Communicating. According to Firdaus (2016), SPS is a tool to solve problems and develop students' higher-order thinking skills such as critical thinking.

The advantage of teachers creating or designing their own LKPD is that teachers can design and implement effective and efficient learning activities for their students. This is because the procedures in the LKPD will be in line with the actual conditions in their school environment. Integrating science process skills into LKPD will help students practice science skills in learning a concept. This is in line with the nature of science, which involves the process, product (result), and scientific attitudes. Science is not only about learning its results (theories, laws, principles, etc.), but also the process that involves scientific methods and attitudes (Diella Dea et al., 2019). The functions of using LKPD include: (1) as a teaching material that minimizes the role of the teacher but activates the students more; (2) facilitates students' understanding of the given material; (3) serves as a concise and task-rich teaching material that facilitates teaching to students (Andi Prastowo, 2011).

According to observations, the utilization of LKPD in involving science process skills is not optimal, even though one way to develop thinking abilities is through learning that emphasizes science process skills, especially considering that learning cannot be fully conducted at school due to the pandemic and lacks variation. As a result, students become bored and less enthusiastic. Therefore, it is hoped that the research results can be used in the implementation of biology learning activities. In accordance with the background, the purpose of this study is to produce LKPD that emphasizes science process skills in the topic of the human excretory system for 11th-grade students, with valid, practical, and effective criteria for student use.

METHOD

The research method used in this study is Research and Development (R&D) with the 4D development model (Define, Design, Development, and Disseminate), which aims to develop and obtain a specific product, followed by testing its feasibility, practicality, and effectiveness (Sa'adah, 2020). The research was conducted at MAS 12 Perbaungan, Sedang Berdagai District. The research subjects were 30 students of grade XI Science, and the research object was the LKPD based on science process skills in the topic of the human excretory system, which was developed for use by students through a mobile application.

The instruments used in this study are: validation sheets for the feasibility of the LKPD (validated by subject matter experts, language experts, and media experts) by lecturers, practicality sheets for the LKPD provided to teachers and students, and effectiveness sheets for the LKPD based on the pre-test and post-test scores of students. The development model used in this study is the 4D model developed by Thiagarajan et al., (1974), which consists of defining, designing, developing, and disseminating stages. The development stages of the LKPD based on Thiagarajan et al., (1974) are as follows:

1. Definition: This stage aims to establish and define the needs in the learning process and development. The requirements and objectives of the LKPD based on science process skills in the topic of the human excretory system are identified and defined.
2. Design: This stage involves designing a prototype or draft of the LKPD based on science process skills in the topic of the human excretory system. The design is developed in the form of an application that can be used on mobile phones. Four steps are performed in this stage: (a) media selection, (b) format selection, (c) test standardization, and (d) initial design.
3. Development: This stage aims to produce the final appearance of the instructional tool after revising it based on feedback from experts. The goal is to create a valid, practical, and effective LKPD. During the development process, the LKPD based on science process skills in the topic of the human excretory system is revised under the guidance of the supervising lecturer, subject matter expert validators, language experts, media experts, teachers, and students.

Data Analysis Technique

The data analysis technique used is descriptive and quantitative analysis to assess the quality of the developed LKPD.

Validation of LKPD by Experts

The data analysis technique used is descriptive and quantitative analysis to assess the quality of the developed LKPD.

$$Ps = \frac{S}{N} X 100\%$$

Explanation:
Ps = Percentage score; S = Obtained score; N = Maximum score

With the suitability categories referring to the criteria (Riduwan, 2012), they are presented in the table below.

Table 1. Criteria for the validity of LKPD

Interval	Level of validity
75-100%	Very Valid
50-75%	Valid
25-50%	Moderately valid
0-25%	Not Valid

Analysis of Student and Teacher Practicality Data

Data obtained in the analysis of the practicality of LKPD based on science process skills can be processed using the formula provided by (Riduwan and Sunarto, 2015). The following are the formulas that can be used

$$Ps = \frac{S}{N}X100\%$$

Explanation:
Ps = Percentage score; S = Obtained score; N = Maximum score

With the suitability categories referring to the criteria presented in the table 2,

Table 2. Criteria for the practicality of LKPD

Interval	Level of Practicality
75-100%	Very practical
50-75%	Practical
25-50%	Less practical
0-25%	Not practical

Analysis of LKPD Effectiveness Data

The effectiveness of the developed LKPD is analyzed through normalized gain (N-Gain). The scores of normalized gain are expressed in the following table (Purnamawati, 2017)

$$N - Gain = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score}$$

The results of the normalized gain scores are divided into three categories in Table 3 as follows:

Table 3. Criteria N-Gain

Criteria	Conclusion
N-gain >0,7	High
0,3≤ N-gain >0,7	Moderate
N-gain < 0,3	Low

Dissemination Stage

The dissemination of the developed LKPD, which has undergone the revision process, is carried out by distributing it to a small group. The dissemination is conducted at MAS Al Wasliyah 12 Perbaungan in the 11th-grade Science class, which consists of 30

students who receive the LKPD, as well as the Science teacher who receives the LKPD, in order to implement the planned learning activities.

RESULTS AND DISCUSSION

The research aimed to determine the suitability, practicality, and effectiveness of developing instructional worksheets (LKPD) that prioritize science process skills in the topic of the human excretory system, using the 4D development model. The obtained results are as follows:

Suitability

The suitability assessment was conducted by subject matter expert Ms. Mira Wahyuni M.Pd, language expert Mr. Syahrizal Akbar M.Pd, and media expert Mr. Ahmad Taufik Al Afkari S.Pd, M.Kom, as indicated in Table 4. Based on the research findings, the average score from the validator's assessment of the developed LKPD indicates that it is highly suitable, with a percentage of 89.39%. Therefore, the LKPD is deemed suitable for further testing, development, and implementation

Table 4. Validator Assessment Results

No	Assessment	Assessment Results	Assessment Criteria
1	Language Expert	89,58%	Highly suitable
2	Subject Matter Expert	85%	Highly suitable
3	Media Expert	93,6%	Highly suitable
	Average	**89,39%**	**Highly suitable**

Practicality

The practicality assessment from the biology subject teachers can be seen in Table 5. The practicality assessment of the developed LKPD yielded an average score of 88.345%, indicating that it falls under the category of highly practical. This implies that the developed LKPD is practical and can be used by teachers as one of the various instructional media for the topic of the human excretory system.

Table 5. Assessment Results by Practitioner Experts

No	Aspects Assessed	Result	Criteria
1	Attractiveness	87,5%	Highly practical
2	Content	90%	Highly practical
3	Language	93,73%	Highly practical
4	Science process skills	82,14%	Highly practical
	Average	**88,34%**	**Highly practical**

Furthermore, the practicality of the LKPD was also evaluated based on the responses of the students, as presented in Table 6. From the obtained data, the average score was found to be 81.58%. Therefore, based on the assessment of the students, the LKPD is considered highly practical and suitable for use as a learning media in the classroom.

Table 6 Student Responses

Number of students	30
Total score	327,7
Average score (%)	81,58%

Effectiveness

The effectiveness of the LKPD was assessed by conducting a pre-test before using the LKPD during the learning process, followed bu a post-test after using the LKPD. The results from the pre-test and post-test scores were then analyzed using the normalized gain (N-gain), as show in tabel 7. The average N-gain score obtained was 0.73, which falls into the high category. A value of N-gain >0.7 indicates a significant improvement in learning outcomes after using the LKPD that emphasizes the skills of the scientific process.

Table 7. N-Gain Test Results.

Average pre-test score	Average post-test score	N-Gain	Category
41,66	84,33	0,73%	High

Discussion

The development of LKPD was originally started at the defining stage, namely analyzing Core Competencies (IC), Basic Competencies (KD), and the material to be loaded. The define stage includes a front end analysis whose results are needed LKPD that matches the target needs of students and LKPD that is more innovative. Then analyze the students, as for the results found that students need teaching materials that can motivate the enthusiasm of learning students, and train skills in thinking, namely with teaching materials that are in accordance with technological developments, namely developed LKPD in the form of applications used on smartphones, so that teaching materials or learning media are not only fixed in the form of books.

Then concept analysis, the results of the concept analysis, then on the LKPD display there will be three main menus, namely material, practicum, and questions. The material to be selected is the material of the human excretory system, namely with points explaining the definition of the human excretory system, organs of human excretory, disorders and abnormalities in the human excretory system. Then the practicum has tools, materials, and practicum steps for urine content testing in the form of animated videos. And on the questions, the questions are arranged based on the skill component of the science process. Furthermore, the task analysis is the need for LKPD that attracts students' learning interest and trains students' science process skills, so LKPD is needed based on science process skills. and the formulation of learning objectives In the formulation of learning objectives, it is hoped that in addition to achieving the learning target of human excretory system material in accordance with KI and KD, it is also expected that there will be a change in learning enthusiasm by improving science process skills obtained from science process skills-based LKPD. Therefore, in LKPD there are materials, outlines, and tasks related to the abilities that must be achieved (Wahyuni et al., 2022)

Then the LKPD design stage, by designing a draft LKPD based on science process skills that will be used on smartphones. At the design stage, an initial draft of LKPD was produced before the validation, practicality, and effectiveness of each validator's tie was carried out.

As for the development of this LKPD, based on the student response questionnaire sheet, it was found that with the development of LKPD in the form of applications used on smartphones, it is interesting to use and increases the enthusiasm for learning of students due to variations in LKPD, which previously LKPD was only in the form of books. Then this LKPD is equipped with an animated video of the implementation of the urine content test practicum, so as to further clarify the procedure for implementing the practicum, which is not only explained with sentences but also equipped with an animated video of its implementation. One way to overcome student learning difficulties and increase student enthusiasm is to provide interesting learning media and as needed (Citra Nova, et al., 2021).

At the development stage, the development carried out is to develop LKPD from the previous book sheet then into the form of applications used on smartphones, and compile based on the goals to be achieved, namely improving the way of thinking of students on the material of the human excretory system with science process skills. So the results of the assessment conducted by the material expert, Mrs. Mira Wahyuni M.Pd, obtained very valid results of 85% with a revision note, adding a scheme of the urine formation process, adding a description to the practicum result video, and the question included with the number. The improvement note given by Mrs. Mira Wahyuni M.Pd as a material expert, namely in the presentation of human excretory system material includes pictures of the human excretory system and tables of the process of urine formation to make it easier for students to understand the explanation of the human excretory system. This is in accordance with the statement (Isran and Rohani, 2018) which states that learning media can clarify the presentation of messages and information so that it can facilitate and improve understanding and learning outcomes of students.

Then the results of the assessment carried out by linguists assessed by Mr. Syahrizal Akbar M.Pd obtained an average of 89.58% which was included in the very valid category with several notes, namely paying attention to writing procedures, and colors in writing. This needs to be considered because with writing and display in accordance with good and correct language rules, the quality of LKPD will be better. This is in accordance with the results of previous research, namely the need for compliance with language rules in making LKPD which refers to the General Guidelines for Spelling Indonesian in order to produce language feasibility in the developed LKPD (Citra et al., 2021). The assessment of linguists really needs to be done in the preparation of LKPD, this is in accordance with the opinion expressed by Rohaeti that language feasibility assessment really needs to be assessed because language is a component of constructive requirements which is one of the main conditions that must be met in making LKPD (Rohaeri, et al. 2009).

And the results of the assessment of media experts by Mr. Ahmad Tufik Al Afkari S.Pd, M.Kom obtained a rating of 93.6% which means it is included in the very valid category, with several improvement notes, namely adding a cover to the LKPD display, using more dynamic colors, and improvements to a clearer button layout. After repairs, a

quality LKPD was obtained. Quality LKPD if qualified to follow effective learning methods, language construction, level of difficulty, vocabulary, and have requirements related to writing, images, and appearance (Diani, et al. 2019)

Sourced from the analysis of the data collected, the results of the development of LKPD prioritize the skills of the human excretory system teaching material science process declared to have met the criteria of very feasible with an average percentage of 89.39%, then the acquisition of practicality tests by teachers obtained a percentage of 88.34% and practical tests by students 81.58%, both of which received very practical group categories used in the implementation of learning. And the results of the effectiveness test obtained N-Gain results of 0.73 which means that it experienced a high increase of N-Gain > 0.7. This is right with the opinion expressed by (Mahjatia et al., 2020) that the product will be said to be effective if there is a difference between pretest and posttest. So that there is a change in the increase in the value of student outcomes after carrying out learning activities using science process skill-based LKPD. This is in line with the results of Nurfitra's research (2021) which revealed that the use of PPP-based LKPD in learning has a better effect than when using conventional LKPD.

The development of the LKPD (Student Worksheets) began with the defining phase, which involved analyzing the Core Competencies (KI), Basic Competencies (KD), and the content to be included. In the defining phase, the analysis aimed to determine the need for LKPD that meets the students' needs and is innovative. The analysis of students revealed that they require teaching materials that can motivate their learning enthusiasm and train their thinking skills. Therefore, the development of LKPD in the form of a smartphone application was deemed appropriate, as it aligns with technological advancements and expands the range of learning resources beyond traditional textbooks.

The analysis of concepts led to the inclusion of three main menus in the LKPD: materials, practical exercises, and questions. The selected material focused on the human excretory system, covering topics such as the definition of the system, human excretory organs, and disorders and abnormalities related to the excretory system. The practical exercises section included tools, materials, and step-by-step instructions for conducting a urine content test in the form of animated videos. The questions were designed based on the components of scientific process skills. The analysis of tasks emphasized the need for LKPD that can captivate students' interest and develop their scientific process skills. The formulation of learning objectives aimed not only to achieve the learning targets related to the human excretory system but also to enhance students' motivation and improve their scientific process skills through the use of LKPD based on these skills. Consequently, the LKPD included materials, an outline, and tasks aligned with the desired capabilities (Wahyuni et al., 2022).

The next phase was the design phase, where the initial draft of the LKPD based on scientific process skills for use on smartphones was created. This draft underwent validation, practicality testing, and effectiveness testing by respective validators. Regarding the development of the LKPD, based on the questionnaire responses from students, the development of an application-based LKPD for smartphones was found to be engaging and boosted students' learning motivation. The introduction of variations in LKPD, as opposed to traditional book-based materials, contributed to this positive response. Additionally, the inclusion of animated videos demonstrating the urine content

test procedure in the LKPD provided a clearer understanding of the practical activity. Citra et al., (2021) It is known that using attractive and student-centered learning media that meet their needs can overcome learning difficulties and enhance students' motivation to learn.

Picture 1. Design before revision

Picture 2. Design after revision:

In the development phase, the LKPD was transformed from a paper-based format into a smartphone application, aligning with the desired objective of enhancing students' thinking skills in the study of the human excretory system. The assessment conducted by the content expert, Mira Wahyuni M.Pd, resulted in a highly valid score of 85%. The feedback for improvement included adding a process schema for urine

formation, enhancing the description in the practical video, and numbering the questions. Mira Wahyuni M.Pd suggested incorporating visual aids such as diagrams of the human excretory system and a table illustrating the urine formation process to facilitate students' understanding of the excretory system. This aligns with the statement by Isran and Rohani (2018) that instructional media can clarify the presentation of messages and information, leading to improved understanding and learning outcomes for students.

The assessment by the language expert, Syahrizal Akbar M.Pd, yielded an average score of 89.58%, indicating high validity. The feedback emphasized the importance of adhering to proper writing conventions and using dynamic colors in the text. This attention to language conventions is supported by previous research suggesting the need to follow language guidelines, such as the General Guidelines for Indonesian Spelling, to ensure language quality in the developed LKPD (Citra et al., 2021). Language assessment is crucial in LKPD development, as stated by Rohaeti et al. (2009), as language is a component of the constructive requirements and a fundamental criterion in creating LKPD.

The assessment by the media expert, Ahmad Tufik Al Afkari S.Pd, M.Kom, resulted in a score of 93.6%, indicating high validity. The feedback included adding a cover to the LKPD, using more dynamic colors, and improving button layout clarity. After implementing the suggested improvements, a high-quality LKPD was obtained. The quality of LKPD is determined by its adherence to effective learning methods, language construction, difficulty level, vocabulary usage, and criteria related to text, images, and visual presentation (Diani et al., 2019).

Based on the analysis of the collected data, the development of the LKPD (Student Worksheet) focusing on process skills in teaching the topic of the human excretory system is deemed highly suitable, with an average percentage of 89.39%. The practicality evaluation conducted by teachers resulted in a percentage of 88.34%, while the practicality evaluation by students yielded a percentage of 81.58%. Both evaluations fall into the category of highly practical and can be effectively utilized in the implementation of teaching and learning activities. The effectiveness test results showed a high improvement with an N-Gain value of 0.73, which indicates a significant increase as N-Gain > 0.7. This finding aligns with the statement by Mahjatia et al., (2020) that a product is considered effective when there is a difference between pretest and posttest scores. Thus, there is evidence of improvement in students' learning outcomes after engaging in learning activities using the LKPD based on process skills. This is consistent with the research conducted by Nurfitra (2021), which revealed that the use of KPS-based (Science Process Skills) LKPD in teaching and learning has a more positive impact compared to conventional LKPD.

CONCLUSION

Based on the research findings of developing Science Process Skills-based Student Worksheets (LKPD), the following conclusions can be drawn:
1. The developed Science Process Skills-based LKPD is highly suitable for use, as indicated by the assessment conducted by the validators, with a percentage of 89.39%.

2. The Science Process Skills-based LKPD, which emphasizes the development of science process skills, is considered highly practical by subject teachers, with a practicality rating of 88.34%. The assessment by students also yields a practicality rating of 82.14%, indicating that the LKPD is highly practical for students to use.

3. The Science Process Skills-based LKPD, which has been developed, is evaluated as highly effective in learning. This can be observed from the improvement in students' learning outcomes, as indicated by an N-Gain score of 0.73, signifying a high level of improvement in student performance.

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