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Developing Student Worksheet Based on System Approach on Water Cycle Topic of Water Conservation Learning at Junior High School

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ABSTRACT

Water is an important component that must exist on earth and must still be preserved with water conservation taught from an early age, through a complex learning system on water cycle material and linking it to systems thinking, an LKPD based on a system approach was developed on the topic of the water cycle in junior high school which Test its validity and practicality through the Developmental Research type II method by Richey & Klein (2005) with two stages, namely the exploration phase and testing for students. The trial phase was carried out through the lesson study method which was observed by five observers with the aim of knowing student activities during the learning process. The results of the LKPD were validated by five validators to test the validity of the LKPD using a Likert scale. The data analysis technique was carried out by analyzing quantitative and qualitative data. The results obtained are in the form of a percentage of the validity test with an average of 78% which means that the LKPD is in the valid category. Then from the results of the practicality test of students, an average result of 81.02% is obtained which indicates a very practical category. So that the LKPD is produced that has validity and practicality values that are suitable for use in the water cycle learning process.

Pengembangan LKPD Berbasis System Approach pada Topik Siklus Air untuk Pembelajaran Konservasi Air di SMP

ABSTRAK: Air merupakan komponen penting yang harus ada di bumi dan tetap harus di jaga kelestariannya dengan konservasi air yang diajarkan sejak dini, melalui sistem belajar yang kompleks pada materi siklus air dan mengaitkannya dengan berpikir sistem dikembangkanlah LKPD berbasis *system approach* pada topik siklus air di SMP yang di uji kevalidan dan kepraktisannya melalui metode *Developmental Research* tipe II oleh Richey & Klein (2005) dengan dua tahapan yaitu fase eksplorasi dan uji coba kepada peserta didik. Fase uji coba dilakukan melalui metode lesson study yang diobservasi oleh lima orang observer dengan tujuan untuk mengetahui aktivitas siswa selama pembelajaran berlangsung. Hasil LKPD divalidasi oleh lima orang validator untuk menguji kevalidan LKPD dengan menggunakan skala *likert*. Teknik analisis data dilakukan dengan analisis data kuantitatif dan kualitatif. Hasil yang diperoleh berupa persentasi uji kevalidan dengan rata-

rata78% yang artinya LKPD sudah dalam kategori valid. Kemudian dari hasil uji praktikalitas peserta didik diperoleh hasil rata-rata 81,02% yang menunjukkan kategori sangat praktis. Sehingga di hasilkanlah LKPD yang mempunyai nilai kevalidan dan kepraktisan yang layak digunakan dalam proses pembelajaran siklus air.

INTRODUCTION

Indonesia is a country that has abundant water resources (Utomo et al., 2020). Human life on earth is very dependent on the abundance of water. Based on the 2020-2024 RPJMN, it is explained that nationally, water reserves in Indonesia are still in the safe category. In 2014 Indonesia was recorded as the seventh largest country in the world as a country with renewable water resources, the water resources contained in Indonesia reached 2,019 billion m³ (Andianti et al., 2020). The abundance of water resources in Indonesia still escapes human attention. Lack of understanding and concern for water quality causes a lot of pollution that occurs so that the quality of clean water in Indonesia is decreasing. Clean water management can be started by increasing human awareness of the importance of water quality by pursuing learning about water conservation. Water conservation is an important thing that we can do to maintain a stable amount of clean water. If water stability is achieved, pollution will not increase. This can be done by increasing awareness of the importance of clean water quality for the future. This is in accordance with the research of Susilo et al.

Through learning activities and understanding about the processes that occur in the water cycle from an early age, it helps them to be aware of the importance of maintaining clean water quality. In accordance with the research that has been done by (Amahmid et al., 2019) that the assessment of students' knowledge of water

such as water cycle, water chemistry and water treatment steps revealed that students were not well informed about these topics because 73% of them did not respond correctly. In fact, 45% of students are aware of the scarcity of water and the need to conserve it, but 70% of their behavior does not reflect an attitude of caring for the environment, so water education through the school curriculum is needed to improve students' knowledge, attitudes, and behavior regarding water-related issues.

The material on the water cycle contains systems that are interrelated with one another, besides that the processes in it are also cyclical and involve several components. It is in accordance with the opinion (Kali et al., 2003) who suggested that environmental topics related to the hydrosphere should be presented in the context of the relationship between the hydrosphere and other components of the Earth system. For example, the water cycle is a complex system. For students to understand it meaningfully, they must understand the following: the relationship between the globe: the hydrosphere and the geosphere (eg, chemical weathering with the dissolution and deposition of minerals from seawater); hydrosphere and atmosphere (eg, evaporation and condensation); and the hydrosphere, biosphere, and atmosphere (e.g., transpiration)

Other research has also been done by (Ben-zvi-Assarf & Orion, 2005) that there are some difficulties in understanding the dynamic-systemic nature of the water cycle including: most students cannot make

connections between the atmospheric water sub-cycle and the geospheric underground water sub-cycle. Most students think of underground water as a static, subsurface lake, disconnected system, where the water has no relationship with the surrounding rock. Most students overestimate the contribution of humans to the water cycle. Most students do not associate the relative size of the ocean with the amount of rainfall that falls in the area. Most students have difficulty understanding the transformation of matter (water) on earth, and to synthesize its components into a coherent system.

Due to the difficulties faced by students in connecting the system, an appropriate teaching material is needed to connect the systems in the water cycle. according to (Susilo et al., 2016) Science learning design with a conservation vision has a significant impact on students' caring attitudes towards the environment. So that in the process of increasing students' understanding of water conservation, it is necessary to have learning resources that are relevant to the surrounding environment, especially on the topic of the water cycle.

One of the learning resources that can be used to increase students' understanding of water conservation is the Student Worksheet (LKPD). According to research conducted by (Trisna et al., 2018) regarding the tendency to assess turtle conservation carried out to develop LKPD where the results obtained that the use of conservation-based LKPD is very feasible to be tested for students and can increase the tendency to behave in turtle conservation as seen from the increase in the results of filling out the questionnaire on the tendency to behave in conservation of students through activities Indoor Outdoor Indoor (IOI) as much as 5.46%. This study shows the results that

LKPD can be a source of learning that can increase students' awareness about conservation.

Through a system approach, LKPD will be arranged based on system components that are interconnected, the system approach according to Ullmer (1986) in (Assaraf & Orion, 2005) is an attitude of mind in the face of complexity that reflects the search for interconnectedness of things in any problem situation. So that by applying learning resources in the form of LKPD based on a system approach on the topic of the water cycle, it is expected to be able to increase students' awareness of the importance of protecting water.

METHOD

This research is a type of development research that uses the Developmental Research type II development design by (Klein & Richey, 2005; Richey & Klein, 2005) which has two stages, namely the exploration stage and the trial stage. This research will produce a product in the form of LKPD which will be tested on students and junior high school science teachers. In this study, the LKPD will be tested on 15 students and 1 science teacher at SMP N 1 Indralaya Utara. Then the junior high school science students and teachers will assess and comment on the contents of the LKPD based on the practicality questionnaire presented. In addition, the LKPD design will also be validated by 3 biology education lecturers and 2 science teachers at SMP N 1 Indralaya Utara. Their answers will be a reference for revising the LKPD until the final results of the LKPD are based on a system approach.

This research consists of two stages, namely the exploration and trial stages. At the exploration stage, we will explore

empirical data from textbooks used by students. The results of the empirical data will be used as a reference in making LKPD. The results of the system approach-based LKPD design are called the construction phase. The construction phase is divided into two phases, namely the initial construction phase and the final construction phase. The initial construction phase is the first LKPD design carried out based on a system approach to the water cycle topic. This initial construction phase will receive advice and input from experts and will be revised into the final construction model.

The LKPD construction phase based on the system approach was tested on research subjects, in this case 15 students of class VIII SMP N 1 Indralaya Utara as samples of the study. The test results are used as reference material for making improvements to the developed LKPD. The improvement results are retested on different students and so on so that this phase is called a cyclical process because it is an accumulation of field trials in a limited number of samples (Akker, 2006)

The data collection technique was carried out by testing the validity of the LKPD feasibility and the practicality test of the LKPD. The validation sheet is reviewed in terms of conformity with didactic requirements or content/material, conformity with construction requirements, and conformity with technical requirements. In addition, validation is focused on the feasibility of content, linguistic aspects, presentation aspects, graphic aspects, and aspects of the relationship between material and systems thinking. The validation results will be calculated using the formula, namely:

$$Persentase = \frac{\text{skor hasil pengukuran data}}{\text{skor maksimal}} \times 100\%$$

(Source: Sugiyono, 2008)

The percentage results refer to the assessment scores adapted from (Komarudin & Thahir, 2019; Oberkamp & Smith, 2014), namely:

Table 1. Validation Results Assessment Criteria

Percentage	Criteria
81%-100%	Very valid
61%-80%	Valid
41%-60%	Quite valid
21%-40%	Not valid

The LKPD will also be tested cyclically, the first cycle of LKPD is tested on 14 students through lesson study, the results of student answers will be analyzed as a reference for revising the LKPD, then in the second cycle the LKPD is again tested on 15 different students and the results of the answers students will be analyzed to revise the LKPD again. Students then fill in the LKPD practicality questionnaire sheet to test how practical the LKPD has been used with a percentage value (%) using the formula:

$$\text{Praktikalitas} = \frac{\text{jumlah skor yang diperoleh}}{\text{jumlah skor maksimal}} \times 100\%$$

Table 2. Criteria for Assessment of Students' Practicality Results (Aini et al., 2018; Komarudin & Permana, 2019)

Percentage (%)	Criteria
$80 \leq \text{Value} \leq 100$	Very practical
$60 \leq \text{Value} < 80$	Practical
$40 \leq \text{Value} < 60$	Practical enough
$20 \leq \text{Value} < 40$	Less practical
$0 \leq \text{Value} < 20$	Not practical

RESULTS AND DISCUSSION

LKPD is made based on a system approach which consists of a preface, introduction, table of contents, basic competencies, competency achievement

indicators, learning objectives, work instructions, material concepts, LKPD, system approach learning model syntax, and lesson plans. The LKPD consists of five cases that link the water cycle and the system approach, which is then added with a reflection containing questions from each case in it.

In the exploration stage, an empirical study was conducted by analyzing the water cycle material in the seventh grade science book. The water cycle material is one of the topics contained in KD 3.10 about explaining the layers of the earth, volcanoes, earthquakes, and risk reduction actions before, during, and post-disaster according to the threat of disaster in the area. The topic of the water cycle is part of the biogeochemical cycle, namely the hydrological cycle. In the textbooks used, students discuss the types of the water cycle and its stages. The data obtained from the exploration phase is analyzed and used as input for the initial design of the LKPD based on a system approach on the topic of the water cycle. The LKPD design in the construction phase is presented in Figure 1, Figure 2, and Figure 3.

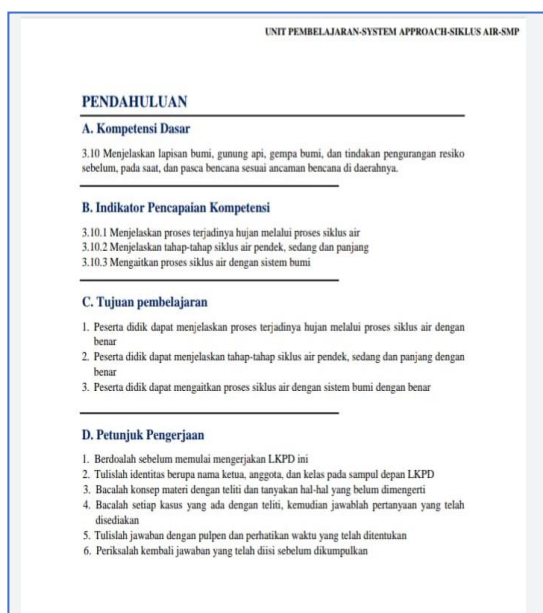


Figure 1. Introduction to LKPD

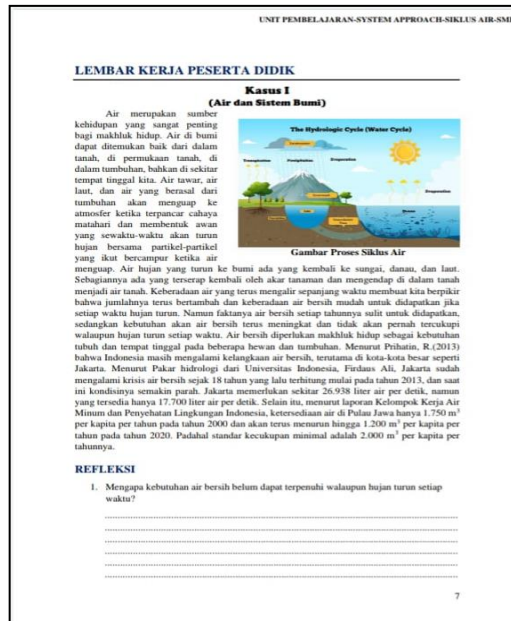


Figure 2. LKPD Material Concept



Figure 3. LKPD case

The LKPD based on the system approach contains interrelated cases between components of the earth system and the water cycle, starting from the relationship between water and the earth system, the hydrosphere and the biosphere, the relationship between the hydrosphere, geosphere, and atmosphere, the relationship

between the sun, the atmosphere, and the geosphere, as well as the interrelationships between between the water cycle and a constant amount of water. In addition, at the end of the LKPD, the syntax of the system approach learning model and Learning Implementation Plan (RPP) is also added as shown in Figure 4 and Figure 5.

The relationship between the water cycle and the earth system in LKPD is in accordance with the material of the water cycle which in each stage involves components of the earth system, ranging from evaporation, transpiration, evapotranspiration, condensation, and precipitation are interrelated with the earth system, namely the hydrosphere, atmosphere, geosphere, cryosphere and the biosphere. This is in accordance with the opinion of Evagorou (2009) that the earth system can be used on issues of the biogeochemical cycle or water cycle, global warming, climate change, acid rain, deforestation, to integrate biology, chemistry, physics, and earth and space subjects.

Furthermore, in the trial phase, it was carried out in two cycles, the first cycle of the LKPD was validated by 3 biology education lecturers and 2 teachers at SMP N 1 Indralaya Utara. The results of the validity test by 5 validators are presented in Table 3.

UNIT PEMBELAJARAN-SYSTEM APPROACH-SIKLUS AIR-SMP

Sintaks Model Pembelajaran System Approach

Fase Pembelajaran	Aktivitas Pembelajaran
Orientasi Sistem	<ul style="list-style-type: none"> Mengamati video pembelajaran mengenai siklus air agar memiliki orientasi sistem sebelum proses pembelajaran dimulai. Membagikan Unit Pembelajaran kepada masing-masing siswa Menjelaskan kembali tujuan pembelajaran kepada siswa Memperhatikan dan memahami tujuan pembelajaran
Identifikasi Organisasi Sistem Siklus Air	<ul style="list-style-type: none"> Memahami isi materi dan kasus pada Unit Pembelajaran terkait mengidentifikasi struktur dan fungsi komponen dan subkomponen siklus air mulai dari evaporasi, transpirasi, evapotranspirasi, sublimasi, kondensasi, adveksi, presipitasi, run off, dan infiltrasi dalam organisasi sistem bumi dalam bentuk mencari istilah-istilah penting dalam struktur dan fungsi pada organisasi siklus air Melakukan aktivitas memahami materi dengan mencarinya pada sumber-sumber belajar yang valid
Eksplorasi Karakter Sistem	<ul style="list-style-type: none"> Bekerjasama dalam kelompok untuk mengobservasi dan mengeksplorasi karakteristik atau perilaku sistem sesuai dengan petunjuk yang ada di Unit Pembelajaran Setiap aktivitas siswa diamati
Eksplanasi	<ul style="list-style-type: none"> Menyampaikan hasil diskusi kelompok secara lisan dengan bergiliran antar kelompok Mengarahkan kegiatan diskusi dan meluruskan konsepsi-konsepsi yang salah dari siswa yang mereka dapatkan dari hasil diskusi
Elaborasi	<ul style="list-style-type: none"> Mengelaborasi konsep tentang struktur, fungsi, dan komponen siklus air serta interaksi antar komponen sistem yang telah di pelajari dalam bentuk studi kasus terkait dengan siklus air

Figure 4. System Approach Learning Model Syntax

Table 3. LKPD Validation Results

No	Validator	Percentage	Category
1	Lecturer I	87.5%	Very Valid
2	Lecturer II	71.69%	Valid
3	Lecturer III	61.5%	Valid
4	Teacher I	87.16%	Very Valid
5	Teacher II	82.26%	Very Valid

UNIT PEMBELAJARAN-SYSTEM APPROACH-SIKLUS AIR-SMP

RENCANA PELAKSANAAN PEMBELAJARAN (RPP)

Mata Pelajaran	IPA	Alokasi Waktu	2 JP (80 menit)
Kelas/Semester	VII/Genap	Tahun Ajaran	2021-2022
Kompetensi Dasar	KD 3.10		
Tujuan Pembelajaran	1. Peserta didik dapat menjelaskan proses terjadinya hujan melalui proses siklus air 2. Peserta didik dapat menjelaskan tahap-tahap siklus air pendek, sedang dan panjang 3. Peserta didik dapat mengaitkan proses siklus air dengan sistem bumi		
Materi Pembelajaran	Siklus Air	Waktu (menit)	
Strategi Pembelajaran: System Approach	Langkah Pembelajaran		
	Pendahuluan <ul style="list-style-type: none"> Mengucapkan salam, dan berdoa Memeriksa kehadiran siswa, dengan menanyakan apakah ada siswa yang tidak hadir? Guru membagikan siswa ke dalam kelompok kecil beranggotakan 3 orang Guru memanggil siswa agar memiliki orientasi sistem dengan cara mengamati video dan animasi sebelum pelajaran dimulai Guru membagikan Unit Pembelajaran kepada masing-masing siswa Guru menjelaskan kembali tujuan pembelajaran Siswa memperhatikan dan memahami tujuan pembelajaran 	10 menit	Orientasi sistem
	Inti <ul style="list-style-type: none"> Siswa memahami isi materi dan kasus pada Unit Pembelajaran terkait mengidentifikasi struktur dan fungsi komponen dan subkomponen siklus air mulai dari evaporasi, transpirasi, evapotranspirasi, sublimasi, kondensasi, adveksi, presipitasi, run off, dan infiltrasi dalam organisasi sistem bumi dalam bentuk mencari istilah-istilah penting dalam struktur dan fungsi pada organisasi siklus air 	60 menit	Identifikasi Organisasi Sistem/Sub Sistem

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Figure 5. Learning Implementation plan

Based on the percentage results in the table, it is known that the LKPD based on the system approach has reached the valid category and is very valid to be used with notes being revised based on suggestions and comments that have been written by the validator in the comments column on the LKPD validation sheet.

Then the LKPD was tested on class VIII B students as many as 14 students. Through

lesson study, each student is observed their movements and activities during the learning process. LKPD is done by students in groups by discussing. In one group consists of 3 people. During the learning process, several students were actively involved in discussing and listening to learning videos and paying attention to the teacher's explanations.

criteria for the results of the questionnaire in Table 2.

CONCLUSIONS AND SUGGESTIONS

The water cycle LKPD based on the system approach can be applied in junior high school or MTs grade VII semester 2 according to the validity results which show an average of 78% meaning that the LKPD is in the valid category, and the practicality of the LKPD which shows an average of 81.02% means it is already shows that the LKPD is also practical for students to use in learning the science of water cycle material.

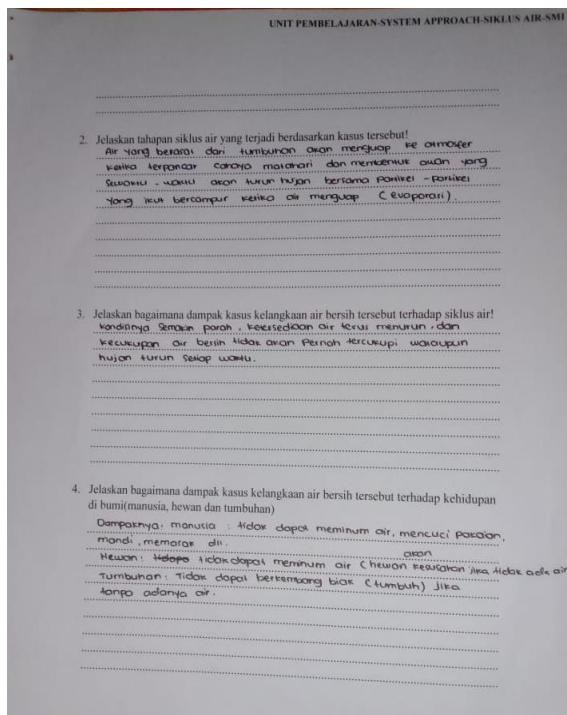


Figure 6. Case Reflection Answer

The results of the practicality test of students are described in Table 4.

Table 4. LKPD Practical Results

Keterangan	Jumlah
Jumlah	1.134,33
Nilai terendah	92,60
Nilai Tertinggi	68,40
Rata-rata	81,02

From the results of the percentage of students' practicality tests, it is known that the LKPD used is in the practical and very practical category. This is adjusted to the

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