

THE DEVELOPMENT OF STUDENTS WORKSHEET STEM BASED ON MIKiR

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Abstract

This study aims to Development the Student Worksheet with the STEM based on MIKiR for theme 2 “Always Save Energy” in grade 4 Elementary School using the Plomp model (2013). The development stage is carried out in three stages: Preliminary Research Stage, Prototyping Stage, and Assessment Phase. The research data were collected using observation, interviews, and questionnaires. Data processing in this study was carried out using quantitative descriptive and qualitative descriptive analysis. The worksheets that were developed are validated by three experts consisting of media experts and material experts , with an avarage skore percentage is 93,52%. Meanwhile, practicality can be seen from the questionnaire responses of teachers, with an avarage skore percentage is 85,99%. In conclusion, the Student worksheet STEM based on MIKiR developed is valid and practical and can be used in learning.

Keywords: LKPD; MIKiR; STEM

Abstrak

Penelitian ini bertujuan untuk melakukan pengembangan terhadap Lembar Kerja Peserta Didik (LKPD) dengan model STEM berbasis MIKiR untuk tema 2 “Selalu Berhemat Energi” pada kelas IV Sekolah Dasar dengan menggunakan model Plomp (2013). Tahapan pengembangan yang dilakukan dengan tiga fase: Preliminary Research Phase, Prototyping Phase, dan Assessment Phase. Data penelitian ini dikumpulkan dengan cara observasi, wawancara dan angket. Pengolahan data pada penelitian ini dilakukan dengan cara analisis kuantitatif deskriptif dan kualitatif deskriptif. LKPD yang telah dikembangkan divalidasi oleh tiga orang ahli yang terdiri dari ahli media dan ahli materi dan memperoleh persentase skor validasri rata-rata 93,52%. Sedangkan kepraktisan dilihat dari angket respon guru dengan persentase skor rata-rata sebesar 85,99%. Maka dapat disimpulkan LKPD STEM Berbasis MIKiR yang dikembangkan valid dan praktis dan dapat digunakan dalam pembelajaran.

Kata kunci: LKPD; MIKiR; STEM.



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INTRODUCTION

Technology is the influence of globalization bring about a change in the order of the community life, including education (Jalinus & Alim, 2019; Safitri et al., 2021). The development of science and technology very rapidly demanding education is the basic need of every human being can provide useful skills for students in the future (Wijaya et al. 2021, Putra et al., 2021). The quality of a nation can be seen from the quality of the education of the nation itself (Amini et al., 2020; Sujana & Rachmatin, 2019).

Education in Indonesia is currently using the 2013 curriculum. The 2013 curriculum strongly emphasizes the importance of creativity and communication that can train students ' problem-solving abilities as an individual and produce quality graduates (Hidayati et al., 2015; N. A. Sari et al., 2018; Setiadi, 2016). Problem-solving skills will not be realized if the learning that occurs within a contextually using the student book and teachers book because in the teacher's book the material presented is not able to achieve KI and KD that was designed, educators must innovate to develop learning tools that can stimulate the problem-solving ability of learners (Alim et al., 2020, 2021; Neni Hermita et al., 2021; Marzuki, 2017; Purnomo & Wilujeng, 2016).

The use of learning tools will increase the interest of students and not be boring for students in understanding the learning materials (Alim et al., 2021; Lestari et al., 2019; Wijaya et al., 2020). One of the innovations that can be used by teachers in learning is with the use of a worksheet Students as a learning device on the 2013 curriculum needs to be done, teachers are required to make learning which can train

students ' skills in technology and science (Alim, 2018; Alim et al., 2019; N Hermita et al., 2020; Lestari et al., 2019; Wijaya et al., 2021).

Student worksheet is the innovation development of teaching materials, with the aim that students understand a concept or learning material independently and help students find the concept of material through the activities that they naturally own or in groups during the learning process, because the activities presented in the book are less able to stimulate students' thinking skills and skills so that students have difficulty understanding learning (Amini et al., 2020; Firdaus & Wilujeng, 2018; Hamzah, 2016; Latifah et al., 2016). It is necessary to develop a student worksheet which is a teaching material that is able to arouse student interest which leads to the creative learning process and understanding concepts by the students themselves (Nareswari et al., 2021). Based on the results of the research, Student worksheet used nowadays do not meet the components to meet the needs of the curriculum in 2013, only in the form of a summary of the material without a detailed description that can not stimulate the creativity, skills, and critical thinking skills of students (Firdaus & Wilujeng, 2018; A. P. P. Sari & Lepiyanto, 2016).

The solution that can resolve the issue is to do with the development of Student Worksheet STEM (Science, Technology, Engineering, and Mathematics) and based Thinking. STEM is the discipline and practice of education that will influence the future (Leni, 2020; Oktapiani & Hamdu, 2020; Oktoriyadi, 2020; Syah & Muttaqin, 2019). Student worksheet can increase students ' interest and stimulate the skills, knowledge, and attitude of

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the learners to be able to think critically in solving problems. The new variation encountered by students in learning can reduce and eliminate the saturation of the study. The aim of this research is to develop a student worksheet that valid and practical STEM based on MIKiR in Grade IV Elementary School.

METHOD

This research is a development research or Research and Development (R&D) with the development model of Plomp that there are three phases namely; (1) Preliminary Research This phase is commonly referred to as the preliminary phase or needs analysis, by collecting and analyzing information, defining problems carried out by field observations, conducting interviews with fourth-grade elementary school teachers, to planning activities to be carried out consisting of needs analysis, curriculum analysis, and student analysis. (2) Development or Prototyping phase, this phase is carried out after analyzing the theory as well as concepts related to the development of design and design in carrying out the learning process in the classroom for the material to change the form of energy in grade IV Elementary School. At this stage, they are directed to build concepts in designing and designing to plan the learning process in the classroom later. The last is the (3) Assessment Phase This phase is carried out after evaluating small groups, in this phase what is tested is the practicality of the design that has been made, whether the design can be used and implemented by teachers and students. The following image of Plomp's phase-to-phase development is based on the progress graph in the research conducted.

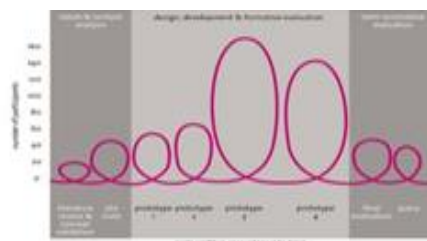


Figure 1. Development phase Plomp

The type of data taken in this study is primary data is data obtained directly through interviews and administration of questionnaires. Data were taken in the form of quantitative data obtained from the results of the validation expert, and questionnaire validation master. As for the data analysis techniques used by researchers in the manufacturing phase prototype using quantitative analysis to determine the feasibility and practicality of the products developed. The subjects in this study were students of class IV SDN 014 Sungai Keranji.

1. Validity

Aspects of validation are assessed by the validator experts. Data analysis to test the validity which is used based on the Likert scale with a score of 1-4. Validation of the product is determined by the value of the average score obtained from the validator. Table 1 of scales used in the assessment given by the validator:

Table 1. Validator rating category

Assessment Score	Category
4	Very Good
3	Good
2	Less Is Better
1	Not Good

Guidelines for the calculation of the percentage score of the questionnaire validator is as follows:

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$$P = \frac{\sum x}{\sum y} \times 100\% \quad (1)$$

Description :

P = The percentage of the feasibility of

$\sum x$ = The number of overall respondents' answers

$\sum y$ = Sum of the cur maximum

In decision-making used criteria based on the Table 2:

Table 2. The percentage of the validation criteria of the media.

No	Interval average score (%)	Category
1	81,25 < skor ≤ 100	Very Worthy
2	62,5 < skor ≤ 81,25	Worthy
3	43,75 < skor ≤ 62,5	Less Worthy
4	25 < skor ≤ 43,75	Not Worthy

2. Practicality

This practicality was obtained from a questionnaire given to teachers and students. Categorization of teacher and student responses was analyzed through percentage (%) using the following formula:

Practicality score:

$$P = \frac{\sum x}{\sum y} \times 100\% \quad (2)$$

Description :

P = The percentage of the feasibility

$\sum x$ = The number of overall respondents' answers

$\sum y$ = Sum of the cur maximum.

The percentage obtained practicality, grouped according to the following criteria (Table 3)

Table 3. Percentage criteria

No	Interval average score (%)	Category
1	81,25 < skor ≤ 100	Very Practical
2	62,5 < skor ≤ 81,25	Practical
3	43,75 < skor ≤ 62,5	Less Practical
4	25 < skor ≤ 43,75	Not Practical

RESULTS AND DISCUSSION

The stage of research and development carried out in this study include (a) the Phase of the Preliminary Study, (b) the Phase of Development or Prototype, (c) Phase Assessment.

a. Preliminary Research Phase

In this phase, carried out the collection of information is required and will be analyzed. The analysis in this phase in the form of needs analysis, curriculum analysis, and the analysis of the learners, the collection of information is done by observation and interview techniques

1. The Results Of The Needs Analysis

Based on the results of interviews conducted by the researcher with one of the teachers in grade IV SDN 014 Sungai Keranji. Obtained data that the learning done by the teacher is still using the conventional method of the lecture method, the teacher will explain the material related to learning, then students are given examples of questions, and then the teacher will give the evaluation questions according to the example problems and the material presented. Learning by using teaching materials in the form of student worksheet is still rarely performed, teachers use only the book of the teacher and the student book as teaching material. In general, student worksheet used by the teacher is still based on the exercises in the book text that has been

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provided by the school by changing some of the components on student worksheet. Activity for finding, conducting experiments, and solving problems that combine some of the science is not yet visible student worksheet used.

2. Curriculum Analysis

Hasil The results of the analysis of the curriculum were used as the basis in formulating the learning outcomes to develop Student Worksheet STEM based on MIKiR. The current curriculum that is being done the draft curriculum of the school drive that uses the basic framework of the curriculum is to set the principles as a reference by the teacher in making the design of learning. Based on interviews conducted by the researcher, obtained information that SDN 014 Sungai Keranji does not use the curriculum drive and still uses K13 in learning. The analysis of the curriculum includes the analysis of the Standard of Competence (SK), the analysis of Basic Competence (KD), and Indicators of learning that are adapted to the material being taught related to the development of Student Worksheet STEM based on MIKiR.

3. The Analysis Of The Learners

The analysis of the learners aims to study the character of the learners to be taken into consideration in designing Student Worksheet STEM based on MIKiR which includes age, learning style, and reasoning ability. The age of the students in class IV SD/MI range between 10-11 years. In the learning of many students who love science, but the method of learning used only in conventional, not few learners love the practicum including variations in learning. Participants did also love the bright colors such as red, blue, and

purple. Students are very enthusiastic when offered to do the lab work while learning, even if you have yet to do lab work earlier because of the learning that happens online.

b. Development or Prototyping Phase

The activities performed in this phase is the design, development, and assessment of Student Worksheet STEM based on MIKiR by the results of the analysis in the previous phase.

1. Design and development of the initial product (Prototype 1)

Design and development of Student Worksheet STEM based on MIKiR For Students 4th Grade Elementary School which is a follow-up of the introduction phase. On the stages of the design specified material by the experiments that can be done in Elementary School, as well as the look that will be loaded in the media is designed. Student worksheet this was develop with app Canva. Canva is an application that can be used to design a variety of design free online, designing animations that are required in the student worksheet, Writing that is used on these materials using the font Alice with variations in sizes 20-32 and spaces between rows of 1-1.5. Teaching materials are designed by combining the features available in the app Canva among others Templates, elements, and graphics that are tailored to each sheet on student worksheet. Teaching materials consist of 7 sheets in which there is a cover, Standard Curriculum (SK)/Indicators and Learning purpose, the elements of STEM, tools, and material, step experiments, and evaluation activities. As for the component-components of the result of the development of

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student worksheet STEM based on MIKiR the:

1. Picture Illustration

In these materials, there are images of the illustrations to clarify content and activities to be carried out in the experiment Student Worksheet STEM-based MIKiR. Images for illustrate electrical energy that can be generated through the fruit is in accordance with the activities that will be carried out on the Student Worksheet (Figure 2).



Figure 2. Picture Illustration

2. Cover sheet

Cover sheets on these materials using a background with a bright color that is purple, following the 4th-grade students who love the color-bar is bright. On the cover, the sheet included pictures of illustration in the form of a picture of an apple, potato, and orange as well as images of wiring to describe the flow of electricity (Figure 3).



Figure 3. Cover sheet

3. Sheet Competency Standards/indicators

This sheet contains indicators for material science and Mathematics according to Curriculum 2013 (K13). On this sheet is written to the achievement of the basis for material science followed the material of Mathematics which can be used as a measure of achievement goals for student learning (Figure 4)

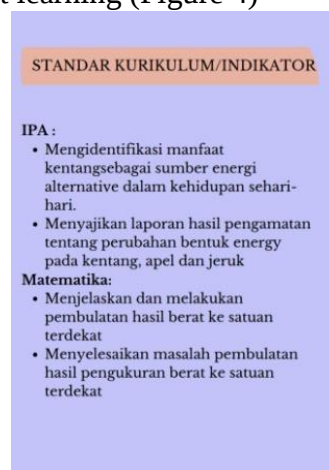


Figure 4. Sheet Competency Standards/indicators

4. Sheet learning objectives

On the sheet is conveyed the objectives to be achieved in learning from the experiments conducted by learners in the worksheet Learners, which is related to science, technology, engineering, and mathematics for STEM (Figure 5)

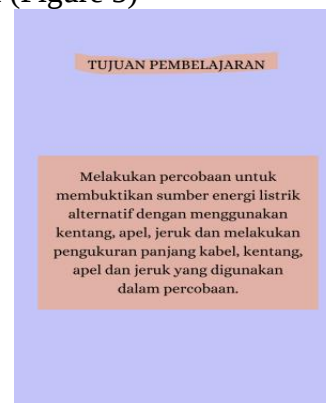


Figure 5. Sheet learning objectives

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5. Sheet element STEM

On this sheet, there is a table of elements STEM that is, science, technology, engineering, and math with the division of the aspects and questions related to the elements of the STEM in the experiment (Figure 6)

UNSUR STEM		
UNSUR STEM	ASPEK	PERTANYAAN TERKAIT
TEKNOLOGI	Sumber energy alternatif	Dari bahan yang disediakan, siswa dapat mengait apa itu sumber energy alternative?
SIENCE	Percobaan kentang, apel dan jeruk	Bagaimana cara melaksanakan percobaan untuk membuktikan sumber energy alternative dari kentang, apel dan jeruk?
ENGINEERING	Melakukan percobaan energy alternative	Bagaimana langkah-langkah percobaan untuk membuktikan sumber energy alternative dari kentang, apel dan jeruk?
MATHEMATIC	Melakukan pengukuran berat kentang, apel dan jeruk yang digunakan dalam percobaan	Bagaimana menentukan berat benda dan melakukan perhitungan hasil pengukuran berat benda?

Figure 6. Sheet element STEM

6. The display of tools and steps of the experiment

On this sheet written tools and materials needed and yhe spes in the experiment (Figure 7)

TOOLS AND MATERIALS
PERCOBAAN 1: -Kentang, jeruk nipis, apel -Lampu LED -Kabel -Penjepit buaya -Lempengan tembaga -Lempengan seng
PETUNJUK PEMBUATAN
• Tusukkan lempengan tembaga dan seng kedalam kentang, apel, jeruk • Jepitkan kabel kepada lempengan tersebut dan hubungkan dengan lampu • Lihat nyala lampu yang terjadi • Jika nyala lampu belum kelihatan, maka tambah kentang, apel, dan jeruk tersebut agar arus listrik yang dihasilkan bertambah

Figure 7. The display of tools and steps of the experiment

7. Evaluation sheet activities

This sheet is part of the evaluation after the experiment according to Student Worksheet STEM based on MIKiR. In this section, there are

questions related to the experiments that have been done, the matter of the related elements of the STEM, and with the activity of Thinking. Each question will be related to the field of natural sciences, Technologies, Engineering, and mathematics (Figure 8)

AKTIVITAS 1: SCIENCE, ENGINEERING, TECNOLOGY
1. Amatilah nyala lampu pada percobaan mu! Dan jelaskan tingkat kecerahan dari lampu yang dihasilkan pada kentang, apel dan jeruk! (Terang, redup, sangat redup)
.....
.....
.....
AKTIVITAS 2 : SCIENCE, TECNOLOGY
1. Dari percobaan yang dilakukan, apakah kentang, jeruk, dan apel bisa menghasilkan energy listrik? Jelaskan menurut pendapat kelompok mu!
.....
.....
.....

Figure 8. Evaluation sheet activities

2. Assessment Expert

After learning media developed successfully, then validate the product. Validation is a stage that needs to be done by researchers to minimize the permissible error in the manufacture of Student Worksheet STEM based on MIKiR valid. Validation is carried by 4 people validators that consist of a 2-validator media and 1 person validator material. The following validation results obtained from the instrument rating in the contents of the validator can be seen in table 4.

Table 4. Analysis of the results of validation experts

No	Assessment Aspects	Validation Average (%)	Category
1	Contents	95,6	Very valid
2	Didactic	87,3	Very valid
3	Language	95,6	Very valid
4	Display	95,6	Very valid
Average		93,52	Very valid

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Through table 4, Student Worksheet STEM based on MIKiR is developed to obtain the average percentage for each of the aspects assessed 93,52%.

3. One to one evaluation

After the validation is done by expert and expert, Student Worksheet STEM based on MIKiR is done stage one to one evaluation. The evaluation of individuals is selected 3 students of class IV SD Negeri 014 Sungai Keranji randomly, this Activity is carried out to test the product Student Worksheet STEM based on MIKiR in elementary school to view the legibility of the learners, which is observed directly by the researcher. At this stage, the interviews with the learners associated with Student Worksheet STEM based on MIKiR that has been developed. On the activities of the one-to-one evaluation to prototype 2 obtained a positive response from learners, students love the activities that occur based Student Worksheet STEM based on MIKiR and be able to add the spirit of the learners in learning. Based on the explanation it can be concluded that the developed products were well received by the learners as instructional materials used in teaching and learning.

c. Assessment Phase

Table 5. Analysis of the results of product practicability by teacher

No	Assessment Aspects	Practicability Average (%)	Category
1	Usage	91,5	Very practical
2	Material	83,16	Very practical
3	Benefits	84,3	Very practical
4	Design	85	Very practical
Average		85,99	Very practical

The phase of the assessment aims to assess the level of validity and the practicability of the products that have been developed through a process of practicability is done by 6 Primary School teachers. The following test results practicalities on teacher in table 5.

From the table 5, the value obtained for the product of Student Worksheet STEM-based MIKiR is 85,99% with the category of very practical. Thus the conclusion that the products Student Worksheet STEM based on MIKiR it deserves to be used in learning. Several studies were carried out related to the use and development of STEM including, (1) Design of STEM Learning Based on 4c Ability in Elementary Schools (Oktapiani & Hamdu, 2020), which conducted research in the development of Learning Implementation Plans (RPP) by applying 4C skills (collaboration, critical thinking, creativity, and communication), (2) STEM which involves 4C abilities further with the title Student Worksheet Design in Stem Learning for Elementary School Students (Hamdu et al., 2020), is also one of the studies related to STEM with the aim of getting the right design to be used by students to achieve 4C abilities (collaboration, critical thinking, creativity, and communication).

CONCLUSION

Based on the discussion and results, it can be concluded that the STEM student worksheet based on MIKiR is valid and practical for use in learning in the fourth grade of elementary school. STEM student worksheets based on MIKiR are able to increase students' interest in learning.

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