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Development of SESD (Science Education for Sustainable Development) based on Student Worksheet 'Climate Action' Social Science Content to Construct Critical Thinking Skills of Elementary School Students

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ABSTRACT

Global environmental challenges, including climate change, require a strong commitment to realising sustainable development, where education plays a key role in building awareness and skills to address these challenges, with Science Education for Sustainable Development (SESD) being an important approach in integrating sustainable concepts into the curriculum. The purpose of this research is to develop SESD-based Student Worksheets with a focus on the topic of "Climate Action" in science subjects in primary schools, to improve critical thinking skills and support sustainable development goals, particularly in handling climate change to support Sustainable Development Goals (SDG). This research uses the ADDIE model, involving needs analysis through interviews with teachers, design of SESD-based Student Worksheets 'Climate Action' by taking into account the characteristics of learners and the applicable curriculum, and development of Student Worksheets by involving expert validation. The evaluation results showed that the SESD-based Student Worksheets 'Climate Action' succeeded in improving students' critical thinking skills, with an average score of 80%, which was included in the good category, and the validation of Student Worksheets and materials by experts also showed the feasibility of the product to be used in learning. The conclusion of this study is that the development of SESD-based Student Worksheets 'Climate Action' is an important step in strengthening sustainable education and increasing learners' understanding and awareness of environmental issues, with suggestions to improve the effectiveness of SESD-based learning in the future.

Keywords: Critical thinking, Worksheet, SESD

INTRODUCTION

Various environmental problems are now issues that require special attention. Environmental problems that continue to occur indicate that a great commitment is needed by the entire world community to make sustainable development a fundamental principle. (Eilks, 2015). Meanwhile, according to (Cebrián & Junyent, 2015), sustainable development requires the integration of three dimensions, namely socio-cultural development of society, economic growth, and the utilisation and preservation of the environment.

Sustainable development can be achieved one of them in the field of education. Education for Sustainable Development (ESD) encourages the realisation of human resources who can be responsible for environmental conservation in the midst of increased development. (UNESCO, 2017).

The implementation of Education for Sustainable Development (ESD) is sought to be integrated both through classroom learning and extracurricular activities, from elementary education to higher education. (Bulan et al., 2017). Education for Sustainable Development (ESD) is like planting important seeds in the next generation. These seeds are knowledge, skills, attitudes, perspectives and values based on sustainable principles (Laurie et al., 2016). (Laurie et al., 2016). Through ESD, the younger generation is encouraged to live life with full awareness and responsibility for the sustainability of the earth for a better future. One of the efforts to implement ESD into subjects is through Natural Science (IPA), hereafter referred to as Science Education for Sustainable Development (SESD).

One of the points contained in SDGs point 13 is "Handling Climate Change" (sdgs.bappenas.go.id). Climate change is an environmental issue that must be a concern. Climate change presents serious challenges to human health around the world. Its complex and multidimensional impacts have become a major concern for public health experts and international organisations. The inexorable rise in global temperatures, increasing greenhouse gas emissions and extreme natural phenomena are clear evidence of the climate crisis facing our planet. The impact is not only on the environment, but also on human health, both directly and indirectly. According to World Meteorological Organisation, (2022), greenhouse gas emissions are now more than 50% higher than in 1990.

Science Education for Sustainable Development (SESD) is the concept of implementing sustainable education in science learning. One of the SESD implementations can be done on the topic of "Climate Action". The implementation of SESD on the topic of "Climate Action" is an optimisation of one of the SOCIAL SCIENCE learning outcomes in phase C of the independent curriculum, namely "Students reflect on how changes in natural conditions on the earth's surface occur due to natural factors and human actions, identify lifestyles that cause environmental problems and predict their impact on social, economic conditions." (curriculum.kemdikbud.go.id). Optimising learning with SESD can make learners realise that actions taken in relation to "Climate Action" will affect environmental, social and economic conditions in the future. (Tareze & Astuti, 2022).

Optimisation of SESD-based learning has so far been very passive. The following research results show the obstacles that arise in the implementation of SESD in elementary schools: 1) Research conducted by (Supriatna et al., 2018) (Supriatna et al., 2018) found that the implementation of learning principles based on sustainable development in elementary schools is still not optimal. This can be seen from the learning indicators, materials, and approaches that have not been effective in developing SESD competencies; so that it can have a weak impact on shaping the understanding of elementary school students. 2) Research conducted by (Birdsall, 2015) (Birdsall, 2015) found that teachers' understanding at the elementary school level is still quite simple related to ESD. Therefore, SESD-based learning on the topic of "Climate Action" in elementary schools is not optimal.

The realisation of SESD-based learning is also inseparable from the 21st century skills that require learners to master. Indonesia has shown that there are efforts to improve the quality of education. Acceleration of the implementation of an independent curriculum, namely "Merdeka Belajar" (Laurie et al., 2016) The main concept is the

ability to think critically (Critical Thinking). In realising Science Education for Sustainable Development (SESD) based learning on the topic of "Climate Action" in elementary schools as an effort to realise sustainable development (SDGs point 13) and 21st century skills (critical thinking), learning tools are needed that can support students to be actively involved, one of which is through the Student Worksheets device. Student Worksheets can be used as a medium for developing students' process skills. (Fauziyah & Hamdu, 2022).. Active learning activities with Student Worksheets guidance provide a stimulus for students to be more active in thinking and doing or what is known as learning by doing.

Based on the various problems above; so this research has the aim of knowing the feasibility level of the SESD (Science Education for Sustainable Development) based Student Worksheets 'Climate Action' SOCIAL SCIENCE Load, to improve students' critical thinking skills, which is applied to learning activities in grade 5 elementary school.

MATERIALS & METHODS

The type of research conducted is development research or *Research and Development* (R&D). Development research is intended to create products that begin with needs analysis activities, development, evaluation, revision, and reproduction of products (Purnama, 2016). (Purnama, 2016). This research uses the ADDIE development model which consists of 5 stages, namely: (1) *Analysis, (*2) *Design,* (3) *Development, (*4) *Implementation, (*5) *Evaluation.* The stages of research to be carried out are described as follows:

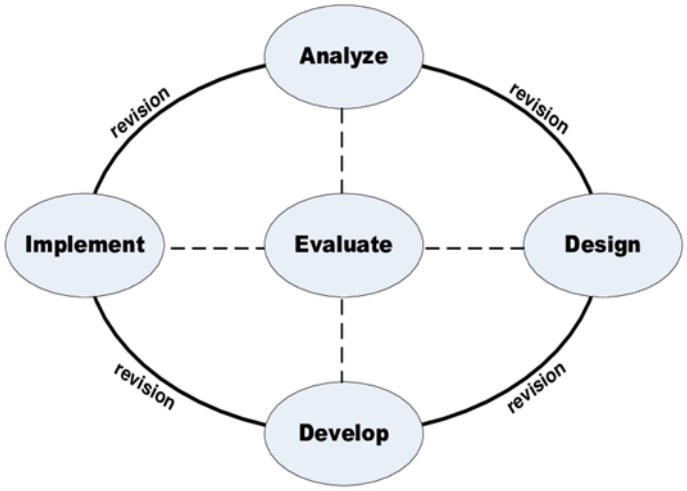

Figure 1. ADDIE stages

First, analysis. On Monday, 4 March 2024, researchers conducted an interview with the fifth grade teacher of Lengkong II Public Elementary School Mojokerto. At this stage, the researcher conducted an in-depth analysis related to the obstacles and needs in social science learning in the classroom. Based on the analysis activities, it was found that there were several problems in Social Science learning in the classroom, namely as follows: 1) In classroom learning, more lecture and question and answer methods are used, this is due to the limited number of student guides or worksheets. 2) In social science learning, there is less discussion on the topic of "*Climate Action*" which there is no guide to implement it.

Second, *design*. The design stage is a stage related to the material/content and design of the Student Worksheets SESD "*Climate Action*". In designing the material, researchers compile and collect material based on several learning resources for students. While the design of student

worksheets design is based on the characteristics of students.

Third, *development*. Furthermore, researchers realised the design that had been planned previously. The student worksheets realisation stage is accompanied by the validation stage, both material experts, and media experts Student Worksheet. This is done to determine the feasibility of the media based on the validation instrument that has been prepared by the researcher. Suggestions from validators will be used by researchers to improve Student Worksheets before further implementation in the field.

Fourth, *implementation*. The implement-ation/ testing of the SESD-based Student Worksheets "*Climate Action*" was carried out at Lengkong II Public Elementary School in Mojokerto, for grade 5 students. In its implementation, researchers distributed evaluations to students based on the critical thinking skills of students. As well as to find out the usefulness Student Worksheets for social science learning.

Fifth, *evaluation*. The next stage in the development of this SESD Student Worksheets "*Climate Action*" is evaluation. Evaluation is carried out by researchers to continue to make improvements if there are deficiencies in the previous stages.

In this study using instruments for data collection. As for some research instruments used by researchers so that the research runs structured and obtains data with good validity, as follows: 1) Material validation sheet, Student Worksheet, and evaluation, which is then addressed to the validator to determine the feasibility of the Student Worksheets developed. 2) Evaluation sheets for students to determine and measure the effectiveness of Student Worksheets in shaping students' critical thinking skills.

The types of data collected are qualitative data and quantitative data. Qualitative data was obtained by researchers through observation and interviews conducted to explore problems and analyse needs in the field. Other qualitative data is a literature study related to the development of SESD (Science Education for Sustainable Development) based Student Worksheets '*Climate Action*'. While quantitative data is obtained by researchers through the test results of media experts and material experts conducted to assess the feasibility of SESD-based Student Worksheets (Science Education for Sustainable Development) '*Climate Action*'.

Table 1. *Likert Scale* Measurement

Score	Category
5	Very good
4	Good
3	Medium
2	Bad
1	Very Bad

The validation instrument that has been assessed by expert validators is then calculated using the formula:

$$\text{Percentage (\%)} = \frac{\Sigma \text{ skor validasi diperoleh}}{\Sigma \text{skor validasi total}} \times 100\%$$

From the final results of the percentage of expert validation, then classified based on existing categories to determine the level of feasibility of both Student Worksheet, material, and evaluation used in the development of Student Worksheets based on SESD (*Science Education for Sustainable Development)* '*Climate Action*'. The following are guidelines for the eligibility criteria for Student Worksheet, materials, and evaluations used in this study:

Table 2: Eligibility criteria

Percentage	Category
0.00%-20.99%	Very Bad
21.00%-40.99%	Bad
41.00%-60.99%	Medium
61.00%-80.99%	Good
81.00%-100%	Very good

RESULT

A. Analyse

The results of the needs analysis conducted through an open interview with the fifth-grade *teacher of* SDN Kaliasin 2 showed that learning only focuses on *teacher centered*, monotonous learning, the absence of

learning media especially on the SOCIAL SCIENCE material, and the LKS used is sourced from the LKS provided by the school. This is felt by the teacher to make students quickly bored and not focused on understanding the subject matter provided, especially on *climate action material* so that the learning outcomes set cannot be achieved. Therefore, an appropriate solution is needed to overcome these problems, one of which is by developing ESD-based electronic Student Worksheet.

The characteristics of Electronics Student Worksheets developed refer to the components of Electronics Student Worksheet, learning activities to support critical thinking skills, and the characteristics of elementary school students. difficulty. Judging from the appearance, Electronics Student Worksheets is made colourful and accompanied by supporting images. The material in the e- Electronics Student Worksheets is made in accordance with the demands of the Merdeka Curriculum. Material selection begins with analysing basic competencies. From this basic competency, it is then realised in the form of learning indicators and learning objectives.

1. Design

The first thing to do to create Electronics Student Worksheets is to compile items and content. Furthermore, the researcher designed the Electronics Student Worksheets in accordance with the learning model used and associated with SESD.

2. Development

At this stage, media and material expert validation tests were carried out. The results of the Student Worksheets validation show that the developed e-Student Worksheets is in the feasible category.

Table 1. Results of STUDENT WORKSHEETS Validation

Media Validation	Aspects			Total Validation Score	Percentage	Eligibility
Trial	Physical	Contents	Usage			
	20	39	15	64	98	Very good

While the results of material validation show:

Table 2: Material Validation Results

Material Validation	Aspects		Total Overall Score	Percentage	Eligibility
	Physical	Presentation of Material			
Trial	20	18	38	95	Very good

3. Implementation

According to Ulandari et al., (2022) The implementation stage is a stage carried out by researchers to start using the new product developed in the learning process, looking again at the objectives of product development and interaction between students when using learning products. At this stage, researchers implemented the Student Worksheets in the classroom using a predetermined learning model. The learning process

4. Evaluation

The last stage in this development is the evaluation stage. Where the evaluation stage is carried out after the trial. The product will be improved if there are obstacles for students and according to the complaints of students in using e- Student Worksheet. Student evaluation results can be shown in table 3.

Table 2: Learner Evaluation Results

No.	Name	Score
1	AAN	100
2	ADW	100
3	AP	70
4	US	70
5	AR	90
6	ARY	90
7	AZR	80
8	BRL	80
9	VIR	70
10	DT	60
11	JZIP	80
12	KNZ	80
13	RHN	80
14	FHR	80
15	IRN	40
16	HD	100
17	NCD	60
18	PIN	90
19	RFK	80
20	SS	50
21	SSK	90
22	SNIP	100
23	SFR	90
24	SDNR	80
25	VNE	90
26	YDS	70
27	ARR	90
Total Overall Score		2.160
Average		80

Based on table 3, it shows that the student evaluation results are at an average percentage of 80%. That is, the results of this score are in the good category. The assessment system used in Student Worksheets is already at C4, C5 and C6. According to Anderson and Krathwohl (Wahtuni, et.al, 2021), levels C4, C5 and C6 are high-level thinking skills. This means that the assessment system in the developed Student Worksheets is HOTS. Thus, students must be prepared to think critically, logically, reflectively, metacognitively, and creatively in answering the questions in the Student Worksheet.

DISCUSSION

The world is currently faced with a variety of increasingly urgent environmental problems. This situation shows the need for a strong commitment from the entire global community to make sustainable development the main foundation (SDGs). One of the important areas to achieve sustainable development is through education. *Education for sustainable development* (ESD) aims to foster a generation that is responsible for environmental sustainability in the midst of rapid development. (UNESCO, 2017).

One of the points contained in SDGs point 13 is "Handling Climate Change" (sdgs.bappenas.go.id). Climate change is an environmental issue that must be a concern. *Science Education for Sustainable Development* (SESD) is the concept of implementing sustainable education in science learning. The implementation of SESD can be done on the topic of "Climate Action". Therefore, this study developed an Student Worksheets based on SESD (*Science Education for Sustainable Development*)

'*Climate Action*' Load of SOCIAL SCIENCE, to improve students' critical thinking skills, which was applied to learning activities in class 5, at Lengkong II Public Elementary School Mojokerto.

This development research uses the ADDIE model in which each stage has a clear and systematic sequence. The research began with the problem and needs analysis stage, then continued with design, development, implementation, and evaluation. In this study, researchers developed an attractive Student Worksheets design. The design results were then realised at the development stage. At this stage, the developed Student Worksheets passed the expert validation stage, both in terms of material, Student Worksheet, and evaluation developed. This is in line with the opinion of (Dewi & Sudaryanto, 2020) that the validity test value plays an important role because it can affect the data obtained in the study.

The validation stage of the SESD Student Worksheets "*Climate Action*" involved a material expert validator conducted by Mrs Atika Maulidina HS, M.Pd., as well as a media Student Worksheets expert validator, namely Mr Drs. Bambang Hidup M, M.Pd. As for the results obtained through the validation process carried out, the Student Worksheets developed obtained "very feasible" criteria, where the validation of Student Worksheets obtained a percentage of 98%, and the material was 95%. In line with the opinion (Nuraini, 2022) that the media is said to be feasible if it reaches at least a percentage $\geq$ 61%.

Based on the validity test that has been carried out, the trial/implementation stage is then carried out. At the trial stage, the advantages of using the SESD Student Worksheets "*Climate Action*" are not only limited to guiding the steps on the worksheet carried out by students. But it also forms students' critical thinking skills (21st century skills). The following is a description of the advantages obtained by students in learning activities using the SESD "*Climate Action*" Student Worksheet:

1. Procedural Knowledge
   This knowledge is related to the knowledge of doing something or things related to the skills and techniques of doing something. Based on the results of the trials carried out, the points in the Student Worksheets show a coherent and systematic work step guide. This helps learners to form their procedural knowledge.
2. Factual Knowledge
   The factual knowledge produced includes various facts that exist. In the trial of the SESD Student Worksheets "*Climate Action*", students are required to form their factual knowledge to be able to work on Student Worksheets properly; so that the evaluation questions given can also be done properly and correctly. This is also related to factual knowledge that emphasises a sustainable system on Student Worksheet; so that the Student Worksheets developed covers seeds in the form of knowledge, skills, attitudes, perspectives, and values based on sustainable principles (Laurie, et al., 2016).
3. 21st Century Skills
   The 21st century skills in question are the formation of *Critical Thinking* in students. After the trial of Student Worksheets SESD "*Climate Action*" was carried out, then students were given evaluation questions to measure their critical thinking skills. The evaluation results show that the average score achieved by students is quite high, namely 80, meaning that the results of this score are in the good category.

Based on a series of SESD "*Climate Action*" Student Worksheets development activities carried out, several advantages and disadvantages of the SESD "*Climate Action*" Student Worksheets are known to form students' critical thinking skills. The following is a description of the advantages and disadvantages of the SESD Student Worksheet "*Climate Action*":

Pros:

1. Student Worksheets SESD "*Climate Action*" is valid and very feasible for teachers to use as a worksheet based on sustainable development.
2. The SESD "*Climate Action*" Student Worksheet is an effective Student Worksheet used to shape students' critical thinking skills.
3. The SESD Student Worksheet "*Climate Action*" can be used as a reference for further relevant development research.

Disadvantages:

Based on the results of the trial, the SESD Student Worksheet "*Climate Action*" requires more intensive supervision from the teacher team; so that the SESD Student Worksheet "*Climate Action*" can be better if carried out with the *team teaching* method.

CONCLUSION

Development of Science Education for Sustainable Development (SESD)-based Student Worksheet with a focus on the topic of "Climate Action" in Science subjects in elementary schools. This research takes the topic of "Climate Action" in elementary schools is considered important to achieve sustainable development goals, especially in handling climate change, especially to support the Sustainable Development Goals (SDG). The research used the ADDIE model which consists of analysis, design, development, implementation, and evaluation. The evaluation results showed that the findings of the SESD-based Electronics Student Worksheet 'Climate Action' successfully improved students' critical thinking skills with an average score of 80%, which is included in the good category. The validation of Electronics Student Worksheet and materials by experts shows the feasibility of the developed products to be used in learning. Suggestions and inputs that can be given based on this research are as follows:

1. Integrate more sustainable development-based learning methods in the elementary school curriculum to improve learning effectiveness.
2. Expand the scope of the topic "Climate Action" in Science subjects in elementary schools by using a more structured guide.
3. Encourage the development of more SESD-based learning tools, such as Electronics Student Worksheet, to support the development of learners' critical thinking skills.
4. Conduct regular monitoring and evaluation of the implementation of SESD-based learning to ensure its effectiveness in increasing students' environmental awareness and critical thinking skills.
5. Promote collaboration between schools, government and relevant institutions to support the implementation of sustainable education in the elementary school curriculum.

With the implementation points of the above suggestions, it is expected that SESD-based learning, especially on the topic of "Climate Action", can be more optimal and effective in increasing students' understanding and awareness of environmental issues as well as developing their critical thinking skills.

Declaration by Authors

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REFERENCES

1. Birdsall, S. (2015). Analysing teachers' translation of sustainability using a PCK framework. *Environmental Education Research*, *21*(5), 753-776.
2. Bulan, P., Musfirowati, I., Ari, P., & Agung, B. (2017). Elementary Schools Eco-Friendly Education in the Frame of Education for Sustainable Development. *International Journal of Environmental & Science Education*.
3. Cebrián, G., & Junyent, M. (2015). Competencies in education for sustainable development: Exploring the student teachers' views. *Sustainability*, *7*(3), 2768-2786.

4. Dewi, S. K., & Sudaryanto, A. (2020). *Validity and reliability of the knowledge, attitude and behaviour questionnaire for Dengue Prevention*.
5. Eilks, I. (2015). Science education and education for sustainable development-justifications, models, practices and perspectives. *Eurasia Journal of Mathematics, Science and Technology Education*, *11*(1), 149-158.
6. Fauziyah, S., & Hamdu, G. (2022). Implementation of ESD-Based E-STUDENT WORKSHEETS on Critical Thinking Competence in Elementary School. *Attadib: Journal of Elementary Education*, *6*(1), 172-179.
7. Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C. (2016). Contributions of education for sustainable development (ESD) to quality education: A synthesis of research. *Journal of Education for Sustainable Development*, *10*(2), 226-242.
8. Nuraini, L. (2022). Integration of local wisdom values in learning mathematics sd/mi curriculum 2013. *Journal of Mathematics Education (Kudus)*, *1*(2).
9. Purnama, S. (2016). Research and development methods (an introduction to developing Arabic language learning products). *Literacy: Journal of Education Science*, *4*(1), 19-32.
10. Supriatna, N., Romadona, N. F., Saputri, A. E., & Darmayanti, M. (2018). Implementation of Education for Sustainable Development (ESD) through Ecopedagogy in Integrated Thematic Learning in Elementary Schools. *Primaria Educationem Journal (PEJ)*, *1*(2), 80-86.
11. Tareze, M., & Astuti, I. (2022). Collaborative Learning Model of SDGs in Formal Education as an Introduction to Global Issues to Increase Learners' Social Awareness. *Visipena*, *13*(1), 42-53.
12. Ulandari, S., Dewi, N. K., & Istiningsih, S. (2022). Development of inquiry-based Jari Baru (Jaring-Jaring Bangun Ruang) teaching aids in mathematics subject for grade VI students of SDN 02 Pejanggik Praya Tengah. *Scientific Journal of Education Profession*, *7*(1), 216-222.
13. UNESCO. (2017). *Education for Sustainable Development Goals: learning objectives*. UNESCO. https://doi.org/10.54675/CGBA9153
14. World Meteorological Organisation. (2022, October 26). *More bad news for the planet: greenhouse gas levels hit new highs.* https://public.wmo.int/en/media/press-release/more-bad-news-planet-greenhouse-gas-levels-hit-new-highs

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