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Development of Project Based *e*-Worksheet to Stimulate Scientific Creativity and Collaborative Skills

Titi Puspita Lupi, Kartini Herlina*, Feriansyah Sesunan, and Doni Andra
Physics Education, Faculty of Teacher Training and Education
University of Lampung, Indonesia
*kartini.herlina@fkip.unila.ac.id

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Abstract

This study aimed to develop project-based *e*-worksheets using *Fliphtml5* on light interference topic. This research used Design, Development, and Research (DDR) with the stages of analysis, design, development, and evaluation. To get a product that is feasible, this product must be valid and practical. Validity of the product's design and construct was validated by 3 experts, indicating that the digital e-worksheet developed was categorized very valid with an average score of 3.44 and the practicality of the product in terms of the teacher's and student's responses with an average score of 85% was categorized very good. Based on the results of validity and practicality of product, it assumed that e-worksheet is feasible to stimulate students' science creativity and collaborative skills.

Keyword: Collaborative Skills; *Fliphtml5*; Project Based *E*-Worksheet; Scientific Creativity.

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INTRODUCTION

The 21st century learning emphasizes skills known as the 4C encompassing creativity, critical thinking, communication, and collaborative (Bialik, Fadel, Trilling, & Nilsson, 2015). In addition to emphasizing 4C skills, the 21st century learning has a characteristic in which students are involved in the digital world so that learning activities, discussions, sharing links and other activities are carried out through digital technology (Jan, 2017). Learning process using digital media can increase student experiences such as critical thinking, problem solving and creativity (Jan, 2017). Creativity in learning is needed to get new understanding, find solutions and combination of knowledge obtained from solving scientific problems (Ahmadi & Besançon, 2017). Creativity in scientific activities or known as scientific creativity can be trained by implementing indicators of science process skills including finding problems, hypothesizing, finding variables, testing/experimenting, collecting data, presenting results, and explaining results (Aktamis & Ergin, 2008). Scientific creativity is related to problem finding activities, science experiments, scientific activities and problem solving (Suyidno et al., 2019).

Problem solving activity can be started by planning the objectives of activity, investigating cases, and solving

project through experiment (Zhang, Xie, & Li, 2019). The use of the PjBL learning based on simple props helps learners understand a subject matter because learners can understand concepts topic from the tool-making that they are for (Sambite, Mujasam, Widyaningsih, & Yusuf, 2019). Problem solving with project-based learning activities can increase student enthusiasm for learning, to train student-centered learning and collaboration (Aksela, 2019).

Students have difficulty learning physics in solving problems, understanding concepts and formulas, using graphs and pictures, and difficulties to conclud the material that has been studied (Azizah, Yuliati, & Latifah, 2015). Camarao & Nava (2017) states that the factors causing learning difficulties in physics are material content, teaching materials, classroom environment, and the way teachers teach. Teaching materials in the form of activity sheets or worksheets can increase students' curiosity about learning topics through activities (Fauziah & Nurita, 2019; Misbah, Dewantara, Hasan, & Annur, 2018). In addition, the selection of learning media must be precise to be interesting and the topic is easy to understand by students (Mahyuddin, Wati, & Misbah, 2017; Zainuddin, Hasanah, Salam, Misbah, & Mahtari, 2019).

Using technology as learning media can be interesting to participated students (Hartini, Misbah, Dewantara, Oktovian, & Aisyah, 2017; Maimunah, An'nur, & Misbah, 2016). Based on semi-structured interviews and distributing questionnaires for needs analysis related learning light interference topic in some schools, it is stated that learning activities on the light interference topic have not trained scientific creativity and collaborative skills.

Based on needs assessment of one of the teaching materials that suit these needs is project-based *e*-worksheet. The *e*-worksheet is composed of activities to train students' skills. For that, researcher aimed to develop a learning media through research entitled "How to Develop Project Based *e*-Worksheet to Stimulate Scientific Creativity and Collaborative Skill". The development of e-worksheet was carried out to find the validity and practicality.

METHOD

This study uses the Design and Development Research (DDR) category of product development research adapted from Richey and Klien (2014) consist of four stages analysis, design, development, and evaluation stages which can be seen in Figure 1.

The analysis stage was carried out by observing the needs of teachers and students about scientific creativity and collaborative skills that must be taught to students in light interference topic. This analysis stage is to prepare product development to suit the needs. The design stage is the stage of designing a product that will be developed. This research designed a teaching material for grade 11 high school, namely project-based e- worksheet to stimulate scientific creativity and collaborative skills.

The development stage is the stage of product development in accordance with the designs that have been made at the design stage. This stage includes the product manufacturing process, validity, and practicality of product. The validity of product is a criterion for the quality of learning tools seen from the material contained in the learning device. The validity of product consists of design and construct validity. The practicality of product said to be practical if the practitioner or expert states that the learning tools developed can be applied. The practicality of product consists by teacher responses and results assessment of the stimulation of scientific creativity and collaborative skills. The last stage is evaluation, to know the suitability of

activities at each stage of the development procedure that have gone well or not and for product improvement needs.

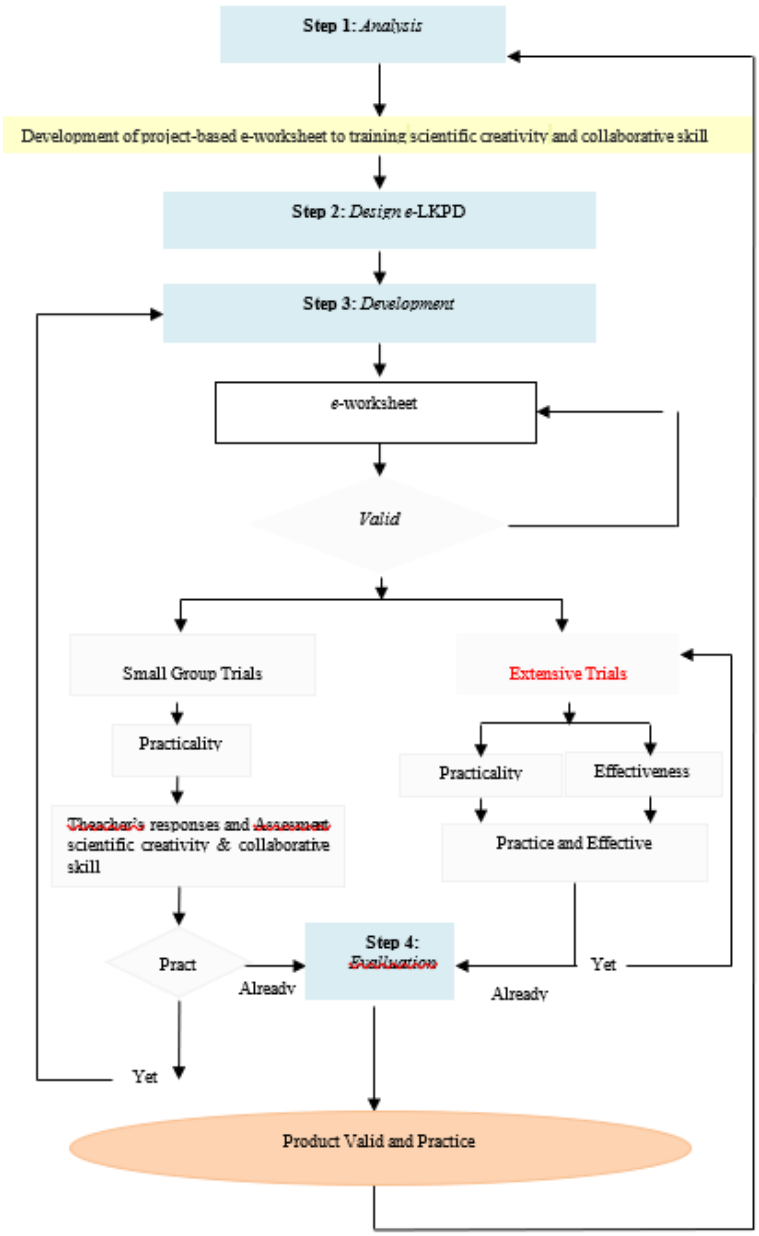

Figure 1 Development Flowchart

The instruments used in this study were interview guidelines for needs analysis, needs analysis questionnaires, validity questionnaire and practicality questionnaires. Scoring in the validity of product and teacher's responses uses a Likert scale adapted from Ratumanan & Laurent (2011) which can be seen in Table 1.

Table 1 Product Score Validity Category

Category	Score
Very Valid	4
Valid	3
Less Valid	2

Invalid	1

This study uses a mixed method, namely qualitative and quantitative with the following data analysis techniques.

The validity of product analyzed using the formula.

$$p = \frac{Average\ score\ obtained}{\Sigma Max\ score} \quad \ldots (1)$$

The percentage results obtained by converting the score to category adapted from Ratumanan & Laurent (2011) can be seen in Table 2.

Table 2 Conversion of Product's Validity

Score Interval	Category
3.26< score <4.00	Very Valid
2.51< score <3.25	Valid
1.76< score <2.50	Less Valid
1.00< score<1.75	Not Valid

Based on Table 2, the product developed is categorized as valid if the score determined by researcher is more than 2.51 with valid category.

Below is a scheme of indicators related to science creativity with collaboration skills by e-worksheet activities, listed in Figure 2.

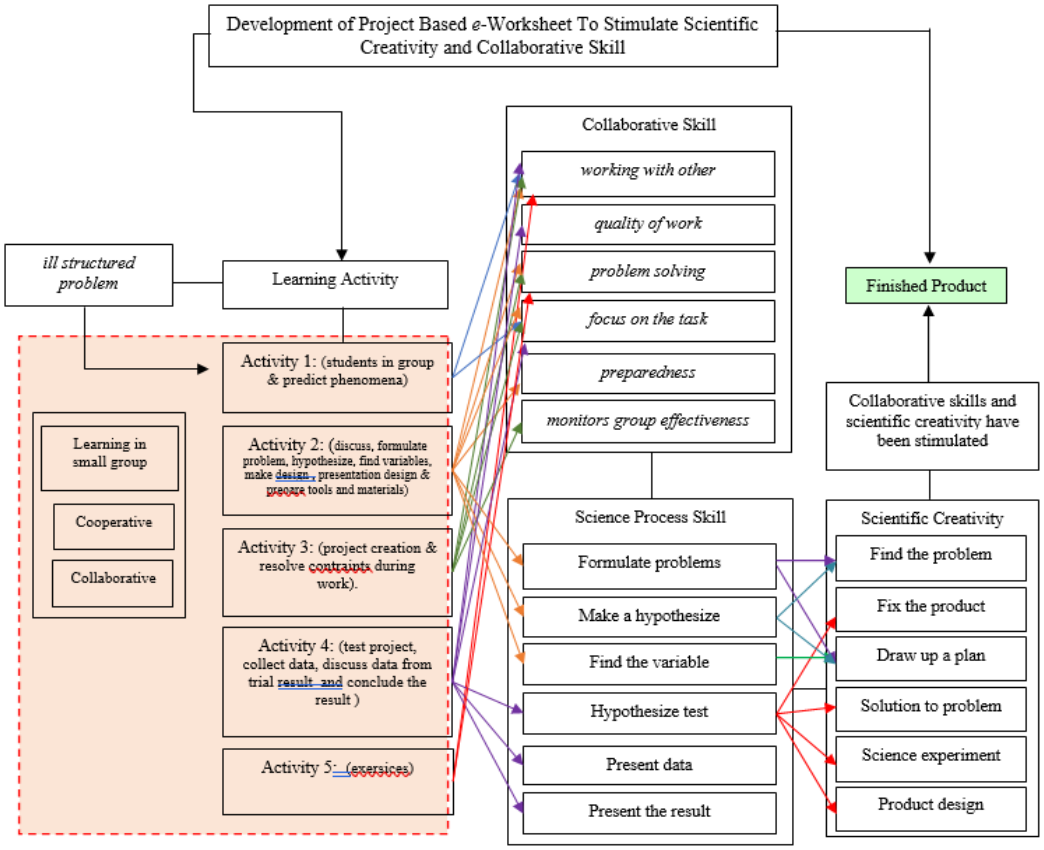

Figure 2 The Relationship between activity on *e*-worksheet, Scientific Creativity and Collaborative Skills

Practicality

The percentage results obtained converted score to category adapted from Arikunto (2013) as shown in Table 3.

Table 3 Conversion of Product's Practicality

Percentage	Category
0.0%-20.0%	Not Good
20.1%-40.0%	Low
40.1%-60.0%	Medium
60.1%-80.0%	Good
80.1%-100.0%	Very Good

Based on Table 3, the researcher defines that the product developed can stimulate scientific creativity and collaborative skills if the average score is more than 60.1% with good category.

RESULT AND DISCUSSION

This research is to develop e-worksheet which able to stimulate scientific creativity and collaborative skills with digital technology using *Fliphtml5* platform. The stages that have been carried out were analysis, design, development, and evaluation.

Analysis

Based on the identification of problems obtained, the student worksheet used by the teacher have not been to train scientific creativity and collaborative skills because it just contained a collection of questions. There were 1 of 13 teachers who used computers as a learning media. Learning with practicum on light interference topic was only carried out by 1 of 13 schools, some other schools only collected practicum KIT without using it; and for e-worksheet on light interference topic, all teachers think that it was needed for learning activities.

The results of the needs analysis that were responded by 83 students from different schools showed that mostly teachers taught the light interference topic without involving students, so there were still only a few students who did learning activities with practicum on light interference topic. There were 10 of 83 students stated that they did not get the light interference topic from the teacher because of the limited time, so that some students did not understand the light interference topic.

Design

This stage is where the researcher makes the e-worksheet design. E-worksheet is designed using Microsoft Word then converted to PDF then converted using *Fliphtml5*, so the display of *e*-worksheet as shown in Figure 3.

Figure 3 The Display of *e*- worksheet using *Fliphtml5*

The e-worksheet consists of opening, content and closing. The scheme of e-worksheet can be seen in Figure 4.

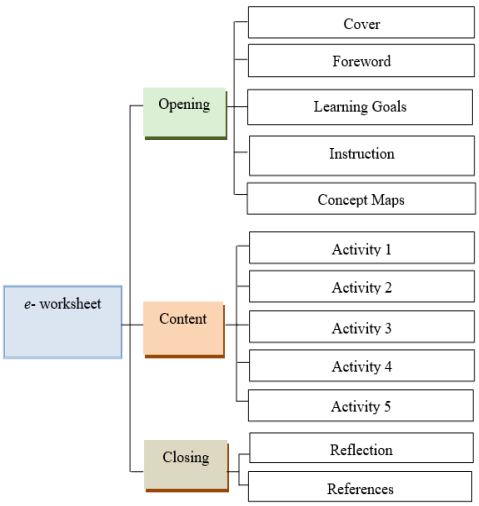

Figure 4 The Scheme of e-Worksheet

In the content section, there are several activities, the activity 1 student are directed to groups and predict the phenomena that have been presented in e-worksheet. In activity 2 students are directed to discuss, formulate problems, hypothesize, determine variables, make designs of project, design presentations & prepare the tools and materials. In activity 3 students are directed to make projects & solve obstacles during working. In activity 4 students were directed to do trial for the project, collect data, discuss data from the trial results

and make the conclusion. In activity 5 students are directed to fill the questions. There are several steps that must be taken to create an e-worksheet via link https://fliphtml5.com//. After clicking the link, the main screen of the fliphtml5 page will appear, as shown in Figure 5.

Figure 5 The Main Screen of the *fliphtml5*

Then click make a Flipping Book in a green column. Then the option will appear to upload files in PDF format which will be converted into e-worksheet format, as shown in Figure 6.

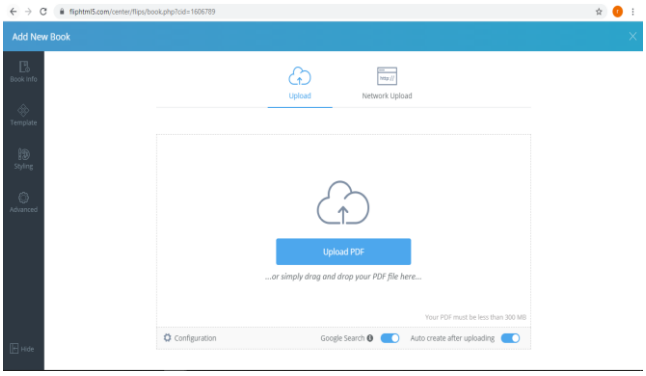

Figure 6 The Convert Screen of the *fliphtml5*

When finished uploading the file, please edit the title and description column to provide a description of the uploaded file, as shown in Figure 7.

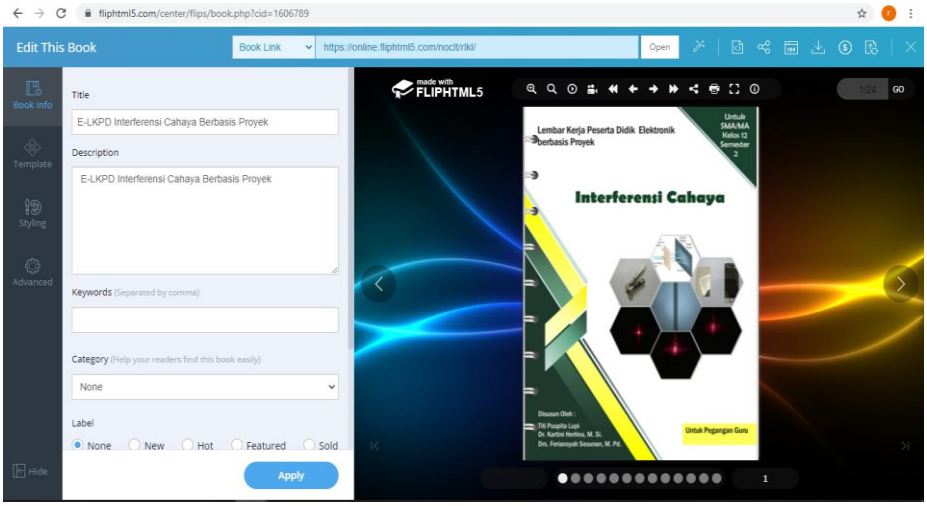

Figure 7 The Setting Screen *e*-Worksheet on *fliphtml5*

After finishing the editing process, sharing the e-worksheet link via social media was done by clicking the share icon on the top right. If the icon social

media is not included in the selection, then to share the e-worksheet link can be done by clicking the book link located at the top. Here is what the screen layout for sharing e-worksheet looks like, listed on Figure 8.

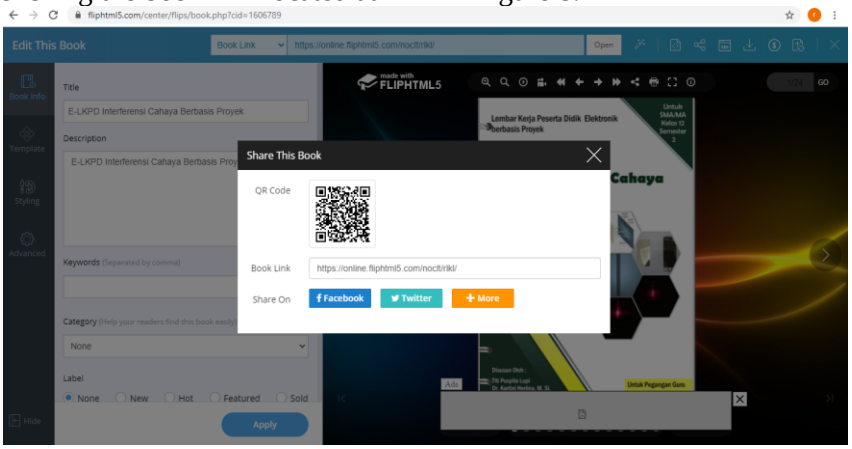

Figure 8 Screen Layout to Share the *e*-worksheet

Development

This stage produces e-worksheet which validity through validation by the experts and practicality through teacher's perception and responses by students.

Results of Product's Validity

To find the validity of e-worksheet which aims to stimulate scientific creativity and collaborative skills, the validity test was carried out. The validity of the e-worksheet was validated by three experts to validate design and construct. Then, revise the e-worksheet according to validator's recommendations. The indicators of product's validity can be seen in table 4.

Table 4 The Indicators Validity of Product

No	Indicators
1	Clarity of core competencies, base competencies, and indicators in e-worksheet with the 2013 revised curriculum
2	Suitability of learning indicators with core competencies
3	Suitability of learning objectives with indicators
4	Suitability of material with core competencies
5	The relevance of the material with learning objectives
6	The suitability of the presentation of the experiment with the learning objectives
7	The suitability of the questions with learning activities at e-worksheet
8	Able to encourage students to find concepts
9	Feasibility as a learning tool.
10	Can train students' scientific creativity
11	Can train students to build collaboration skills
12	The correctness of the grammar used in e-worksheet
13	The suitability of the sentence with the level of thinking and reading skills as well as the age of the student
14	Sentences used in e-worksheet encourage work interest
15	Simplicity of sentence structure
16	The sentence used is not ambiguous
17	Clarity of instructions for using e-worksheet
18	The communicative nature of the language used

The results of the product's validity can be seen in Table 5.

Table 5 The Result of Product's Validity

Indicator	Score by Experts	Average Score	Category
1	4	3.44	very good
2	3.33		
3	3.33		
4	3.33		
5	3.33		
6	4.00		
7	3.33		
8	3.33		
9	3.67		
10	3.00		
11	3.33		
12	3.33		
13	3.33		
14	3.33		
15	3.67		
16	3.67		
17	3.00		
18	3.67		

The validity product was carried out by 3 experts, 1 expert is physics education lecturer at the University of Lampung and 2 experts are high school physics teacher. The results of the design and construct validity showed a final score of 3.44, so the resulting product was categorized as very good. This makes the product ready for testing in small groups to stimulate student's scientific creativity and collaborative skills.

Results of Product's Practicality

The practicality of the product is in the form of analysis results from the e-worksheets done by 9 students and 5 high school physics teachers after the product was implemented.

Indicators of practicality according to the work of the e-worksheet by students can be seen on Table 6.

Table 6 Indicators of Practicality by Students

No	Indicators
1	I feel comfortable using the computer
2	My internet access skills are sufficient I feel comfortable studying via computer
3	I feel comfortable communicating and sharing information with friends and teachers online
4	I can search and access information from various sources
5	I can develop my skills to solve problems
6	Project-based learning can improve my understanding.

7	My skills to apply what I have learned have improved.
8	My skills for analyzing data have improved
9	I can share my ideas clearly in the group during the discussion.
10	I can listen to the different perspectives and points of view of my group members and keep an open mind with their views.
11	I do my fair share of work in my group
12	I can learn new things during problem solving
13	I am actively involved in learning activities with group members
14	I am more interested in using simple materials to make simple physics props.
15	I am more interested in relating phenomena in everyday life with the concept of physics.
16	Learning physics combines well with offline learning and online learning
17	Project-based learning using e-LKPD affects my collaboration skills
18	Project-based learning using e-worksheet affects my scientific creativity skills
19	Project-based learning using e-worksheet is suitable for implementation on light interference topic.

Indicators of practicality according to the teacher's perception after the e-worksheet was implemented are in accordance with the activity steps on the e-worksheet. Indicators of practicality by teachers are listed in Table 7.

Table 7 Indicators of Practicality by Teachers

No	Indicators
1	Find the problem
2	Project Design
3	Schedule Arrangement
4	Monitor students and project progress
5	Assessment and testing of project results
6	Evaluation of activities

The results of product's practicality response by student are listed in Table 8.

Table 8 The Result of Product's Practicality Response by Student

Score of Each Indicator	Score by Student	Max Score	Percentage	Average of Percentage	Category
1	31	36	86%	80%	very good
2	28	36	78%		
3	32	36	89%		
4	26	36	72%		
5	31	36	86%		
6	30	36	83%		
7	26	36	72%		
8	27	36	75%		
9	27	36	75%		
10	31	36	86%		
11	29	36	81%		
12	26	36	72%		
13	33	36	92%		

14	29	36	81%
15	29	36	81%
16	29	36	81%
17	29	36	81%
18	27	36	75%
19	30	36	83%

The results of product's practicality response by teacher are listed in Table 9, and the total percentage of practicality by teacher and student are listed in Table 10.

Table 9 The Result of Product's Practicality Response by Teacher

Score of Each Indicator	Score by Teacher	Max Score	Percentage	Average Percentage	Category
1	54	60	90%	90%	very good
2	136	160	85%		
3	19	20	95%		
4	19	20	95%		
5	67	80	84%		
6	18	20	90%		

Table 10 The Total Percentage of Practicality by Teacher and Student

No.	Aspect	Percentage
1	Student's responses	80%
2	Teacher's responses	90%
	Average Score	85%
	Category	Very Good

Result of practicality consists of teacher's perception by analyzing the five high school physics teacher's responses and 9 high school students' who were divided into 3 groups to work on project-based e-worksheet using *Fliphtml5*. The results of the scoring were used as researchers to review the achievement of indicators. The practicality of product got average percentage of 85% which indicates that project-based e-worksheet using *fliphmtl5* can stimulate scientific creativity and collaborative skills.

The responses of students who have worked on e-worksheet show that this project-based e-worksheet using *fliphtml5* support students to understand light interference topic because it does not need a private account, interesting, and comfortable to use in online learning. E-worksheet is also able to train scientific creativity and student collaborative skills. This is suitable with the opinion of Munakata & Vaidya (2015) which states that work in the form of projects involves students in creative processes in science and Sari, Prasetyo & Widodo (2017) which states that learning to use project-based student worksheet can improve collaborative skills.

Evaluation

The evaluation stage is the last stage of development research which aims to determine whether the procedure was proper or not. The evaluation was carried out in the form of product and instrument improvements. Improvements made include improvements when compiling

questions on the questionnaire or interviewing questions arranged according to the objectives of the observation, so that the results of the analysis obtained are in accordance with target. Other improvements are suggested to use authentic sources and sentences that are easy to understand, but in this study, it has not been implemented to know the effectiveness of product.

Through the evaluation and improvement that has been carried out, this research produced a product in the form of a project-based e-worksheet using *fliphtml5* to stimulate scientific creativity and collaborative skills that are valid and practical for use to stimulate scientific creativity and collaborative skill for online or offline learning.

CONCLUSION

Based on the results of research and discussion, it is concluded that the e-based project-based student worksheet using *fliphtml5* is very valid and practical to stimulate scientific creativity and student collaborative skills

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