

# The Development of E-Worksheet Based on Project to Promote Student's Creative Thinking and Digital Literacy Skills

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## ABSTRACT

E-worksheets can be an alternative learning media during the COVID-19 pandemic, which requires online learning. This study aims to develop an e-worksheet based on project to promote student's creative thinking and digital literacy skills on the theme City Noise for grade eight students. This research and development according to the Borg & Gall model. Data were collected through a media validation questionnaire. The results of this study indicate that (1) the development of an e-worksheet based on project on the theme of City Noise is carried out following the procedure development based on the Borg & Gall model, namely (a) preliminary study, (b) planning, (c) initial product development, (d) product validation, (e) revision to produce main products, and (f) limited product dissemination; (2) the quality of the e-worksheet based on project that has been developed is in category A (very good) according to didactic, construction and technical aspects. Therefore, e-worksheet based on project is feasible to be used as a learning media to promote students' creative thinking and digital literacy skills.

**Keywords:** *E-worksheet, Project based learning, Creative thinking skill, Digital literacy skill*

## 1. INTRODUCTION

The rapid development of science and technology in the 21<sup>st</sup> century has become a major challenge in the field of education. Therefore, the education process must focus on preparing new generation that can face global challenges and master 21<sup>st</sup> century skills [1][2][3]. These skills include problem solving, critical thinking, creativity, productivity, collaboration, communication, digital literacy, and citizenship [4]. Changes in the job market also require graduates who can gather information, solve problems, exchange information, and develop ideas in a digital context [5][6].

Creative thinking, which is one of the higher order thinking skills, can take a person's success in working competition in the 21<sup>st</sup> century [7]. Mastering creative thinking skills is an important thing related to the ability to solve problems and create new ideas [8]. However, the creative thinking skills of Indonesian students are still in the low-moderate category [9][10]. Indonesia's global creativity index is also at the bottom of the category for human resource creativity and innovation [11]. Whereas digital literacy skill is related to someone's ability to access and collect information from various sources digitally, communicate information and awareness between traditional tools with networked media and social networks [12]. Therefore, it is very

important to develop creative thinking and digital literacy skills of students.

The preliminary study was carried out through the online questionnaire filling method and interviews with several teachers. The questionnaire given contains questions about the use of digital media, digital literacy and students' creative thinking skill development. The results of filling out an online questionnaire to 17 science teachers in Central Java Province showed that the development of students' creative thinking skills and digital literacy in learning is still not optimal. The frequency of digital media usage in science learning is still low. The teacher usually uses Microsoft PowerPoint and videos. In addition, during the COVID-19 pandemic, many teachers found it difficult to prepare teaching materials for online learning. This is reinforced by the results of interviews with 6 science teachers from junior high schools in Semarang City with high, moderate, and low categories. Students also meet difficulties when faced with the contextual problems that require divergent and convergent thinking skills, especially on the science concepts. In addition, when teachers giving the task to analyze the relationship between concepts or make simple experimental designs regarding the material being studied, students tend to do it according to the book or the same as what the teacher has explained. The teaching materials used by the teacher are still limited to modules and printed worksheets.

Developing e-worksheet is an alternative for online learning during COVID-19 pandemic outbreak since teachers and students have limited experience in this new learning environment process [13]. Online learning indicates independent learning activity. Involving students in the use of information and communication technology leads them to share works and improve interaction between teacher-student on inquiry [14]. The rapid advance of information technology supports educational field to integrate various kinds of media into electronic teaching materials [15]. The use of e-worksheet is not only to provide text information but also images, graphics, video, and audio to foster students' understanding. At the same time, using e-worksheet helps teachers to increase the level of students' attention [16]. According to the relevant research, interactive electronic teaching materials can engage students in higher order thinking by guiding them to observe and answer series of questions [17].

Participation in the own finding knowledge during learning process provides the concrete experience for students. Project based learning is one of most teaching models that enable students to involve in active learning environment [18]. Project integration into e-worksheet allows students to take a part on generate original ideas and develop it into specific products through digital technology. Many research studied about electronic teaching materials to enhance higher order thinking

skills using inquiry approach [19] and using flipbook format [20]–[22]. But, less study were talked about project integration in vibration and sound wave topics despite the results of the National Science Examination for the 2019/2019 academic year show students have low scores on this topic [23]. Vibration and sound wave topic related to Semarang city environment that is have the noise pollution. Thus, this research aims to develop an e-worksheet based on project to enhance student's creative thinking and digital literacy skills on the theme City Noise for grade eight students.

## 2. METHOD

This research is research and development (R&D). The research was conducted in March-June 2020. This study modified the R&D stages of the Borg & Gall model, namely (1) preliminary study, (2) planning, (3) initial product development, (4) product validation, (5) revision to produce main products, and (6) limited product dissemination [24].

The preliminary study stage consists of field studies and literature studies. The field study aims to obtain information about the conditions of science learning and the needs of teachers related to digital-based student worksheets. The field study was conducted by giving an online questionnaire to 17 science teachers in Central Java Province using Google Forms. The questionnaire contains open-ended questions about digital-based learning, and development of student's creative thinking also digital literacy skills in science learning. Besides, interviews were also conducted with several science teachers in Semarang City about science learning integrated 21<sup>st</sup> century skill. A Literature study is carried out by exploring the literature relevant to research.

At the planning stage, mapping the competency that must be mastering students in vibrations and waves topic. Next, developing the learning indicators based on competencies that students must be achieved and be adapted to the indicators of creative thinking and digital literacy skills. Indicators of creative thinking skills used in this study, namely (1) fluency, (2) elaboration, (3) flexibility, and (4) originality [25]. While the digital literacy indicator namely operation skills, thinking skills, collaboration skills, and awareness skills [26]. The next step, designing learning activities that will be entered in e-worksheet.

At the product development stage, the initial product worksheets are arranged for the City Noise theme. There are two learning activities in e-worksheet, which are measuring frequency and intensity of sound and creating a sound suppression simulator. Next, an e-worksheet validation questionnaire was conducted based on indicators of the quality of student worksheets that referred to the theories and opinions of experts according to their fields. The questionnaire was

arranged on a Likert scale with four answer choices. The scores obtained are then converted to scores on a scale of four. Validation questionnaire was then consulted with colleagues and revised based on criticism and suggestions provided.

The development of e-worksheets must meet three requirements namely didactic, construction, and technical [27]. Didactic requirement is related to the universality of the use of worksheets. The use of worksheets must be able to accommodate various abilities of students, enable students to find the concepts of subject matter, and develop students' thinking skills. Construction requirements related to the use of language,

sentence structure, vocabulary, difficulty levels of questions, and clarity of material presented. While the technical requirement related to the use of fonts, images, and display of e-worksheets. The criteria for quality judgment of project-based e-worksheets that been developed refers to these three aspects.

In e-worksheets, project assignments and questions are given which can discuss by students in groups to facilitate developing creative thinking skills and digital literacy. Project assignments in e-worksheets are developed based on indicators of creative thinking ability and digital literacy. Details of learning indicators presented on the e-worksheet can be seen in Table 1.

**Table 1.** Details of project tasks on an e-worksheet.

Project	Learning indicator	Creative thinking indicator	Digital literacy indicator
Measuring sound frequency and intensity	(1) Understand the concept of sound wave magnitude through experiments.	Flexibility	Thinking skill
	(2) Measure the intensity and frequency of different sound sources using the sound spectrum analyzer application.	Originality	Collaboration skill
	(3) Analyzing the relationship between sound sources with their intensity and frequency.	Fluency	Awareness skill
	(4) Analyze the sound intensity critically by varying the distance between the sound source and the listener.	Elaboration	Operation skill
Creating a sound suppression simulator	(1) Analyzing problems related to noise in the surrounding environment	Flexibility	Operation skill
	(2) Analyzing the relationship of sound intensity with human hearing ability	Elaboration	Thinking skill
	(3) List of tools and materials that can be used to make a sound suppression simulator	Originality	Thinking skill
	(4) Explain the design steps for making a a sound suppression simulator	Fluency	Operation skill
	(5) Create a sound suppression simulator according to the design steps that have been made	Elaboration	Collaboration skill
	(6) Test the a sound suppression simulator that has been made	Originality	Awareness skill

Validation of the e-worksheet draft is carried out to material experts and media experts. The next step is data analysis and revision of the e-worksheet based on the input provided. Furthermore, instrument products are distributed to science teachers in several SMP / MTs. E-worksheets is expected to be used to support the learning process of vibration and wave material.

The data obtained in this study can be grouped into two namely qualitative data and quantitative data. Qualitative data in the form of responses provided by material experts and media experts regarding the quality of e-worksheets developed. Qualitative data in the form of criticism and advice provided by material experts and media experts are tabulated and abstracted as a guideline for the revision of e-worksheets products.

Quantitative data in the form of product evaluation data by the validator. The e-worksheets validation score data obtained for each assessment indicator is tabulated, and the average number of scores is calculated and then converted to interval data with a scale of four. Reference on changing the score of each component can be seen in Table 2.

**Table 2.** Score conversion to be four scale. [28]

No.	Interval	Category
1	$M_i + 1,5 S_{di} \leq \bar{M} \leq M_i + 3,0 S_{di}$	Very good
2	$M_i + 0 S_{di} \leq \bar{M} < M_i + 1,5 S_{di}$	Good
3	$M_i - 1,5 S_{di} \leq \bar{M} < M_i + 0 S_{di}$	Enough
4	$M_i - 3 S_{di} \leq \bar{M} < M_i - 1,5 S_{di}$	Low

Notes :  $M_i$  = ideal mean  
 $S_{di}$  = ideal deviation standart

### 3. RESULT AND DISCUSSION

During this time of the COVID-19 pandemic, all learning activities must be carried out online. This poses a new challenge for teachers to design a flexible learning process that allows students to study independently at home, both individually and in groups. Self-directed learning allows students to develop their cognitive abilities [29]. In addition, the learning process must optimize students creative thinking and digital literacy skills considering that education is currently directed at developing 21st century skills. The learning process can use a variety of learning resources, digital tools, or interdisciplinary learning based on a specific project or problem.

Based on interview results in the preliminary study, the fact that students feel difficult to understand the concepts of physics in science learning, for example on vibration and sound waves topic. The material presented and the learning activities carried out by the teacher also haven't optimized students' skills to explore new ideas in solving problems, or maximize students' skills in operating digital applications or media. Therefore, an appropriate learning model is needed to improve students' creative thinking and digital literacy skills, one of which is the project based learning model.

The results of filling out the online questionnaire by 17 science teachers in Central Java also showed that teachers rarely use digital media in the learning process. In addition, teachers only use books and printed worksheets in the learning process. Therefore, supporting books such as e-worksheets are needed to guide students in learning [15][17] in this pandemic era, as well as discovering concepts through activities carried out. E-worksheets can be created by referring to project-based learning syntax. E-worksheets can be packaged by presenting problems related to applications of material concept in daily life which can be resolved through project assignments in groups.

E-worksheet within the theme "City Noise" was developed as science learning media to 8<sup>th</sup> grade of junior high schools. The development procedure carried out referring to the Borg & Gall (1983) model [24]. The competences included in e-worksheet are basic competence 3.10 about the concepts of vibration, waves, sound, and hearing systems in daily life including sonar systems in animals; and 4.10 about presenting the

results of experiments on vibration, waves, and sound. The development of e-worksheets is adjusted to the steps of project-based learning, namely 1) finding a topic, 2) project planning and design, 3) gathering information, 4) making prototypes or projects and their applications, 5) developing final presentation; and 6) evaluation [30].

E-worksheet based on project presents integrated concepts between fields of sciences; physics concepts about vibration and waves; and biology concept about the hearing system. The integration of materials on e-worksheets can motivate students to learn the material because the material presented is related to phenomena in daily life. The learning process associated with everyday life can maximize student understanding of the material [31].

Project-based e-worksheet creation uses Kvisoft Flipbook Maker Pro 4 which is supported by other programs such as Camtasia 8 for editing animated videos, Tellagami for creating animated videos, Corel Draw 2020 for designing layouts and using the [www.animaker.com](http://www.animaker.com) platform to create animations. The e-worksheet component developed includes (1) the title of the activity, (2) learning objectives, (3) introduction, (4) project planning, (5) information gathering, and (6) discussion and planning for the result presentation. Competency achievement indicators that must be mastered by students through learning with project-based e-worksheets are presented in the learning objectives section.

In the introduction, an animated video is presented to motivate students to carry out projects. The problems presented are related to vibrations and sound waves. With project learning, students are faced with the essential question of how to compare the intensity and frequency of measurements of different sound sources; how the distance sound source is related to its intensity and frequency; and how to reduce noise pollution. Based on information obtained by students from various sources during learning activities, students are asked to design projects to measure the intensity and frequency of sound sources with the Sound Spectrum Analyzer application and to create a sound suppression simulator. An example of a page layout on e-worksheet based on project can be seen in Figure 1.

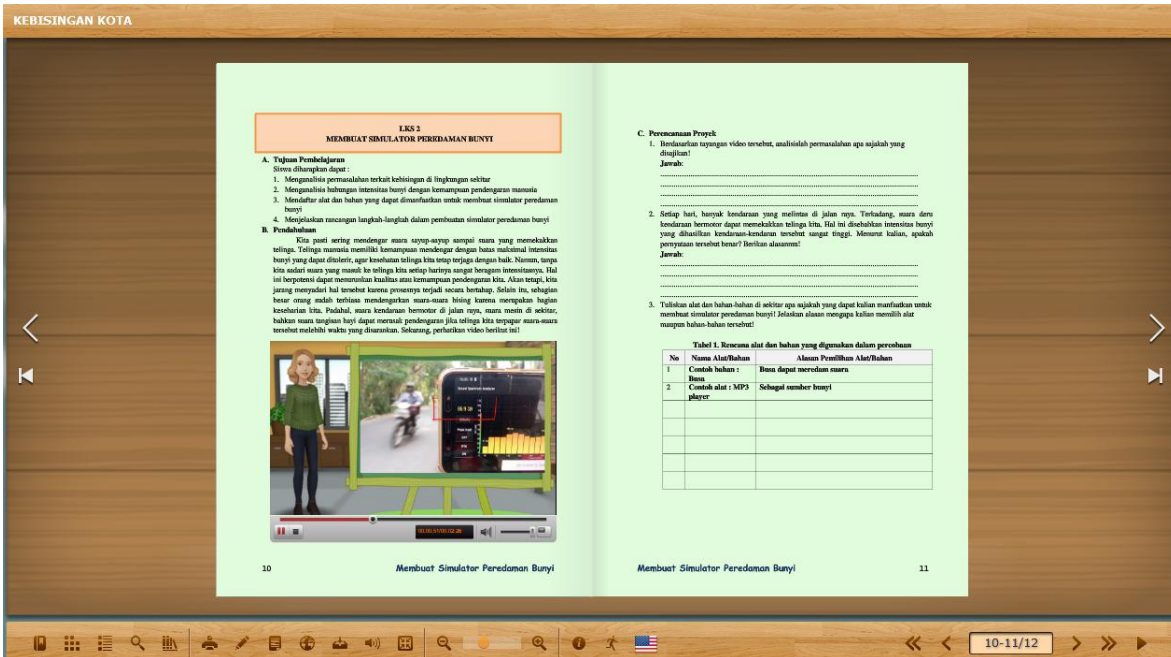


Figure 1 Page layout on e-worksheet based on project.

The video shown in Activity 1 is how to use a sound spectrum analyzer application to measure sound frequency and intensity. Whereas in activity 2, there is a video about measuring the frequency and intensity of sounds caused by motorized vehicles, as well as the voices of people who are discussing. Based on the problems presented in the animated video, students are invited to carry out projects ranging from identify tools and materials to be used, designing experimental steps, conducting experiments, recording the results of

experiments, and planning the presentation of experimental results.

The problems presented on the e-worksheet allow students to explore ideas and creativity in designing problem solutions, optimizing students' abilities in operating digital applications, and improving collaboration and communication skills in groups. Example of questions presented in the e-worksheet based on project can be seen in Figure 2.

4. Bagaimanakah hubungan antara jarak dari sumber kebisingan ke tempat pengukuran terhadap besarnya intensitas bunyi yang dihasilkan?  
**Jawab:**

Figure 2 Example of question on e-worksheet.

This question is presented in activity 1 in the e-worksheet based on project. Based on these questions, students are required to investigate the effect of distance from noise sources on the intensity of the sound produced. This is done by varying the distance between the noise source and the measurement site, so that elaboration skills (having broad ideas and detailing certain details) can be optimized for learning. In addition, students can also develop the ability to access and use digital applications, namely the Spectrum Sound Analyzer, and communicate the results of measuring sound intensity from noise sources.

The e-worksheet based on project validation involved 2 material expert lecturers and 2 media expert lecturers. Validation of the e-worksheet product based

on the developed project in terms of didactic, construction, and technical aspects [27]. The didactic aspect consists of 18 assessment indicators which are divided into 3 components, namely material, development of creative thinking skills and digital literacy, and the effectiveness of animated videos. The construction aspect consists of 4 components, namely the correctness of the concept, use of language, clarity of sentences, and presentation of the material. Meanwhile, the technical requirements consist of 10 assessment indicators which are divided into 3 components, namely layout, text readability, and animation video quality. The score obtained in each aspect is then converted into a scale value of four. The results of the assessment score conversion can be seen in Table 3.

**Table 3.** The results quality assessment score conversion of e-worksheet based on project

Aspect	Interval score	Value	Category
Didactic	$26 \leq \bar{M} \leq 32$	A	Very good
	$20 \leq \bar{M} < 26$	B	Good
	$14 \leq \bar{M} < 20$	C	Enough
	$8 \leq \bar{M} < 14$	D	Low
Construction	$26 \leq \bar{M} \leq 32$	A	Very good
	$20 \leq \bar{M} < 26$	B	Good
	$14 \leq \bar{M} < 20$	C	Enough
	$8 \leq \bar{M} < 14$	D	Low
Technical	$32,5 \leq \bar{M} \leq 40$	A	Very good
	$25 \leq \bar{M} < 32,5$	B	Good
	$17,5 \leq \bar{M} < 25$	C	Enough
	$10 \leq \bar{M} < 17,5$	D	Low

The results of the e-worksheet based on project product validation from material experts are presented in Table 4.

**Table 4.** Data on the validation results of material expert lecturers

Aspect	Average score	Value	Category
Didactic	29	A	Very good
Construction	27	A	Very good
Technical	37,5	A	Very good

The results of the e-worksheet based on project product validation from media experts are presented in Table 5.

**Table 5.** Data on the validation results of material expert lecturers

expert lecturers

Aspect	Average score	Value	Category
Didactic	29,5	A	Very good
Construction	28	A	Very good
Technical	38	A	Very good

The validation results from both material experts and media experts show that the e-worksheet based on the project developed is suitable for use by the teacher as a learning medium on vibration and sound waves. The revision of the e-worksheet based on project product is carried out based on the responses and input from the validator. Examples of product revisions carried out are presented in Table 6.

**Table 6.** Example revision of Student worksheet based on project

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E-worksheet based on project within the theme City Noise that had been developed were disseminated to science teachers in several SMP / MTs in Semarang

City. This product is expected to be used as an alternative learning media that teachers can use to promote creative thinking skills and digital literacy of students in science learning.

#### 4. CONCLUSION

Based on the results of research and development, the following conclusions can be drawn: (1) the stages of developing an e-worksheet based on project within the theme City Noise for grade eight students carried out, namely preliminary studies, planning, initial product development, product validation, product revision, and limited dissemination; (2) the quality of the e-worksheet based on the project that has been developed in terms of didactic, construction and technical aspects are included in category A (very good). The e-worksheet based on project was disseminated teachers of several SMP / MTs in Semarang city. Thus, the e-worksheet based on project product that has been developed is feasible to used the learning process to promote students' creative thinking and digital literacy skills.

#### AUTHORS' CONTRIBUTIONS

D.S.S, Y.W, and I.N arranged the research design. M.M. and C.W.B provided input on the research design that had been prepared. D.S.S, Y.W, and I.N developed a project-based e-worksheet and conducted product validation with experts. D.S.S, Y.W, I.N, M.M, and C.W.B interpret and analyze the results of product validation. D.S.S, Y.W, and I.N revised the e-worksheet product that was developed. All authors contributed in arrange research articles.

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