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Developing Worksheet Based on Creative Problem-Solving Models

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Abstract: The focus of this research is to develop worksheets on biology content for the eleventh graders in high school. The development research research design included the following steps: research and information collection, planning, develop preliminary form of product, preliminary field testing, and main product revision. The participant are 12 students in the initial product trial for the eleventh graders of *SMA N 1 Suralaga* in the school year of 2021/2022. Using a closed questionnaire to gather research data and student worksheets covering the eleventh-grade material, such as the movement system, blood circulation, digestion, respiration, excretion, coordination, and psychoactive substances, to assess the validity of the instrument supplied to experts and students. Analyzing the outcomes of expert instrument validation, determining the average value, and using percentages to group the results into five categories—very bad, not good, good enough, good, and very good—represent quantitative descriptive data analysis. It was discovered from the limited test results that the implementation indicator received the lowest percentage in the extremely unfavorable category during the development at the initial product test stage were the very bad category (85.7%) and very not good (14.3%). Development indicators; good enough (28.6%) and good (71.4%). Ideate indicators; 100% very good. Clarify indicator; very not good (14.3%), not good (28.6%), good enough (42.6%), and very bad (14.2%). It can be concluded that it was necessary to revise the initial product, namely by including in more detail the components of the creative problem solving indicator both at clarify, ideate, develop, and implement.

Keywords: Creative; Problem-Solving; Worksheet

Introduction

The 2013 curriculum is being implemented with the intention of preparing Indonesians for life skills such as becoming productive, innovative, and creative citizens in coping with global civilization. Learning biology is distinctive in that it fosters logical reasoning, involves sophisticated thinking, and applies to subjects that call for solutions to issues that are encountered. To create resources that can compete in society using their intelligence. According Mat (2019), biology is a branch of science and one of the disciplines that can aid a bright and talented new generation. Teaching that is focused on science helps pupils develop into scientifically literate citizens (Hebert & Cotner, 2019).

High school biology courses incorporate biology to help students learn concepts or facts and develop their talents in terms of attitudes, skills, and knowledge. Also, one of the goals of studying biology is to help students develop problem-solving skills and higher order thinking skills that will help them throughout their life (Fitriani et al., 2020a; Saputri et al., 2019). To help students learn in class and comprehend the subject to be studied so that their talents are integrated when applying their knowledge, constructivist-based learning aids are required.

The issue, though, is that the usage of these learning aids in the learning process, such as the use of student worksheets, does not demonstrate constructivist-based learning. Instructors typically assign worksheets from textbooks, and the types of questions still prioritize low-level cognitive skills rather than high-level cognitive

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skills or even creative problem-solving skills. This is also consistent with observations made at a public high school in East Lombok, where pupils are only given tasks from the textbook to complete individually or in groups when they are practicing or talking, and the teacher doesn't even create worksheets for them. As found by Kristanti et al. (2018), the questions in the worksheet tend to lead to concepts, and lack the ability to think. Conradty et al. (2020) stated that in learning teachers are faced with confusion about how to integrate creativity in the classroom. So students are less likely to grasp the facts given and express ideas when given a problem (Kumalasari et al., 2017). In addition, Asma et al. (2020); Astutik et al. (2020) also suggested the need to design and develop more interactive HOTS-based worksheets that include components of the scientific process at all levels starting from primary and secondary schools.

It is well recognized that science concepts are poorly retained by students for a variety of reasons, including the abstract character of science and the traditional and repetitive nature of teaching methods. The first step is to create teaching materials in the form of scientifically oriented student worksheets. Mutia & Prasetyo (2018) recommend that the created student worksheets be tailored to the needs of the students to meet the learning objectives. According to Kupers et al. (2019), offering students assignments that call for various answers gives them the chance to exercise their creativity.

Worksheets for students that are scientifically oriented might take several forms. A constructivist teaching method called creative problem solving encourages pupils to come up with original solutions to challenges. Patresia et al. (2020); Wahyuni et al. (2020) advises making worksheets more interactive, adapting them to changing needs, promoting students' real-world problem-solving abilities, and incorporating all phases of the scientific method. According to Gomes & McCauley (2021); Ichsan et al. (2021); Khairini et al. (2021), worksheets created by teachers aid students in increasing their knowledge and encourage them to be creative in coming up with different interpretations of the concepts being taught. As a result, the previous researcher conducted development research relating to scientifically oriented student worksheets, specifically worksheets based on creative problem solving in biology courses at the eleventh graders, based on preliminary studies and conclusions.

Method

The focus of this study was to create worksheets for middle school biology class XI students that focused on creative problem solving. Borg & Gall (2007), the research design used was development research and included the following steps: research and information collection, planning, develop preliminary form of product, preliminary field testing, and main product revision. Participants were 12 students of class XI SMA N 1 Suralaga in academic year 2021/2022 for *Preliminary Field Testing* worksheets based on creative problem solving (see Figure 1).

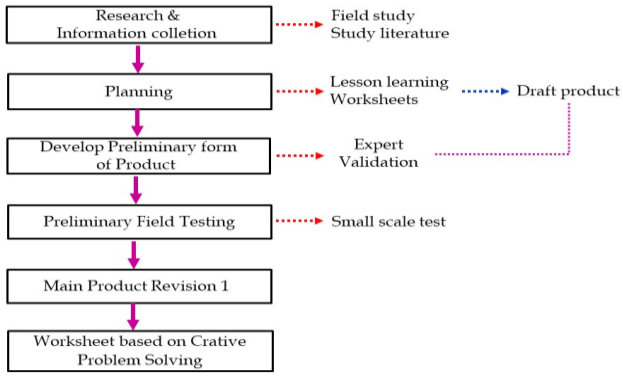

Figure 1. Research flow for developing worksheets based on creative problem-solving

Research data are being collected using a closed questionnaire to assess the validity of the instrument given to experts and students, and student worksheets using the indicators of creative problem solving consisting of Clarify, Ideate, Develop, and Implement (CEF, 2015). The content for the eleventh grade is the movement system, circulatory system, digestive system, respiratory system, excretory system, coordination system, and psychotropic substances. Data were analyzed using descriptive quantitative methods, including expert instrument validation results analysis, averaging all materials based on the outcomes of the initial restricted trial product, and grouping data into five categories using percentages. To determine the revision of the product being developed, the percentage of product ideality is calculated using the following Formula 1.

$$\text{Percentage: } \frac{Obtained\ Score}{Maximul\ Score} \times 100\% \quad (1)$$

Then for decision making to determine the level of validity and revision of the product being developed, the following provisions are used shown in Table 1.

Table 1. Criteria for product validity and revision levels

Rank Score (%)	Validity Category
81 - 100	Very Valid
61 - 80	Valid
41 - 60	Fairly valid
21 - 40	Invalid
0 - 20	Invalid

Source: (Pertiwi, 2018)

Each response on the worksheet is given among score of 3, 2, and 1 to determine the average score. The proportion of category acquisition for each indicator is then determined using the intervals used for categorization (see Table 2).

Table 2. Shows the intervals for classifying the outcomes of the average worksheet score based on creative problem solving

Interval	Category
> - 40	Very bad
41 – 55	Not Good
56 – 70	Good Enough
71 – 85	Good
86 – 100	Very Good

Result and Discussion

For this initial development research, 5 of the 10 stages of research and development namely: research and data collection, planning, development initial product draft, initial field trial, and revision of trial results—were carried out. These stages were modified according to field conditions. These 5 phases' outcomes are listed below:

Figure 2. Form of worksheet based creative problem solving in one of content developed: (a) cover, (b), table of contents, (c) basic competencies, (d) content of summary, (e) question in worksheet.

Research and data gathering: In this step, a needs analysis is conducted, which comprises: a literature review that includes curriculum analysis, material mapping, and learning tools; Field studies that comprise the following elements: observing the curriculum employed by schools; using learning resources in accordance with the curriculum, such as lesson plans, student worksheets, and teaching materials; learning observations; and evaluating the learning outcomes of the students.

Planning: This phase entails creating a prototype in the form of student worksheets based on the creative problem solving and created in accordance with the lesson plan. The locomotor system, circulatory system, digestive system, respiratory system, excretory system, coordination system, and psychotropic substances make up the eleventh-grade material in the worksheet (see the Figure 2).

Development of the initial product draft: At this stage, a creative problem solving-based student worksheet that had been previously created was developed. An instrument validation test was also carried out to specialists in the content field (from the lecturer) and learning at this stage of the draft creation (from the teacher). The findings of the two experts' validation are listed below (Figure 3).

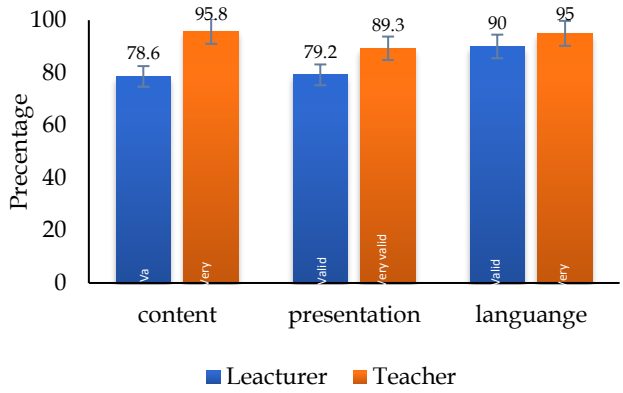

Figure 3. The validity results of worksheet based creative problem solving

Figure 3 show that the worksheet based creative problem solving that were validated by experts fall into the valid and very valid categories for three aspects in terms of both content, presentation, and language, indicating that the worksheets are extremely practical to use for small-scale trials and that the author doesn't need to make any revisions.

First, preliminary field tests were conducted at SMAN 1 Suralaga with a total of 12 classes of the eleventh grade students to determine if the worksheet based creative problem solving fell into the categories of very good, good, good enough, not good, and very not good. However, the worksheet first analyzes the average value of all the material (Figure 4),

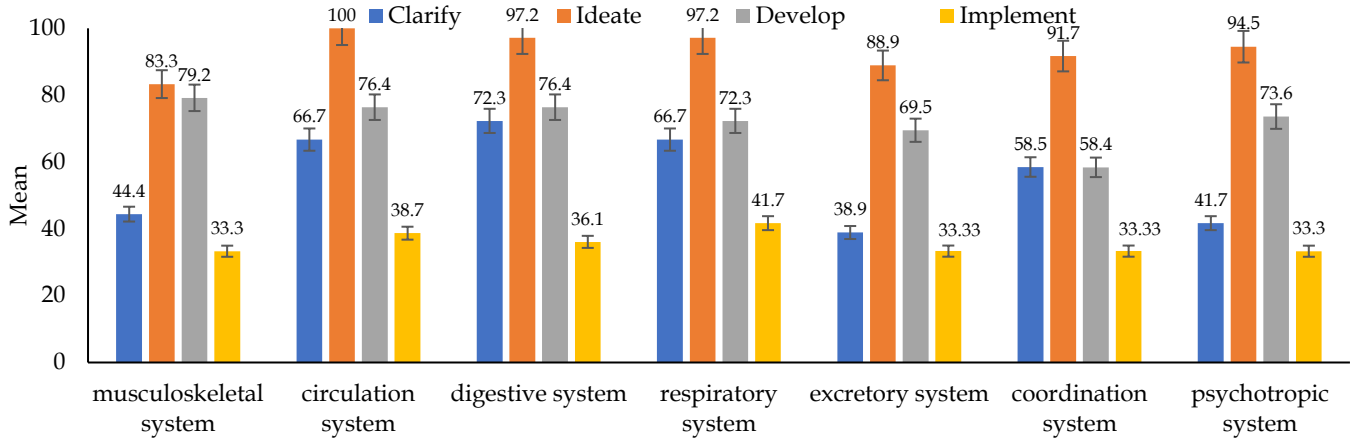

Figure 4. Preliminary field testing of worksheet based creative problem solving

After testing the initial small-scale product, Graph 2 displays the average value for each material in the worksheet. For each creative problem solving indication, each material displays the acquisition of an average value that varies. According to the graph, the ideal indicator for all materials has the highest average value in the very good category, while the implement indication has the lowest average value and is very awful. The average score's findings are divided into categories for very good, good, good enough, not good, and very not good (Figure 5).

After determining the average value for the 7 materials evaluated, figure 5 displays the percentages for the 5 categories. The implementation indicator, which has the lowest results of the four creative problem solving indicators and is in the very unfavorable (85.7%) and not good (14.3%) categories, can be seen from the descriptions of each creative problem solving indicator (see table 1), showing that students still are unable to put their ideas into practice despite having put forward their ideas.

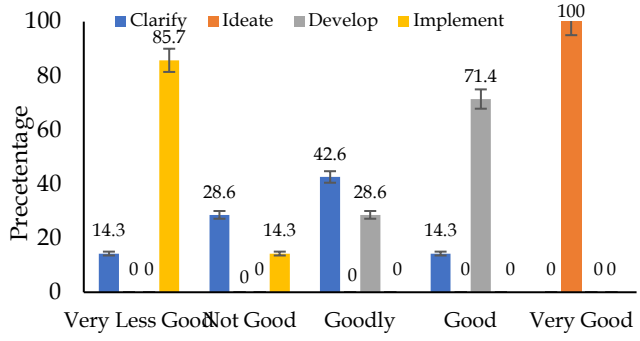

Figure 5. Percentage of worksheet based creative problem solving indicator categorization results

Furthermore, the highest creative problem solving indication, ideate (100%) is very good, showing that students can use their original thinking to solve issues including all the information in the Worksheet. This indicator is followed by develop (71.4%) in the good group and by 28.6% in the good category really good. The creative problem solving indicators from the development outcomes, shown in Table 3, are described in the paragraphs in Figure 5.

Table 3. Description of Creative Problem-Solving indicators based on development results.

Steps	Activities
Clarify*	• Describe the problems. • Identify problems* • Formulate problems*
Ideate*	*Propose ideas to solve problems*
Develop*	• Develop ideas made by taking one of the ideas that had been discussed before* • Conduct an evaluation namely conveying the advantages and disadvantages in chosen idea *
Implement*	• Formulate the plans made * • Create a design from the selected idea including a) the purpose of overcoming the problem, b) tools and materials, and 3) working methods*
Evaluation**	• Assess the process progress of each activities stage conducted.

*Source; revised from CEF 2015
** result from developing the models

Revision of the product: Based on the results of a few limited trials, it is necessary to provide more information about the creative problem solving indicator components, particularly implementation indicators, to the instrument so that students can contextually compose their replies in depthly.

It can be challenging for teachers to introduce a new method into the classroom, let alone to encourage students to use their imaginations when addressing problems. According to Johnson (2002), when students are given the chance to employ their critical thinking abilities during studying, they become accustomed to

digesting information and organizing it logically and according to facts. According to Juhji & Nuangchalerm (2020), learning is the process through which a person acquires new knowledge, abilities, and behaviors because of his interactions with numerous environmental cues. This process aids in the development of problem-solving abilities.

According to Khaira et al. (2020), teachers should use creative approaches to improve the learning environment. In order to help students, develop their thinking skills, teachers should introduce them to creative problem-solving learning strategies. According to Fatmawati et al. (2021), students should receive intensive training in high-level thinking skills using student worksheets based on creative problem-solving.

According to Lince (2016), learning can be made more effective by effectively managing students' learning styles, mental processes, and intelligence. Using instructional resources in the form of student worksheets based on creative problem solving is one technique to encourage students to be more engaged in creating their knowledge. According to Fatmawati (2020), employing constructivist-based student worksheets, especially creative problem solving, can help students become accustomed to thinking, especially high-level thinking on a regular basis.

A worksheet based higher order thinking skills was developed by Astutik et al. (2020); and Sinta et al. (2020) to examine and enhance students' higher-order thinking skills. Each question was written with consideration for the indications and facets of scientific creativity skills. This is also in line with the 2013 curriculum's recommendations, which teach pupils how to solve difficulties they could encounter in everyday life. Open-ended questions, according to Risnanosanti et al. (2019), can aid students in discovering concepts based on their own research.

One of the disciplines taught in school that develops students' abilities to examine problems and come up with solutions based on their knowledge and experience is biology (Fitriani et al., 2020b). Making links between scientific information and other areas of knowledge, creating questions, and explaining the results are all science learning strategies that can be used with students, according to Lee & Shea (2016). According to Guptaand & Sharma (2019), science needs imagination and creativity to make new breakthroughs and other discoveries.

Conclusion

One of the learning aids for students to refine and train their thought processes on elements of their abilities and knowledge, the application of which might be in the form of problem-solving and scientific investigations, are student worksheets focused on creative problem solving. Therefore, the development of its application was conducted, one of the objectives was to determine student mastery in conducting learning using students' worksheets based on creative problem solving. From the results of the development at the initial product test stage by means of a limited test, it was found that the implementation indicator got the lowest percentage in the very good category (85.7%) and very not good (14.3%). development indicators; good enough (28.6%) and good (71.4%). Ideate indicators; 100% very good clarify indicator; very not good (14.3%), not good (28.6%), good enough (42.6%), and very not good (14.2%).

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Author Contributions

The role of Baiq Fatmawati and Sitti Rohmi Djalilah in this study was to compile the background and find problems that occur, design research methods, analyze, process and present data, discuss research results and findings. Meanwhile, the role of Nurul Wafiah are to process data.

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Conflicts of Interest

Because this research is independent, there is no conflict of interest to anyone.

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