

VALIDITY OF STUDENT WORKSHEET BASED ON SCIENTIFIC APPROACH TOWARD CRITICAL THINKING SKILLS ON WAVE AND DISASTER THEME

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ABSTRACT

Natural disasters can negatively affect life because they cause damage. Therefore, students have to be equipped with knowledge regarding them. One way is to use a student worksheet based on a scientific approach to waves and disasters. This research aimed to measure the validity levels of the student worksheet based on the developed scientific approach. According to Thiagarajan, the research and development method with the 4D development model. However, the development stage was narrowed down by defining, designing, and developing. These steps were done because this research is limited by energy, time, and cost and focused on measuring product validity; as a result, the dissemination stage was not conducted. The instrument used in this research was validation sheets filled out by two expert lecturers and three science teachers. The research results showed that the validity level of the student worksheet based on a scientific approach oriented to critical thinking skills on wave and disaster themes obtained a percentage of 83.62%, with very valid criteria. As a result, the student worksheet based on the scientific approach of the wave and disaster theme can be tested in science learning to foster students' critical thinking skills.

Keywords: *Critical Thinking Skills; Student Worksheet Based on a Scientific Approach, Wave and Disaster Theme*

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Introduction

The life of the 21st century requires various competencies that every individual should master to obtain superior education so that students can become competent and can compete in the real world. The 21st-century competencies that are very important are critical thinking and problem solving, creativity and innovation, communication and collaboration (Redhana, 2019). One of the competencies that must be mastered is thinking critically (Febri et al., 2019). Critical thinking is a thinking process based on the results of thinking to draw conclusions and solve problems with logical reasons (Amalia & Pujiastuti, 2013). Students must think critically to get used to thinking logically, analytically, and systematically. Critical thinking ability is the intellectual potential of each individual that can be improved by participating in learning activities (Zubaidah, 2017). One of them is studying Natural Sciences (IPA). Students must have critical thinking skills because the material is very complex with various fields of study.

Science is one of the subjects at the SMP/MTs level equivalent. Science learning in the 2013 curriculum has been presented in an integrated manner. Yani et al. (2019) state that integrated science holistically and authentically encourages creativity in formulating material. Science is related to the discovery process of systematically seeking information about nature and understanding facts, concepts, and principles (Dahlia et al., 2019). With integrated science learning, students get meaningfulness to grow critical thinking skills. However, integrated science learning has not been implemented in several schools.

Based on the interviews with junior high school science teachers, it was explained that science learning had not been implemented in an integrated manner. The learning process was still carried out in the form of concepts presented separately using the lecture method. Students tend to be passive, so they are less effective. It is because the available teaching materials are not yet integrated. The school only provides textbooks and Student Worksheets designed by the Subject Teacher Conference. Additional other teaching materials are worksheets which are prepared by the teacher but only contain a summary of the material and questions so that it does not attract the attention of students. In addition, the work steps presented in the worksheets do not train critical thinking skills. Therefore, the development of teaching materials using the right strategy is needed to cultivate critical thinking skills. The

scientific approach is a learning strategy that can foster critical thinking skills and is suitable to be applied in learning (Izzudin, 2019).

The 2013 curriculum emphasizes learning activities using a scientific approach. Azizah et al. (2015) argue that the scientific approach is an activity of investigating various phenomena, gaining new knowledge, and improving and adapting knowledge that previously used the scientific method. According to the Ministry of Education and Culture (2013), the scientific approach's main activities are observing, asking, trying, reasoning, and communicating. Based on the activities of the scientific approach, Machin (2014) states that the scientific approach can develop critical thinking skills, communication, teamwork, exploration, and character attitudes because the learning experiences that have been obtained can perfect educational goals. Learning activities certainly require intermediaries to convey information or materials such as exciting teaching materials that can attract students' attention, such as Student Worksheets.

Worksheets in learning activities are used to explore the material being studied. Andriana et al. (2020) explain that worksheets are part of teaching materials using convey concepts that students must learn. A suitable worksheet is prepared, containing a summary of the material, experimental procedures to find learning concepts systematically, and questions that can grow students' thinking skills. The use of worksheets can help compile students' knowledge based on the 2013 curriculum (Anggraini et al., 2016). The existence of a worksheet is very influential in maximizing students' learning understanding.

The development of a scientific approach-based worksheet is a worksheet that integrates the scientific approach stages as a flow of activities that students must follow. The stages in the worksheet include observing, asking, trying, reasoning, and communicating (Sari & Lepiyanto, 2016). Activities in scientific approach-based worksheets can train students to observe natural phenomena in the surrounding environment. They were asking questions from material that had not been understood—looking for answers by experimenting or seeking information from various sources and then being trained to reason or explain the findings. Finally, convey the results by drawing conclusions based on the analysis results in writing, verbally, and others (Winahyu et al., 2016). Thus, the development of student worksheets that integrates the scientific approach makes the teacher center learning process a student center that can foster critical thinking skills.

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Khasanah & Supardi (2019) state that a worksheet based on a scientific approach to train critical thinking skills is feasible to use with an n-gain of 0.57 in the medium category, 85% validity aspect, 92% practicality aspect (learning implementation), and 94% (learning implementation). student activities) and 93% effectiveness aspects. Rezki et al. (2016) stated that the worksheets developed were valid. The teacher's limited trial results were worth 100% on the aspects of content suitability, attractiveness, and readability. Students responded with 96% of attractiveness aspects and 97.03% of readability. Sari and Lepiyanto (2016) stated that the student worksheet was feasible, with the results of the recapitulation of media experts 79.66%, material experts 81.22%, and students 80.3%. Some of these studies prove that the scientific approach-based worksheets are practical and exciting. They are suitable to be applied in learning that can help students develop critical thinking skills.

Based on the relevant research above, the location of the novelty in this thesis research is in the theme used. The theme of this research is waves and disasters. In this case, Indonesia is a disaster-prone country due to the confluence of three major tectonic plates globally, namely the Eurasian, Indo-Australian, and Pacific plates (Soleman et al., 2012). This condition causes natural disasters to occur every year in several regions in Indonesia. Therefore, students must be critical thinkers to minimize the risk of disasters that can occur in life.

The themes of waves and disasters are chosen based on phenomena that occur in everyday life. Earthquakes, tsunamis, and volcanic eruptions are natural events or events that can occur at any time, so knowledge about these needs to be learned by students. The theme of waves and disasters consists of three subjects in science, namely chemistry, physics and earth, and space sciences. Class VII Basic Competence (BC) 3.3 on elements and compounds, BC 3.10 on earth layers and disasters, and BC 4.10 on disaster response actions closely related to class VIII BC material. 3.11 vibrations and waves. Students can understand the elements and chemical compounds in the earth's layer, namely the lithosphere, which can experience plate movement so that natural disasters such as earthquakes, tsunamis, and volcanic eruptions can occur due to vibrations and waves occur below the land surface and the ocean. The theme of waves and disasters uses the Webbed model because it can foster critical thinking skills. The four BC formed a theme that was combined from several different concepts so that learning

took place more meaningfully. Based on the description above, this study aims to determine the validity of worksheets based on a scientific approach oriented towards critical thinking skills on the theme of waves and disasters.

Research Methods

The research method used is Research and Development (R & D). Research and development is a design to create a product or improve a product that has been developed and can be proven true (Sukmadinata, 2016). The research design used is a 4D model, according to Thiagarajan et al. (1974), consisting of defining, designing, developing, and disseminating. However, the development stage is narrowed down to only carrying out until the development stage. It was done because this research and development were carried out only focusing on developing and measuring the level of product validity due to limited human resources, time, and cost. According to Krismawardani et al. (2018), the dissemination stage requires much energy, takes a long time, and costs a lot. Therefore, this study did not carry out the dissemination stage. Sari & Lepiyanto (2016); Putra & Hakim (2019); Sari & Wulandari (2020) state that regarding the development of scientific approach-based worksheets that only carry out three stages of development by simplifying the 4D development model into 3D. The research was carried out only to produce the product and determine the feasibility due to time and cost constraints, so the dissemination stage was not carried out. In this case, the development stage can be used according to the research that needs to be carried out. The following is an explanation of the research and development flow as follows.

Define stage

The defined stage is the initial stage to finding obstacles regarding learning activities faced by schools. This stage is conducted by analyzing needs, curriculum, and materials and formulating learning objectives. It is done to obtain an overview of essential concepts as the basis for developing student worksheets based on the scientific approach.

Design Stage

The design stage is the stage for compiling the initial design of a product by selecting the format, compiling instruments, and compiling worksheets. It aims to get an initial picture of the product in general to obtain a prototype of student worksheets based on the scientific approach.

Development Stage

The development stage is the stage for creating student worksheets based on a scientific approach oriented towards critical thinking skills on the theme of waves and disasters. Two expert lecturers and three junior high school science teachers validated the product. In the validation process, the data results give criticism, and suggestions are obtained, which aims to determine the quality of the product. Furthermore, the product improvement process is carried out based on the criticism and suggestions of each validator of a product improvement.

The data collected in this study used a validation sheet to measure the validity of student worksheets based on the scientific approach. Validation sheets were submitted to 2 expert lecturers (material experts and media experts) from FKIP Untirta and three science teachers from SMPN 1 Karang Tanjung, SMPN 2 Serang City, and SMPN 1 Ciruas. The validation sheet is arranged according to the Likert scale calculation using the four assessment criteria in table 1.

Table 1. Likert Scale

Skor	Description
1	Very Low
2	Not good
3	Good
4	Excellent

The obtained data are then calculated as the average value in each aspect with formula 1.

$$P = \frac{f}{N} \times 100\% \quad 1$$

Information :

P : Percentage (%)

f : Total score obtained

N : The total number of ideal scores

(Riduwan, 2012)

After obtaining that, it can be analyzed to determine the level of validity of the scientific approach-based LKPD using the interpretation of the scores in Table 2.

Table 2. Interpretation of worksheet Validity Score

Percentage	Criteria
25,00% - 43,74%	Invalid
43,75% - 62,49%	Quite Valid
62,50% - 81,24%	Valid
81,25% - 100,0%	Very Valid

(Modifikasi dari Riduwan, 2012)

Result and Discussion

Define

The define stage is carried out by analyzing four things, namely needs analysis, curriculum, concepts, and formulating learning objectives. The analysis results were obtained based on the results of interviews with junior high school science teachers that some schools had not implemented integrated science learning. Thus, the learning process carried out is still in the form of concepts. In addition, most teachers use conventional methods and tend to be teacher's centers, so they are not effective. Schools still use teaching materials that have not been integrated, such as textbooks from the government and student worksheets made by the Subject Teacher Council and compiled by themselves. Student worksheets used in schools are content summaries, activities in student worksheets that are not based on learning methods/strategies, questions that have not explored the achievement of critical thinking indicators, and unattractive designs. In this case, student worksheets need to be developed based on learning methods/strategies and referring to indicators of critical thinking skills. Therefore, using teaching materials in the form of student worksheets based on a scientific approach that refers to the indicators of critical thinking skills on the theme of waves and disasters is expected to help achieve learning objectives so that their critical thinking skills can increase.

The concept of the theme of waves and disasters consists of three subjects in science lessons, namely chemistry, earth and space science, and physics. Class VII BC 3.3 on elements and compounds, BC 3.10 on earth layers and disasters, BC 4.10 on disaster response actions are closely related to the material for class VIII BC. 3.11 vibrations and waves. Several interrelated BCs are combined using the Webbed cohesive model. BC 3.3, BC 3.10, and BC 3.11 explain the elements and chemical compounds that exist in the layers of the earth, phenomena that occur in the lithosphere, and disasters related to the concept of vibrations and waves. In addition, BC 4.10 gave performance tasks to make posters regarding disaster response actions and communicate their work. The material connected is the earth's structure, which has elements and compounds as its constituents in the lithosphere layer, which can experience plate movements and cause vibrations and waves, resulting in earthquakes that produce seismic waves and disaster response measures need to be taken.

Meanwhile, vibrations below the land surface cause earthquakes, while vibrations below the sea surface can cause earthquakes in the ocean, so tsunami waves occur. Earthquakes can also affect

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the occurrence of volcanic eruptions, thereby releasing chemical elements and compounds. Therefore, several BC is merged into one theme so that learning takes place more meaningfully.

Design

The design stage is carried out to create an initial picture of student worksheets based on a scientific approach oriented towards critical thinking skills on the theme of waves and disasters. This stage consists of three stages: selecting student worksheet formats, compiling instruments, and compiling student worksheets to become the initial product.

The format selection is made by designing a storyboard used as a reference in compiling student worksheets based on the scientific approach. The storyboard has three main parts, namely; 1. Introduction; contains front and back covers, cover pages, introductions, student worksheets on the theme of waves and disasters, a table of contents, guidelines for using student worksheets based on a scientific approach, a webbed integration chart, concept maps, and indicators and learning objectives to be achieved by students. 2) Contents; contains the presentation of material on the theme of waves and disasters, which are arranged based on the stages of the scientific approach. 3) Cover; includes bibliography and glossary.

Furthermore, compiling a research instrument in a validation sheet refers to the guidelines for the feasibility of teaching materials according to the National Education Standards Agency (2008). Validation sheets will be submitted to 2 expert lecturers and three junior high school science teachers to measure product validity. They were compiling student worksheets as the initial design of the product based on the guidelines for the feasibility of teaching materials according to the National Education Standards Agency (2008) and storyboards that have been designed. The scientific approach-based student worksheets were created with the help of the main application, namely Microsoft Word, to design the contents of the student worksheets and an additional application, namely Microsoft PowerPoint, for the front and back cover designs. The fonts used are Comic Sans MS and Time New Roman with a size of 11-22 pt and spacing of 1-1.5. Inayah et al. (2020) argue that Time New Roman and Comic Sans MS are the typefaces favored by students. In addition, the size of the student worksheets used follows the provisions of ISO A4 21.0 x 29.7 cm (BSNP, 2008). There are case examples, facts, and pictures regarding natural disasters such as earthquakes, volcanic eruptions, and tsunamis in the scientific

approach-based student worksheet learning activities. In addition, there are problems and performance activities that refer to indicators of critical thinking skills. It is intended that students can be trained to think critically so that they can solve any given problem.

Develop

The development stage is carried out to measure the level of validity of the scientific approach-based student worksheets that have been developed. The product is validated by expert lecturers and junior high school science teachers so that the quality of the product can be known. From the assessment carried out, criticism and suggestions were obtained to improve the product being developed. The aspects assessed are the feasibility of content, language, presentation, graphics, stages of the scientific approach, and indicators of critical thinking skills. The aspect of content feasibility is shown to determine the suitability of the material's content with the basic competencies used in the product. The linguistic aspect determines the validity and suitability of using language in designing products. The presentation aspect is shown to determine the validity and accuracy of the presentation in designing the product. The visual aspect determines the validity and suitability of designing a product to make it more attractive. The aspect of the scientific approach stage is shown to determine the validity and suitability of the learning activity flow on the product. Finally, the aspect of critical thinking skills is shown to determine the validity and suitability of the indicators measured on the product. The following explains the validity of test results by two expert lecturers from FKIP Untirta and three science teachers at junior high schools in Banten Province.

Content Validation

Validation of content by experts provides an assessment of the product developed. The expert assessment was carried out by a Physics Education lecturer, FKIP, Untirta. The validator assesses five aspects that contain several assessment indicators. In the aspect of content feasibility, there are four indicators, linguistics, six indicators, four indicators in the presentation, the scientific approach stage has one indicator, and critical thinking skills have one indicator. Table 3 is the result of the content validation recapitulation.

Table 3. Recapitulation of Material Expert Validation Results

No.	Aspect	Σ per aspect	Σ ideal	%	Criteria
1.	Content	19	24	79,17	Valid

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Eligibility					
2.	Language	21	24	87,50	Very valid
3.	Presentation	21	28	75,00	Valid
4.	Scientific Approach Stages	17	24	70,83	Valid
5.	Critical thinking skills	21	36	58,33	Quite valid
Average				74,17	Valid

Based on the product assessment by material experts, it is shown in Table 3 that the recapitulation of material expert validation results from all aspects gets an average percentage value of 74.17% with valid criteria. Each aspect gets a different value. The content feasibility aspect got a percentage value of 79.17% with valid criteria. In this case, it means that the student worksheets based on the scientific approach follow the basic competencies and learning objectives used and meet the primary substance of the wave and disaster themes that match the characteristics of the development of students. It is in line with Prastowo (2011) statement that the material in the student worksheets must be under the curriculum.

The linguistic aspect of student worksheets based on the scientific approach was 87.50%, with very valid criteria. Furthermore, the language used in student worksheets is simple and easy to understand, exciting and does not contain multiple meanings, and follows the characteristics of the development of students. In addition, the grammar and terms on the student worksheets are consistent with the Indonesian language rules. Therefore, using language in student worksheets based on the scientific approach is effective and efficient. Based on the statement explained by Sukiman (2012), the language in the learning process should be simple language and convey the material clearly, so that students can understand the content of the material.

The presentation aspect on student worksheets based on the scientific approach gets a percentage value of 75.00% with valid criteria. In this case, the presentation of activities in student worksheets has been presented clearly, easily understood, and systematically. Supporting presentations, incomplete student worksheets, and case examples can make it easier for students to formulate the material they are studying. Besides that, the material involves students and reflects the unity of the theme. Student worksheets based on a scientific approach contain indicators of the feasibility aspect of the presentation (BNSP, 2008). However, the presentation of the questions is not following the indicators of critical thinking ability. Therefore, practice questions were designed to

refer to critical thinking skills indicators. Astuti et al. (2017) argue that practice questions in student worksheets must be based on the indicators used to foster critical thinking skills.

Aspects of the scientific approach stage on student worksheets based on the scientific approach got a percentage value of 70.83% with valid criteria. It means that the activities in the student worksheets have been adjusted to the stages of the scientific approach. It is supported by research by Sari and Lepiyanto (2016) that the development of student worksheets based on the scientific approach must integrate the stages of the scientific approach as a learning flow. However, the communicating stage must be revised by turning the independent conclusions into questions. Therefore, questions are designed that can conclude the overall material being studied. The goal is that students can communicate to foster a thorough attitude, think systematically and express arguments clearly (Permendikbud, 2013).

In critical thinking skills, the percentage value is 58.33%, with quite valid criteria. The aspect of critical thinking ability has the lowest percentage value and has not been maximized. However, learning activities have not encouraged students to think critically in solving a problem, especially on the indicators of asking and answering questions, considering credibility, and making and determining considerations. Therefore, analytical questions refer to indicators of critical thinking skills to train students in solving problems. Zubaidah (2017) argues that one way for students to grow their critical thinking skills is to provide problems in the form of analytical questions. Critical thinking must have thought that can give reasons for something, explain something, and solve problems. In critical thinking, one must have thoughts that can prove, interpret something and solve problems on something (Facione, 2015). Furthermore, Hassoubah (2007) states that critical thinking skills can be improved by growing analytical skills, observation skills, curiosity, the ability to ask questions and reflect, and discussion to solve problems. Therefore, to produce valid criteria, revisions must be made by adding questions based on critical thinking indicators so that students can think about solving a problem.

Media Validation

Media expert validation provides an assessment to determine the validity of the design content on the Scientific Approach-based student worksheets that have been developed. The media assessment was carried out by a Science Education Lecturer, FKIP, Untirta. The media expert validator assesses two aspects that contain several

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assessment indicators. In the linguistic aspect, there are six indicators, and in the visual aspect, there are three indicators. Table 4 is the result of media validation recapitulation.

Table 4. Recapitulation of Media Expert Validation Results

No.	Aspect	Σ per aspect	Σ ideal	%	Criteria
1.	Linguistic	19	24	79,17	Valid
2.	Graph	73	76	96,05	Very Valid
Average				87,61	Very valid

Based on the experts' product assessment, Table 4 shows that the recapitulation of the validation results of media experts from all aspects gets an average percentage value of 87.61% with very valid criteria. The linguistic aspect of student worksheets based on the scientific approach got a percentage value of 79.17% with valid criteria. In this case, it means that the student worksheet has used language that is straightforward, communicative, interactive, adapts to the development of students, according to Indonesian language rules and the terms are consistent (BSNP, 2008). In addition, Permendikbud (2013) states that the use of language must be based on Indonesian language rules to create a communicative atmosphere and adapt to the development of students. The use of language is effective and efficient if it is further simplified to facilitate students' understanding.

The visual aspect of the scientific approach-based student worksheets got a percentage value of 96.05%, with very valid criteria. In this case, it means that the size of the student worksheet follows ISO, and the cover design and content of the student worksheet follow the shape, color, image, and typeface used based on the material and appearance of the student worksheet. Student worksheets based on the scientific approach have met the visual aspects related to appropriate writing, colors, and images and the appearance of attractive student worksheets. This statement is supported by BSNP (2008) that good graphic aspects are used in student worksheets, namely the suitability of student worksheet sizes, attractive student worksheet cover designs, and clear student worksheet content designs. However, there are still illustrations that have not been effective, one of which is a picture of a volcanic eruption. Therefore, the image is replaced according to the news content in which meaning is conveyed. Prastowo (2011) argues that a good picture for student worksheets is an image that can provide information about the clarity of the content as a

whole. Another opinion, Soedarso (2014), states that illustrations have an essential role in textbooks to make it easier for readers to imagine the events to be conveyed.

Validation by Science Teacher

Validation by a junior high school science teacher provides an assessment that aims to determine the validity of the content and design in the student worksheets based on the Scientific Approach that has been developed. Three science teachers at junior high schools in Banten province carried out the assessment, namely SMPN 1 Karang Tanjung, SMPN 2 Serang City, and SMPN 1 Ciruas. Middle school science teachers assess six aspects that have several assessment indicators. In the aspect of content feasibility, there are four indicators, linguistics six indicators, the presentation has four indicators, the visual aspect has three indicators, the scientific approach stage has one indicator, and critical thinking skills have one indicator. Table 5 results from the validation recapitulation of junior high school science teachers.

Table 5. Recapitulation of Science Teacher Validation Results

No.	Aspect	Σ per aspect	Σ ideal	%	Criteria
1.	Content Eligibility	65	72	90,28	Very Valid
2.	language	63	72	87,50	Very Valid
3.	Presentation	72	84	85,71	Very Valid
4.	Graphics	219	228	96,05	Very Valid
5.	Stages of scientific approach	11	12	91,67	Very Valid
6.	Critical thinking skills	10	12	83,33	Very Valid
Average				89,09	Very Valid

Based on the product assessment by the junior high school science teacher, it can be seen in Table 5 that the recapitulation of the validation results of the junior high school science teacher from all aspects got an average percentage value of 89.09% with very valid criteria. Each aspect gets a different value. The content feasibility aspect gets a percentage value of 90.28% with very valid criteria. In this case, it means that the scientific approach-based student worksheets already refer to the curriculum, the accuracy of the material, and the up-to-date material that can encourage students' curiosity. This is supported by BSNP (2008) states

that the development of teaching materials must match the indicators on the aspect of content feasibility.

The linguistic aspect of student worksheets based on the scientific approach was 87.50%, with very valid criteria. In this case, the language in the student worksheets based on the scientific approach can inspire enthusiasm and does not contain double meanings. The language is appropriate based on the development of students, and the Indonesian language rules and the terms applied are consistent (BSNP, 2008). Prastowo (2011) supports this argument that the language used in student worksheets must be communicative so that readers do not just read but understand the content of the material. Therefore, using language in student worksheets based on the scientific approach is effective and efficient.

The aspect of presentation on student worksheets based on the scientific approach got a percentage value of 85.71% with very valid criteria. It means that the presentation of activities in student worksheets already contains aspects of the feasibility of the presentation (BSNP, 2008). The presentation technique in student worksheets is precise, the completeness of supporting presentations is easy to understand, and the presentation of learning helps understand a concept and the proper flow of thought. In this case, the presentation on student worksheets is effective and efficient.

The visual aspect of the scientific approach-based student worksheets got a percentage value of 96.05%, with very valid criteria. In this case, the scientific approach-based student worksheet has a size that follows ISO. The student worksheet's cover design and content design have an attractive and harmonious appearance, shape, image color, typography of letters, and the size of the layout on the student worksheet. This shows that student worksheets based on the scientific approach have met the feasibility aspects of graphics (BSNP, 2008). In addition, based on the statement of Devi et al. (2009) that in compiling student worksheets the appearance must be considered, such as; 1) making student worksheets that are simple, clear, and easy to understand, 2) illustration images according to the concept, 3) arrangement of illustrations, tables, and questions must be correct 3) explanations, instructions, and questions must be clear, 5) motivate students to think.

The aspect of the scientific approach stage got a percentage value of 91.67% with very valid criteria. It means that the activities in the student worksheets have been adjusted to the stages of the

scientific approach. According to Permendikbud (2013), student worksheets using the scientific approach are student worksheets adjusted to the scientific approach's stages, namely observing, asking, trying, reasoning, and communicating the results that students have learned. By learning using a scientific approach, students can be trained in developing knowledge, attitudes, critical thinking skills, communication, and collaboration (Liana, 2020).

Aspects of critical thinking skills on student worksheets based on the scientific approach got a percentage value of 83.33% with very valid criteria. In this case, it means that the activities on the student worksheets based on the scientific approach have referred to the critical thinking ability indicators used to be effective and efficient. Students can practice working on critical thinking skills in the student worksheets. According to Timur et al. (2019), this is supported by the statement that students can grow their critical thinking skills with student worksheets based on a scientific approach. There are problems containing indicators of critical thinking abilities.

Based on the exposure to data on the validity of student worksheet products based on a scientific approach, which material experts view, media experts, and junior high school science teachers. It can be seen that the average percentage value obtained by each validator is different. The recapitulation of the validation results from all validators is presented in Table 6.

Table 6. Final Recapitulation

No.	Expert	%	Criteria
1.	Content	74,17%	Valid
2.	Media	87,61%	Very Valid
3.	Science Teachers	89,09%	Very Valid
Average		83,62%	Very Valid

Table 6 shows that the results of content validation get a percentage value of 74.17% with valid criteria, media is 87.61% with very valid criteria, and validation from junior high school science teachers is 89.09% with very valid criteria. Meanwhile, the recapitulation of the validation results from all validators gets an average percentage value of 83.62% with very valid criteria. The development of student worksheets based on the scientific approach that has been developed has met the eligibility guidelines according to the BSNP (2008), thus obtaining very valid criteria. According to Purwanto (2013), if the validation test results with an average percentage belonging to the criteria are very valid, then student worksheets can be used for classroom learning. Thus, the product means that it can be

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used in the learning process to make it easier for students to train their critical thinking skills. This is because the activities in it train students to observe a natural phenomenon, make questions from material that has not been understood, discuss reasoning, and formulate data through performance activities and communicating the information they have encountered. Marza, Suryawati & Yustina (2015) argue that student worksheets based on the scientific approach can train students' thinking processes in growing their critical thinking skills with various activities at each stage of the scientific approach. Learning activities with a scientific approach present interesting, fun, and not dull activities, thus helping students learn independently and think critically.

Although the recapitulation of the validation results stated that it was very valid and had met the validity standard, products developed must improve following the criticism and suggestions of each expert. In order to make the product perfect so that it will be of higher quality and can be tested in science learning at school. The novelty in the student worksheets developed with the others is that the student worksheets are prepared on a scientific basis. The flow in the learning activities uses the stages of the scientific approach to guide students in independent learning to help develop their thinking skills. The learning activities contain various activities and questions that refer to indicators of critical thinking skills.

Furthermore, students can improve their critical thinking power to analyze the problems given. The material in the student worksheets explains natural phenomena that often occur in everyday life, which are integrated with the theme of waves and disasters using a Webbed type of integration model. In addition, students can gain knowledge holistically and authentically. On the other hand, the design display in student worksheets provides harmonious color variations and images that match the natural phenomena. Students use worksheets that are more attractive, interesting, and easy to understand. This product can attract students' attention to study hard to foster critical thinking skills.

Conclusion

This study develops student worksheets based on a scientific approach oriented toward critical thinking skills on the theme of waves and disasters carried out based on the Research and Development (RnD) method and the 4D model of Thiagarajan et al. (1974). The development stage was narrowed down because this development was

carried out only focusing on developing and measuring the level of product validity due to limited workforce, time and cost, so the dissemination stage was not carried out. This research only carried out three stages: define, design, and develop. The defined stage analyzes needs, curriculum, and concepts and formulates learning objectives. The design stage selects the format of the student worksheet and composes the student worksheet.

Furthermore, this development stage involves validation with two expert lecturers (material experts and media experts) and three junior high school science teachers to get criticism and suggestions as a reference for product improvement. The level of validity of the student worksheets shows the results of material expert validation getting a percentage value of 74.17% with valid criteria, media experts 87.61% with very valid criteria, and 89.09% junior high school science teachers with very valid criteria. The recapitulation results of all validators obtained a percentage value of 83.62% with very valid criteria. However, some improvements must be implemented to produce a more quality, optimal and attractive product. Student worksheets based on the scientific approach to the theme of waves and disasters can be tested in school science learning activities to foster students' critical thinking skills.

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