

## VALIDITY OF STUDENT WORKSHEET BASED GUIDED INQUIRY ON VIBRATION AND WAVE MATERIALS TO TRAIN CRITICAL THINKING SKILLS

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### Abstract

This study aims to describe validity of Student Worksheets based on guided inquiry learning on vibration and wave material to train junior high school student's critical thinking skills. This student worksheets was developed using ADDIE model. The results was obtained from validation by two science expert lecturer and a science teacher of junior high school which obtained mode score of 4 with valid criteria at all aspect i.e. Content suitability, presentment suitability, terms suitability, and student worksheets based on guided inquiry suitability. Based on the results of this study, it can be concluded that validity of student worksheets based on guided inquiry valid to train student critical thinking skills.

**Keywords** : Student Worksheets, Guided Inquiry, and Critical Thinking Skills .

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### PRELIMINARY

The 21st century begins with changes and updates in the knowledge and technology that have an impact on human lifestyles so that every individual must be able to adapt (Lamapaha, 2017). The National Education Association explains that 21st Century skills are "The 4Cs", namely critical thinking, creativity or creativity, communication, and collaboration (Goodson & Rohani, 2010). 21st Century skills are skills that must be possessed by every individual to be able to conquer every problem in life in the 21st century (Redhana, 2019).

Various 21st-century skills have been responded by the 2013 curriculum in Indonesia which is currently high-level thinking skills are the main thing in learning, one of which is in science learning (Silvia, 2019). Reformation of science education focuses on learning to develop scientific thinking and reasoning skills (Lawson in Silvia, 2019). The 2013 curriculum also provides demands for teachers to emphasize questions that require deep thinking (Kurniasih & Sani, 2014).

Science learning has a goal that students can increase their curiosity towards the interplay of relations between science, the environment, technology, and society (BSNP, 2016). Students have meaningful learning when they can link material with natural phenomena or their experiences in everyday life. According to SCANS (Johnson, 2007), the ability to be able to do this is supported by think critically.

Critical thinking is the ability to analyze information and ideas carefully from a variety of different perspectives (Facione, 2011). According to Ennis (2011), critical thinking is the ability to think more effectively so

that it can help students make decisions about what has been done. Critical thinking is also a way of evaluating the thought process itself. (Johnson, 2007).

Critical thinking skills of students are useful for solving problems in everyday life (Omstein & Levine, 2007). Lambertus (2009) states that if students apply abilities at a higher level, then they will easily distinguish between truth and untruth, facts, and opinions. Students are also able to determine alternative solutions to a problem and can analyze the effects of personal assessments and assessments from those around (Hove, 2011; Changwong et al., 2018).

Based on the results of pre-research tests in class VIII-G using the essay model questions with aspects of critical thinking skills of Facione related to science process skills, it was found that 100% of students did not answer the questions in the interpretation aspects assessed in the formulation of problems and hypotheses as well as aspects of analysis assessed from solving discussion questions. But in the inference indicators assessed in concluding the experiment, 10.3% of students answered correctly.

Critical thinking skills have been attempted in science education in schools. But in reality, the results of the 2018 International Student Assessment Program (PISA) survey on Trends Performance in Science, Reading, and Mathematics show that students' high thinking abilities in Indonesia are still low, especially in the science. Indonesia received an average score of 396 in the Science aspect with a category lower than the OECD average. PISA assessments in the Science aspect represent students in applying knowledge to various situations,

modeling mathematical complex situations, selecting, comparing, and evaluating problem-solving strategies that demand higher-order thinking skills (OECD, 2018).

The low critical thinking skills of students need to be supported by appropriate learning models. Learning models that can support activities using high-level skills are inquiry learning (Damayanti & Mintohari, 2014). Llwellyn (2005) defines inquiry as a scientific process in an investigation in which the use of logic, critical thinking, and individual interest is necessary. The purpose of guided inquiry learning is to facilitate students to be able to improve their intellectual abilities and other abilities, such as asking questions and finding out (Sanjaya, 2010).

According to Sanjaya (2010), the guided inquiry model is a learning model in which the teacher has the role to guide with instructions or questions to students. These guidelines are guiding students so they can develop their information in problem-solving (Ngerini et al., 2013). The guided inquiry learning model can develop students' formal thinking abilities and the teacher's role in asking questions can obtain material based on facts through experiments (Effendi, 2012).

Guided inquiry learning is suitable for practicing critical thinking skills because it can be well planned to develop high-level thinking from early grades to secondary school (Kulthau, 2007). Based on the results of Oktaverina's research (2018) and Prahasta (2018) it was found that students' critical thinking skills increased with an average gain in high criteria after applying learning with the guided inquiry model. This is supported by Nisa's research (2017) that the application of guided inquiry not only helps students understand the material but also develops scientific skills such as critical thinking skills.

Students at the junior high school level are at the transition stage towards more abstract knowledge (Kulthau, 2007). The statement is also supported by Piaget's Theory (2010) which states that children aged 12 years and over are at a stage of transition to more abstract knowledge. Students begin to be able to investigate ideas from various sources, integrate the ideas into their knowledge, and begin to form a focused perspective in the process of finding information that they can develop to be applied (Kulthau, 2007). Based on this, it can be seen that students at the junior high level can apply their critical thinking skills in gaining knowledge and information during learning.

Critical thinking skills with guided inquiry learning models can be trained in science learning, including the material of vibrations and waves. Material vibration and waves have the basic competence to analyze the concepts of vibration and waves in aspects of knowledge and present the results of vibration and wave experiments on aspects of skills. Students need to master critical thinking skills to be able to achieve these basic competencies. Critical thinking relates to skills in the scientific process (identification, analysis, and problem-solving) with valid thinking so that finding the right decision (Syafurudin et al., 2016).

Based on the results of interviews with two science teachers at SMP Negeri 1 Madiun, the results show that the science scores on vibration and wave material are still low because students find it difficult. This is supported by Rohmah and Nurita's research which is on the material of vibrations and waves of students required to find relationships between similarities and connect concepts in everyday life (Rohmah & Nurita, 2017).

The application of guided inquiry learning in practicing critical thinking skills can be supported by appropriate learning tools, including student worksheets (LKS) (Piawi et al., 2018). Students can improve their critical thinking skills when teachers use appropriate learning methods, support appropriate curriculum (such as worksheets and teaching materials), and active learning strategies for students and teachers (Vong & Kaewurai, 2017).

Based on the results of observations, students and teachers use PR books published by Intan Pariwara and BSE books published by Erlangga. Both of them already have indicators of Facione's critical thinking skills implicitly. In the results of the interviews, the two science teachers stated that they often use simple demonstration methods which are supported by books to help students analyze and make conclusions. However, the activities are still classical, not independently of each student so that is why the teacher and students make analyses and conclusions together. Both teachers still have not found the right way so that the critical thinking skills in the supporting books can be well trained during the learning of each individual.

The existence of some supporting facts above, it is necessary to have a development that can help students in practicing critical thinking skills on vibration and wave material. Efforts to realize this requires a valid learning tool that can be applied by teachers and students (Rando, 2016). Student's worksheet is one of the learning tools that can help teachers in developing student interaction in the learning process (Darmodjo & Jenny, 2002).

The worksheets developed by researchers are not yet on the market because most of the worksheets distributed contain all the material, not every material. Also, the student's worksheets developed by researchers contained three critical indicators of Facione's thinking that were explicitly written so that students knew the skills achieved. A similar student's worksheet on vibration has been developed by Umaroh (2017), but the LKS is focused on high school students and uses five aspects of Facione's critical thinking skills. Therefore the researcher wants to make student's worksheet that focuses on one material about vibrations and waves for junior high school students so that they can practice their critical thinking skills.

Based on research conducted by Wilda Al Aluf in 2018, LKS-based Guided Inquiry based on Acid and Base material obtained results in the validity aspect in the good category, the practical aspect in the very good category, and the effectiveness aspect in the good category. Based on research conducted by Ella Kurnia Oktaverina in 2018, guided inquiry-based student's worksheet to train students' critical thinking skills on

business material and potential energy get results on validity aspects with proper categories, on practical aspects with very feasible categories and the effectiveness with very feasible categories.

The student's worksheets developed by researchers are deemed eligible if they meet three conditions, one of them is validity (Anggaretna et al., 2019). The student's worksheet based on the guided inquiry can be reviewed for eligibility through the validation process so this study aims to describe the validity of student's worksheets based on the guided inquiry on vibration and wave material to train the critical thinking skills of junior high school students.

## RESEARCH METHOD

The study was conducted using the ADDIE development model (Analyze, Design, Development, Implement, and Evaluation). In this study, the results obtained through validation covered in the Development stage. The learning tool developed in this study was a student's worksheet based on the guided inquiry on vibration and wave material to practice the critical thinking skills of junior high school students.

The data collection techniques in this study are research and validation techniques to assess the validity of the student's worksheet. The research instruments needed in this study are the research sheets and validation sheets. This research was conducted at the Natural Sciences Department, State University of Surabaya, and Public Middle School 1 Madiun. The student's worksheet validation was carried out by 3 validators consisting of 2 science expert lecturers and a junior science teacher. The validation sheet provides suggestions for further development of the previous design. The final results obtained by the author of validation are the validity score of the worksheet and the revised results of the worksheet development.

Validation data were analyzed using a scale of 1-5 adopted from Riduwan (2015) with very less valid to very valid criteria. The worksheet based on the guided inquiry model developed was declared feasible in terms of validity if the mode score was  $\geq 4$ . The score and validation criteria of the worksheet were presented in the following table.

Table 1. Student's Worksheet Validation Score and Criteria

Score	Criteria
5	Very Valid
4	Valid
3	Quiet Valid
2	Less Valid
1	Very Less Valid

## RESULT AND DISCUSSION

Based on the research that has been done, the results of the study using the ADDIE stages that obtain results up to the Development stage can be described as follows.

### Analyze Stage

The analysis stage in this study is divided into 2 stages: the first analysis stage to collect data or problems and the second analysis phase to find solutions to the problems that have been obtained. In the first analysis phase, obtained through interviews with science teachers, observing science teaching materials, and distributing pre-research questions. The results of interviews with the two science teachers of SMP Negeri 1 Madiun show that so far the two teachers often use simple demonstration learning methods in front of the class.

The 2013 curriculum expects students to be actively involved in learning so that students get their information in the process of finding out through research with process skills to be able to see a fact that is related to all circumstances (Hamdani, 2011). The curriculum content is also supported by Permendikbud Number 22 of 2016 which learning is carried out with full interaction, inspiration, motivation so students can actively participate. Teachers must create learning that invites students to be active in learning such as working with groups to find various information (Fauziah et al., 2017).

Teachers often do simple demonstrations when learning. Students are asked to observe, analyze, and conclude. Students will have meaningful learning if they can relate the material that they have with natural phenomena or their experiences in daily life directly (BSNP, 2016). From the student activities, there are already critical aspects of Facione's thinking including analysis and inference or making conclusions.

Students and science teachers use the same teaching materials during science learning, including when observing demonstrations by the teacher. The teaching materials used are PR Intan Pariwara books and BSE books. The results of observations found that in the book already contain components of aspects of critical thinking Facione implicitly that support students to practice their critical thinking skills. Analysis activities and making conclusions supported by teaching materials used should have helped students to master critical thinking skills.

The students' critical thinking skills test uses questions that contain 3 aspects of Facione's critical thinking, namely interpretation with questions formulating problems and hypotheses, analysis with results analysis questions, and inference with questions formulating conclusions. It can be seen that in the aspect of interpretation and analysis, none of the students answer the problem. Only 10.3% of students answered correctly on the aspect of inference.

Based on the results of the pre-tests of critical thinking skills, it was found that the students' critical thinking skills were still low. This is certainly not in line with what has been taught by the teacher during learning where students are also taught to analyze and make conclusions. From the interview results, the teacher uses the classical model when conducting simple demonstrations and making analyses and conclusions together. Classical learning tends to place students in a passive position and as recipients of learning materials (Usman, 2012). According to Moon (2007), critical thinking skills can be trained by determining their own

decisions not based on the influence of others. From these statements, it can be seen that students have not mastered critical thinking because they are rarely asked to make analyzes and conclusions independently.

From the interview results, there is a fact that the value of natural science, especially in physics material is still relatively low. Students find it difficult for mathematical and abstract material. One of them is on vibration and wave material with basic competence, analyzing knowledge, and conducting experiments on skills. Based on Rohmah and Nurita's research (2017), the material of vibrations and waves is difficult because students are required to find relationships between similarities and connect concepts in daily life.

The problem of low student scores on physical material can be caused by students rarely doing analysis related to the concepts of physics material so that students find it difficult to understand abstract material. According to Hasuddin (2009), allowing students to think critically is necessary so students can solve every problem present in their lives. In this case of critical thinking, students are also required to use certain cognitive strategies that are appropriate for testing the reliability of problem-solving ideas and overcoming mistakes or deficiencies (Syah, 2010).

In the second analysis stage, analysis is carried out to provide solutions to problems that have been analyzed previously. Vibration and wave material with a low score, have basic competence to analyze the concepts of vibration and waves in the aspect of knowledge and present the results of vibration and wave experiments on the aspect of skills. Both aspects are following critical thinking skills. Critical thinking skills relate to scientific abilities (identification, analysis, and problem-solving) and think carefully to get the right decision (Syafuruddin et al., 2016). This shows the need to be trained in critical thinking skills in learning science.

According to Facione (2011), critical thinking is a systematic cognitive process to produce a product of thinking that can be answered for. Critical thinking aims to produce interpretations, analysis, evaluation, and conclusions along with an explanation of the evidence, concepts, methodologies, and criteria or considerations that form the basis of assessment (Facione, 2011). The purpose of critical thinking is related to Facione's six aspects of critical thinking skills. In this study, there are 3 aspects involved in assessing students' critical thinking skills, namely interpretation, analysis, and inference.

Critical thinking skills can be trained in learning through appropriate learning models, one of which is guided inquiry. This learning emphasizes the process of discovery, thus it can encourage students to learn and help develop students' thinking skills, especially critical thinking skills because students can independently do and find solutions to problems provided by the teacher (Seranica et al., 2018). Based on the research of Oktaverina (2018) and Prahasta (2018), it was found that students' critical thinking skills increased with an average gain with high criteria after applying guided inquiry learning.

Science learning that uses guided inquiry to practice critical thinking can train student skills with the help of student activity worksheets (LKS) (Piawi et al., 2018). Students can improve their critical thinking skills when teachers use appropriate learning methods, support appropriate curriculum (such as worksheets and teaching materials), and active learning strategies between students and teachers (Vong & Kaewurai, 2017). LKS or student's worksheets is a learning device that can help teachers in developing student interaction in learning (Darmodjo & Jenny, 2002).

### Design Stage

Research at the Design stage was conducted because the worksheets with vibration and wave material for junior high school level which used three aspects of Facione's critical thinking skills were not available before. This research was conducted as a form of follow-up from the previous problem, namely the development of student's worksheets based on the guided inquiry on the material of vibrations and waves to practice critical thinking skills of junior high school students who had been analyzed at the analyze stage. The Design Phase begins with reviewing the Basic Competencies of 3.11 and 4.11 of vibration and wave material in class VIII of SMP following the 2013 Curriculum. The basic competencies are divided into several indicators and learning objectives as a reference to determine practicum topics in the student's worksheet. Curriculum analysis in the preparation of student's worksheets is done by determining the competencies students must have to choose the material to be taught (Prastowo, 2011). Based on the basic competencies of 3.11 and 4.11 of vibration and wave material, the worksheets in this study are organized into three headings including (1) Vibrations in Pendulum, (2) Vibrations in Spring and (3) Waves in Strings.

This student's worksheet based on guided inquiry is arranged according to the syntax of guided inquiry according to Sanjaya (2011), namely: (1) orientation phase, (2) problem formulation stage, (3) hypothesis formulation stage, (4) data collection stage, (5) analysis phase data and (6) conclusion formulation stage. This student's worksheet refers to aspects of Facione's critical thinking skills (2011) consisting of: (1) interpretation, (2) analysis, (3) inference, (4) evaluation, (5) explanation, and (6) self-regulation.

In developing this worksheet, it uses three sub-critical Facione thinking skills, namely: (1) sub-interpretation with indicators identifying elements that are important for solving problems, classifying elements based on certain rules, criteria or procedures and displaying a result of experiments by different, (2) sub-analysis with indicators comparing concepts or statements by determining similarities and differences, and (3) sub-inferences with indicators reaching valid conclusions based on evidence. The relationship between guided inquiry learning models and critical thinking skills in the student's worksheets arranged is presented in the following table.



Table 2. Relationship between Guided Inquiry Learning Model and Facione Critical Thinking Indicators in the Formulation of Student Worksheet

No.	Syntax of Guided Inquiry	Display on Student Worksheet	Critical Thinking Indicators
1.	Orientation	There are illustrations in the form of text and images related to students' daily experiences	-
2.	Problem Formulation	There are questions relating to the problem in the illustration	Identifying elements that are important for solving problems ( <b>Interpretation</b> )
		There are questions about the cause of the problem in the illustration	Identifying elements that are important for solving problems ( <b>Interpretation</b> )
		There are questions relating to the elements that influence the problem	Classifying elements based on certain rules, criteria or procedures ( <b>Interpretation</b> )
3.	Hypothesis Formulation	There are questions relating to the tendency that occurs if one of the influential elements is made different	Identifying elements that are important for solving problems ( <b>Interpretation</b> )
		There are questions relating to the elements that must be made the same and the elements that will be obtained in the practicum	-
4.	Data Collection	There are tools and material instructions, experimental design drawings, and experimental steps.	-
		There is a guiding sentence to create a table of experiment results	Displaying a result of experiments by different ( <b>Interpretation</b> )
		There is a guideline to the graph of the results in the table	Displaying a result of experiments by different ( <b>Interpretation</b> )
5.	Data Analysis	Two graph analysis questions from the graph that have been made before	Comparing concepts or statements by determining similarities and differences ( <b>Analysis</b> )
		There are analytical questions related to problems in everyday life	Comparing concepts or statements by determining similarities and differences ( <b>Analysis</b> )
6.	Conclusion Formulation	There are guiding sentences to write conclusions	Reaching valid conclusions based on evidence ( <b>Inferential</b> )
		There are questions about the accuracy between the conclusions with the initial assumption	-

The student's worksheets that have been arranged are complemented by (1) questions that can guide students in practice, (2) questions that contain indicators of critical thinking skills, (3) illustrations adapted to student experience and (4) sidebars that show syntax guided inquiry and indicators of critical thinking that are trained. Student worksheets (LKS) provide guidance sentences so they are easy for students to understand. Student's worksheets (LKS) should be accompanied by various guidelines or guidance to achieve goals such as basic competencies (Minister of Education and Culture Indonesia, 2014).

The display layout on the student's worksheet (LKS) is complemented by dominant orange and blue colors on the border text box and the worksheet border. Giving an interesting color to the student's worksheet is done because students initially focus on the appearance, not on the content (Salirawati, 2004). The student's worksheet (LKS) also provides an answer column for students to fill in answers during the practicum. Worksheets must provide enough space and there is a frame to fill the

answers or draw as in the instructions provided (Salirawati, 2004).

The specifications of this worksheet consist of: (1) Cover page which contains the worksheet number, the title of learning material, and student identity column, (2) Guidance page that contains the purpose of practicum, instructions for using the worksheet, and sidebar explanation, (3) Content section consisting from the illustrations, sub Let's Identify, let's Investigate, Let's Try, Let's Collect, Let's Analyze and Let's Conclude, and (4) The reference section is the bibliography.

#### Development Stage Research Result

In the first Development stage, the worksheets are reviewed by science expert lecturers to get suggestions about the student's worksheets that have been prepared. The research instrument used at this stage was a research sheet. The results obtained are that there are three suggestions in the following table.

Table 3. The Research Result of Student Worksheets

No.	Suggestions	
1.	Added a number on the LKS cover as the LKS identity	
	<b>Before Revise</b>	<b>After Revise</b>
2.	The questions on problems are replaced by more specific sentences to the illustration	
	<b>Before Revise</b>	<b>After Revise</b>
3.	Added a problem to the analysis of problems based on daily life	
	<b>Before Revise</b>	<b>After Revise</b>

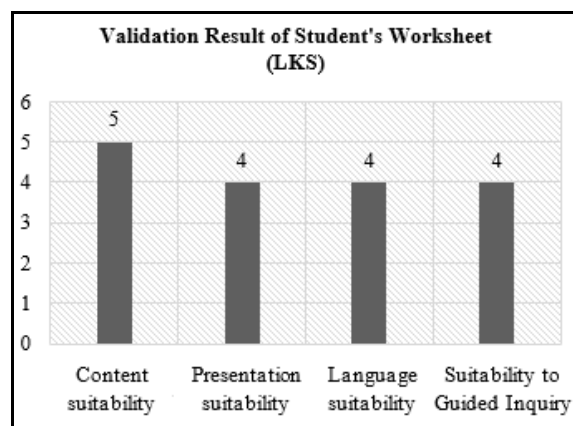
The first suggestion is to add identity numbers on the Student’s Worksheet (LKS) cover. Student’s Worksheet (LKS) which has a label greatly simplifies the identification process. For example, topics, worksheet numbers, classes, subjects, materials, names of students or group members, and so on (Salirawati, 2004). Student’s Worksheet (LKS) identity will help students learn in the order of learning topics. The Student’s Worksheet (LKS) functions to motivate students to be involved in the learning process and help students to find material information through systematic learning activities (Prianto and Harnoko in Loza, 2018).

The second suggestion is to replace the question on the problem to be more specific in the illustration. Questions that are too global can make students not focus on the illustrations given. Based on the Student’s Worksheet (LKS) construction requirements (Salirawati, 2004), clear questions without demanding deep thought processes should be avoided. The suggested questions are questions with answers that obtained through a clear information process so that the instructions that lead are needed. The questions presented in the worksheet are a form of guidance from the guided inquiry learning model. Forms of guidance and instruction for students can be presented through questions that encourage students to get their information in problem-solving (Ngerini et al., 2013).

The third suggestion is to add analytical questions related to problems that are close to the student’s experience. Students will have meaningful learning if they can link the material they have with natural phenomena or their experiences in everyday life (BSNP, 2016). A question is a form of follow-up to the results of the practicum conducted by students. The concepts obtained by students during practicum are associated with other problems in daily life. The analysis problem is also a way to practice critical thinking skills. Critical thinking skills provide benefits for students to be able to deal with various problems in everyday life (Omstein & Levine, 2007).

**Validation Result**

The second stage of development is the validation of the Student’s Worksheet (LKS). The Student’s Worksheet (LKS) validation stage is the LKS assessment stage by 2 science expert lecturers and a science teacher regarding the LKS that has been developed. The Student’s Worksheet (LKS) based on guided inquiry is declared valid if the validation result obtained score 4 with valid criteria. The validation data is presented in the following graph.



Picture 1. Validation Result of Student’s Worksheet

The validity of LKS is assessed based on aspects of content suitability, presentation suitability, language suitability, and suitability to the guided inquiry learning model. Component aspects of the suitability of the content assessed include the writing of the title, writing the purpose of the practicum, the presentation of the concept of material in the worksheet, the suitability of the purpose of the practicum with the concept of the material, writing a bibliography and the suitability of the worksheet in facilitating students' critical thinking skills. The validation mode results obtained in the aspect of content suitability of 5 with very valid criteria. This proves that the worksheet has been valid and is following the terms of worksheet validity on the content suitability aspect.

The contents of the Student’s Worksheet (LKS) based on guided inquiry developed have been adjusted to the applicable material and basic competencies. Prastowo (2011) states that the first thing to consider in preparing

LKS is curriculum analysis that applies so that LKS is following curriculum components (Competency Standards, core competencies, basic competencies, indicators, learning objectives, subject matter), as well as following learning steps. Writing the title also needs to be considered because the identity of the worksheet such as the topic name, material, and title will make it easier for students to use it (Salirawati, 2004).

Writing a bibliography on the worksheet needs to be done so that it can be seen that the worksheet compiled refers to the appropriate source for student learning. Based on the terms of the construction of student's worksheets, the preparation of student's worksheets must be sourced from books that have been prepared concerning the ability of students (Salirawati, 2004). The Student's Worksheet (LKS) facilitates students in practicing critical thinking skills through activities such as identifying, investigating, trying, collecting, analyzing, and concluding that have been adjusted to aspects of critical thinking of Facione. These aspects include interpretation, analysis, and inference (Facione, 2011). Critical thinking skills relate to scientific skills (identification, analysis, and problem-solving) so that they can find the right decision (Egok, 2016).

Validation of the aspect presentation suitability is reviewed from 4 components. These components include the suitability of the illustrations with the material, the suitability of sentences and letters, the display of worksheets (pictures and colors), and systematic worksheets. The results of the validation mode obtained on the aspect of the presentation suitability of 4 with valid criteria. This proves that the worksheet has been valid and is following the terms of worksheet validity on the aspect of the presentation suitability.

The illustrations contained in the worksheet are presented in the form of pictures and interesting narrative text. The topic in the illustration is chosen according to the topic of vibration and waves in student's experiences in everyday life. The choice of sentences in the illustrations is adjusted to the ability of students as it can be easily understood. Based on the research of Sholikhah and Nasudin (2017), the preparation of LKS body parts must pay attention to shape or size, and illustrations or images that can increase student interest in student's worksheet (LKS) and so students are encouraged to read it. An interesting presentation of images and writing can increase student motivation in learning and help students get material easily (Cahyono et al., 2014).

Writing sentences and letters in the worksheet needs to be considered so it will not cause apperception in the questions and instructions provided. Based on the student's worksheet (LKS) construction requirements, the use of clear sentence structures is needed. The student worksheets are arranged following the technical terms of the student worksheets: (1) there are different guide frames and student answer frames, (2) the use of printed letters (not Latin and roman), and (3) the use of larger letters on the topic. LKS applies a color pattern that is dominated by blue and orange. This is needed because the appearance is very necessary for the preparation of the student's worksheet (LKS). Students initially focus

on appearance rather than content (Mendikbud, 2014). The picture in the illustration is the author's way to provide an effective picture of the contents of the illustration.

The student's worksheet (LKS) is a learning tool in the form of guidance that can encourage students to interact with each other in learning (Darmodjo & Jenny, 2002). The instructions contained in the student's worksheet are arranged systematically according to the syntax of guided inquiry. This is intended so that students can build their knowledge in the order in which critical thinking skills are supposed to be. According to Johnson (2007), critical thinking is a systematic process in which students can prove a concept.

Validation on aspects of language suitability is reviewed from 2 components. These components include the use of language that is easily understood and the use of good and correct grammar in the student's worksheet. The validation mode results obtained in the aspect of language suitability of 4 with valid criteria. This proves that the worksheet is valid and following the terms of worksheet validity in the aspect of language suitability.

One of the criteria to arranged student's worksheets according to the Minister of Education and Culture Indonesia (2014) is the preparation of sentences in worksheets must be presented clearly so that students are easy to understand and can convey messages correctly. Based on the construction requirements of the student's worksheet preparation, the use of language that is following the level of student understanding and the use of appropriate sentence patterns is something that needs attention (Salirawati, 2004).

The results of the validation in this language aspect are supported by the results of Ningrum and Hidayati's research (Ningrum & Hidayati, 2017) which obtained an average score of 3 in the valid category in the same aspect. The results of their research explained that the feasibility of student worksheets on aspects of language must be arranged following the rules of writing good and correct Indonesian language and must be aligned with students' thinking abilities. The student's worksheets that are aligned with students' thinking abilities can help students understand the content (BSNP, 2016).

Validation in suitability with the guided inquiry model in terms of 3 components. These components include the learning model phase, the existence of sentences that guide, and the existence of discussion material following the objectives of the student's worksheet. The results of the validation mode obtained in the aspect suitability to the guided inquiry model of 4 with valid criteria. This proves that the worksheet is valid and following the terms of worksheet validity in terms of suitability to the guided inquiry model.

The compiled student's worksheet (LKS) refers to the syntax of guided inquiry. The guided inquiry syntax that is applied in student worksheet (LKS) has 6 phases namely orientation, formulating the problem, formulating a hypothesis, collecting data, analyzing data, and formulating conclusions written in the student worksheet (LKS) sidebar in sequence. According to Matthew and Kenneth (Matthew & Kenneth, 2013), the guided inquiry

learning model is a learning model that guides students to find concepts systematically and coherently from identifying problems to making conclusions from what has been found. This relates to the theory of constructivism which explains that students must find and build their knowledge into a deep understanding (Amri, 2010).

According to Sanjaya (2010), the guided inquiry model is a learning model in which the teacher is tasked with giving problems and guiding students by giving instructions in the form of questions so that students can find solutions to these problems. The student worksheets developed have provided sentences that guide students in the form of instructions, statements, and questions. The form of guidance given is following the stage of guided inquiry and adjusted to the indicators of Facione's critical thinking (2011). The purpose of guided inquiry learning is to encourage students to be able to improve their intellectuality and be able to develop their thinking skills through questions given to students during the guided inquiry process takes place (Effendi, 2012).

The student's worksheets (LKS) that are developed contain discussion materials that fit the learning objectives. Each question in the worksheet is formed as student discussion so that the expected activity when working on the worksheet is that students can work collaboratively with each other. This is supported by Jauhar (2011) that guided inquiry is a learning model for finding concepts and material that is carried out with a discussion of the questions asked. The worksheet developed was similar to the worksheet developed by Permana (2013) and Alfonita (2016) who applied guided inquiry at each step. The results of his research explained that the application of the student's worksheet (LKS) based on guided inquiry was following the expected learning objectives.

The suggestions provided by the validator is to add the details of the component contents to the results table of the experiment. Detail components of the contents of the results of the experiment are displayed so that students are directed in collecting data and can sort out the necessary data. The second suggestion is to add the grid to the graphic part so the scale of the student's graph is the same. The third suggestion is to add line graphs to make it easier for students when drawing it.

## CLOSING

### Conclusion

Based on the results of the research, it can be concluded that the validity of student's worksheets based on the guided inquiry on vibration and wave material that has been developed gets an overall validation mode score of 4 with a valid category. So these worksheets are valid for use in practicing critical thinking skills of junior high school students.

### Suggestion

Based on research that has been done about the validity of student's worksheets based on the guided inquiry on vibration and wave material to practice critical

thinking skills of junior high school students, there are some suggestions from researchers for further research as follows.

1. The selection of basic competencies (KD) in determining material is important because not all basic competencies can practice critical thinking skills. The basic competency characteristics chosen should contain the C4 level of knowledge and above because one of the basic skills of critical thinking is analyzing.
2. In preparing the worksheet, it is better to look for information about the skills that have been mastered by students. Simply, it's like drawing a graphic. If students are not able to draw graphs, the researcher can give the grids and lines to make it easier for students to draw.
3. In ensuring that the language used in worksheets can be understood by students, it should be tried by asking students to read worksheets and responding to sentences and language in the worksheets.

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