



STATE UNIVERSITY OF MEDAN

**DEVELOPMENT OF TEST INSTRUMENT TO ASSES
CRITICAL THINKING SKILLS ON SOUND
MATERIAL USING E-LEARNING**

THESIS

**Submitted to Fulfill The Requirement for Degree of
Sarjana Pendidikan**

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**DEPARTMENT OF PHYSICS
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Skill On Sound Material Using E-Learning**

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BIOGRAPHY



Tumpal Leonardo H. Sinurat was born in Kabanjahe on September 18th, 1998. Father's name is Parman Sinurat and mother's name is Asianna Pandiangan. The author is first child of four siblings . In 2004, the author started his Elementary school at SD Negeri 01 Kabanjahe and graduated in 2010. In 2010, the author continued his education at SMP Negeri 1 Kabanjahe and graduated in 2013. In 2013, the author continued education in SMA Negeri 1 Kabanjahe, and graduated in 2016. During his school education in high school the authors also include students who are smart enough due to the author always got top rank in his class and also able to bring school name to Top 3 in physics olympiad for karo region. In the year 2016, the author received in Program Study Physics Education Department, Faculty of Mathematics and Natural Science, Universitas Negeri Medan through SBMPTN.

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ABSTRACT

Development of Test Instrument To Asses Critical Thinking Skills On Sound Material Using E-Learning

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This research aims to develop critical thinking baset test instrument on Sound Material Using E-Learning, test the feasibility of the instrument and determine the level of students' critical thinking. The research was designed with the ADDIE Learning Design Model and was carried out at SMA Negeri 3 Medan with the subject of class XI students in the MIA program. The initial stages of this research are Analysis, the next stage is Design, the next stage is the Develop stage by conducting product trials in small and large groups, and the last stage is Implement with evaluation at each step, the last stage is the distribution of instruments carried out within the scope of SMA Country 3 Medan. The results showed that the test instrument based on Critical Thinking Skills On Sound Material Using E-Learning the sound wave material developed by the researcher had met the criteria worthy of being used as a sound wave material learning outcome test instrument. The feasibility of this test instrument was based on validity and reliability tests, from validity test, from 20 questions obtained 7 valid questions. For the large group reliability test, the value of 0.72 is included in the feasible category. It can be concluded that the questions developed by researchers can be used as a measuring tool for students' cognitive knowledge and can be well received by students.

Kata kunci : Critical Thinking Skills, E-Learning.

PREFACE

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The author would especially like to thank the two beloved parents, who always provide prayers, support, encouragement, and material to the author so that thanks to the love and prayers of the authors' parents, they were able to complete their undergraduate education studies at the Universitas Negeri Medan. Thanks also to my all brothers and sister who have cared about my studies and helping me finishing this thesis.

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The author has tried his best in completing this thesis, but the author realizes that there are still many weaknesses in both the content and grammar of the thesis writing, for that the writer expects suggestions and criticism from the readers for the perfection of the thesis. Hopefully this thesis can be useful in enriching education knowledge

Medan, January 2022

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CHAPTER I PRELIMINARY

1.1 Background

According to Law No. 20 of 2003, Education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, the community, the nation and country.

The problems of education in Indonesia are still quite diverse, including issues of teacher competence, curriculum issues to physical problems such as inadequate or inadequate learning facilities, so there is a need for mutual awareness and concrete action in overcoming various educational problems in order achieve maximum educational success to improve the quality of education so that it can support the progress of the country.

In the PISA 2018 issue, Indonesia was ranked below which was considered very low, in reading ranks, Indonesia was ranked 72 out of 77 countries, Mathematical Ranking was ranked 71 out of 77 and ranked 71 out of 80 in the science section. this is one of the problems that occur in Indonesia that needs to be considered.

Learning becomes a procedure used by educators in building students' thinking abilities and adding understanding in new knowledge such as efforts in mastering a concept in learning. The ability to think is divided into two, namely basic thinking skills and higher level thinking skills, basic level thinking skills only on things that are general in nature, such as memorizing,

remembering to repeat the information that has been obtained. Instead the ability to think at a high level from problem solving to making decisions. In making decisions to solve problems correctly students are expected to be able to have critical and creative thinking skills.

Higher Level Thinking Skills as Critical and Creative Thinking John Dewey argued that critical thinking is essentially as an active process, where one thinks things deeply, asking questions, finding relevant information rather than waiting for information passively (Fisher, 2009).

Critical thinking is a process in which all knowledge and skills are mobilized in solving problems that arise, making decisions, analyzing all assumptions that arise and conducting investigations or research based on data and information that has been obtained to produce the desired information or conclusions.

Critical thinking is no longer new in the world of education. Critical thinking is a procedure of thinking that has reasons and emphasizes in making decisions about what needs to be trusted and carried out in the evaluation. Critical thinking is an indicator of success in learning where critical thinking in learning is a cognitive process so students can identify, analyze and evaluate. Critical thinking can also raise many important questions and problems to formulate and assess information in a relevant and open-minded way. In the process of learning, critical thinking becomes a necessity that needs to be maintained and developed.

In assessing critical thinking students are expected to be able to identify, analyze, interpret, and evaluate evidence, arguments, claims, and data presented extensively through in-depth Assessment, as well as reflect it in everyday life - today.

Critical thinking is not only developed in the process of mere learning but also must be assisted with an instrument of critical thinking assessment to obtain data or information about the quality of appropriate learning and to

find out whether these critical thinking skills are achieved or not. To find out whether or not critical thinking skills are achieved towards students we can know about the results of assessments conducted by educators. In order for students to be able to provide answers to questions raised by educators, the reasoning is needed by students in learning until students are able to provide answers to questions given by educators because to answer these questions students need to have knowledge, understanding, and skills.

In previous studies, there were many studies on the development of questions to assess critical thinking skills, some of which were the development of critical thinking questions for junior high school students, the development of critical thinking questions in general, the Development of Questions for Geometry material and some of the questions of critical thinking for temperature physics problems and heat. From these research studies, the researchers decided to develop critical thinking questions for sound wave material.

As technological developments are increasingly developing in the 21st century, especially in the world of internet education has become common, everyone uses it, including students. If the evaluation process is done using the technology of Internet use, besides, it enables educators to do Input value and save on printing costs given the higher paper values, is also expected to evoke excitement and interest of learners in working on evaluation.

In addition to the influence of 21st-century developments, technology also has an influence on environmental development, namely on the development of learning systems towards environmentally-friendly learning. To realize environmentally-friendly learning can be done by reducing the use of paper in the world of education. Every year the use of paper in Indonesia is always increasing. Because paper is the most fundamental part of life so that its presence is taken for granted. Whereas in making paper the raw

material used is wood so that the use of wood as raw material also means reducing the number of trees in the world. According to P-WEC (Petungsewu Wildlife Education Center), it states that every 15 reams of A4 size paper require 1 tree to be cut down. In the next 5 to 10 years how many tree trunks will be cut down to meet the growing demand for paper. If this keeps happening, it will make the world environment more inhospitable to life. That way it is necessary to have an alternative and an effort in saving the environment so that the environment is not damaged.

In early 2020, the world have announced global pandemic, in Indonesia we declared national emergency for global pandemic in march 2020. This global pandemic affect all human activity that decrease productivity, include education. As global Pandemic happens, government restricted all gathering, event, party, and all activity that could gather crowd. School is one of them, this make school cannot be operated as always and made teaching and learning process halted. This is the chance that technology will help education and that is E-Learning.

Along with the development of technology, especially in the field of education, the development of evaluation media in learning began to be widely used. Offering online practice application questions is easier to find. Even some applications can be accessed using an android smartphone. Among them, Moodle. MOODLE (short for Modular Object-Oriented Dynamic Learning Environment) is a software package produced for internet-based learning activities and websites that use the principle of social constructionist pedagogy. MOODLE is one of the applications of the concepts and mechanisms of teaching and learning that utilize information technology, which is known as the concept of electronic learning or e-learning.

Based on observations at the public high school 3 Medan for several days, and also interviews with students and teachers, the researcher found

that the physics teacher at the high school had not used renewable technology and was still using traditional media, namely print media. According to researchers, research on the use of E-Learning in schools is very important for developing Indonesian education. The development of E-learning based questions is also expected to make students tech-savvy and assist teachers in assessing students.

In the world of e-learning in Indonesia, Moodle is better known for its function as a Course Management System or " Learning Management System" (LMS). With a display like a web page in general, Moodle has a feature to present courses, where teachers can upload teaching materials, questions and assignments. Students can log in to Moodle then choose the course provided or be enrolled for it. Student activities in Moodle will be monitored by their progress and grades. In Indonesia itself, it is known that Moodle has been used for high schools, colleges, and companies.

1.2 Identification of Problems

Based on the background that has been explained, the following problem identification is obtained:

1. There are many media that can be used in the evaluation process but educators only use print media.
2. Lack of educators in integrating learning using the latest technology, especially in evaluating learning.
3. Instruments needed that fit the characteristics of critical thinking physics and meet the goals in physics are to analyze, evaluate, create and utilize natural phenomena so that students' critical thinking skills increase.
4. A media-based or web-based question instrument is needed to make it easier for educators to value processing and provide varied evaluations for students so that the evaluation is not only focused on print media.

5. Global pandemic that force all teacher to learn E-learning and implement new method of evaluation.

1.3 Limitation of Problems

So that the problem observed is not too wide, therefore the following problem limitations are obtained in the study:

1. The target of the study which is used as a reference in research is physics class XI
2. The test instrument are based on Moodle E-learning LMS
3. The time and cost of research will be kept as low as possible so that research can be continued for further research.
4. Development focuses only on Critical thinking.

1.4 Problem Formulation

Based on the various problems that have been raised, the formulation of the problem in this study are:

1. What is the requirement to make good Critical thinking Test?
2. How to develop Critical thinking Test Based on E-learning Moodle?
3. How to integrate critical thinking test on e-learning?
4. What are the level of critical thinking on SMAN 3 medan?

1.5 Research Objectives

Based on the problem formulation that has been described, the purpose of this research is:

1. To find out how the characteristics of instruments about the ability to think critically
2. To determine how the validity and reliability items to think critically about the ability of the instrument to use in E- learning.
3. To Produce Critical thinking based Test on Moodle LMS

4. To determine critical thinking level of student in SMA 3 MEDAN.

1.6 Research Benefits

The benefits of doing this research are :

1. Theoretical Benefits

The results of this study are expected to be able to add scientific insights and be able to develop mindsets in developing evaluation tools using web E-learning.

2. Practical Benefits

a. For Students

Able to provide useful knowledge for students during learning.

b. For Educators

Give something different to students in learning and build learning communication between educators and students.

c. For Researchers

To be able to add insight and knowledge about the development of evaluation tools using web E-learning to be able to become a provision for educators, especially in creative and innovative physics subjects and be able to motivate students in increasing understanding in learning physics.

d. For schools

Give schools an understanding of e-learning so that it can be applied in schools and increase school credibility. Schools can also use this research to assess the effectiveness of e-learning and question making techniques to assess critical thinking skills.

CHAPTER II

LITELATURE REVIEW

2.1 Concept of Instrumen Development

2.1.1 The Nature of Learning Evaluation

This definition also underscores the potential subjective evaluation, where different individuals tend to have diverse expectations. In learning evaluation activities, there are three interrelated things, namely evaluation, measurement and tests. Measurement is a process that produces a numerical picture of the levels of specific characteristics possessed by individuals (students). The test is a systematic tool or procedure for measuring a sample of behavior.

Based on the above opinion, it can be concluded that the evaluation is more comprehensive in that it includes measurements, and tests as a tool to carry out the measurements themselves. The decision judgment (value judgment) is not only based on the results of measurements (quantitative description), it can also be based on observations (qualitative description). Both those based on measurement results and non-measurements ultimately result in a decision about the value of the object being assessed.

2.1.2 Learning Evaluation Functions and Objectives

If you want to carry out evaluation activities, the teacher must know and understand in advance about the purpose and function of the evaluation. If not, then the teacher will have difficulty planning and carrying out evaluations. The main functions of evaluation in learning can be grouped into four functions, namely:

a. Formative Function

Evaluation can provide teacher feedback as a basis for improving teaching and learning and conducting remedial programs for students who have not fully mastered the material being studied.

b. Sumative Function

Evaluation can determine the level of student mastery of the subject matter, determine the value of the grade as a material for grade promotion decisions and reports on student learning progress and can increase student motivation.

c. Diagnostic Function

Evaluation can determine the background of students (psychological, physical and environmental) who have learning difficulties.

d. Selection and placement functions

Namely the results of the evaluation can be used as a basis for selecting and placing students according to their interests and abilities.

Evaluation according to psychological requirements is intended so that the teacher knows students as completely as possible and so that students know themselves completely. In addition, the evaluation is also useful to enhance teaching results, because the evaluation can not be separated from learning and teaching, and the point is the evaluation of learning with the aim to improve it. Evaluation must be carried out by all concerned, not only teachers but also students. Then the objectives of learning evaluation include:

1. To see the productivity and effectiveness of teaching and learning activities
2. To improve and perfect teacher activities
3. To improve, perfect and develop teaching and learning programs

4. To find out what difficulties students face during learning activities and find solutions
5. To place students in teaching and learning situations that are appropriate to their abilities.

The product produced in the form of an instrument of critical thinking based on E- learning on sound wave material that can be utilized by educators and students as an evaluation media.

2.2 Theoritic References

2.2.1 Nature of Learning

Humans have the ability to always develop the potential that exists in him. The ability of humans increases with the amount of experience gained. Learning is a process where humans look for experiences to continue to survive. According to Burton (1984) in Siregar (2014: 4), "learning is a process of changing behavior in individuals because of the interaction between individuals and their environment so that they are better able to interact with their environment". Gagne and Berliner (1983: 252) in Rifa'i (2011: 82) state that learning is a process in which an organism changes its behavior as a result of experience.

Fontana (1981) in Winataputra (2007: 1.8) argues that learning as a process of change is relatively fixed in individual behavior as a result of experience. Like Fontana, Gagne (1985) in Winataputra (2007: 1.8) also states that "learning is a change in ability that lasts long and does not originate from the process of growth".

Characteristics - Learning Features

According to Surya (1997) in Rusman (2015 : 14) there are eight characteristics of behavior change, namely:

- 1) conscious and intentional changes,
- 2) continuous change,

- 3) functional changes,
- 4) positive changes,
- 5) changes that are active,
- 6) permanent changes,
- 7) intended and directed changes,
- 8) changes in overall behavior.

A conscious or deliberate change means that change is the result of a thought. Changes are made without coercion and occur on a whim. Continuous change means that the change that occurs is a continuation of knowledge or the result of previous changes. Functional changes means that the change is good, change is good is intended that the changes result from the study is the change that can serve for the things that are positive. Active change means that the change is the result of an action carried out, not because of an external treatment. Change is permanent is defined as a change that lasts a long time, and permanent. These changes are not temporary. A directed change means that the change has been planned in such a way or is interpreted again as a conscious change. And changes in behavior as a whole means that changes that occur as a whole are not part by part.

2.2.2 Learning Outcomes

According to Dimiyati and Mudjiono (2009: 3) learning outcomes are the result of an interaction of learning and teaching. This opinion emphasizes that learning outcomes come from an interaction. Interaction is communication between teachers and students. From the teacher's point of view, the act of teaching ends with a process of evaluating learning outcomes.

Meanwhile, according to Suprijono (2009: 5) learning outcomes are patterns of actions, values, meanings, attitudes, appreciation, and skills. This means that learning outcomes are a reflection of students during the learning process. This reflection is the result of a process of interaction between teacher and student called the learning process.

Learning activities are based on a learning goal to be achieved. The achievement of learning objectives can be seen from the learning outcomes that have been obtained by students. Rifa'i (2011: 85) said "learning outcomes are changes in behavior obtained by students after experiencing learning activities". In line with Rifa'i's statement, Susanto (2013: 5) argues that "learning outcomes are abilities obtained by children after going through learning activities". Gagne in Purwanto (2014: 42) added that "learning outcomes are the formation of concepts, namely the categories we give to existing stimuli in the environment that provide an organized scheme to assimilate new stimuli and determine relationships within and between categories".

The success of students in achieving learning outcomes is influenced by various factors. Wasliman (2007) in Susanto (2013: 12-13) states that learning outcomes achieved by students are the result of the interaction of various factors that influence it, these factors are :

1. Internal factors: are factors that originate from within students, which affect their learning ability. These internal factors include: intelligence, interest and attention, learning motivation, perseverance, attitude, study habits as well as physical and health conditions.
2. External factors: are factors that originate from outside the learners themselves which affect learning outcomes namely family, school and community.

2.3 Concept of Higher Order Thinking Skills (HOTS)

2.3.1 High-order Thinking Skills

Higher- order thinking skills commonly known as Higher Order Thinking Skills (HOTS) are triggered by four conditions.

- 1) A particular learning situation that requires a specific learning strategy and cannot be used in other learning situations.

- 2) Intelligence which is no longer seen as an ability that can not be changed, but the unity of knowledge that is influenced by various factors consisting of the learning environment, strategies and awareness in learning.
- 3) Understanding of views that have shifted from unidimensional, linear, hierarchical or spiral towards understanding views to multidimensional and interactive.
- 4) More specific higher-order thinking skills such as reasoning, analytical skills, problem solving, and critical and creative thinking skills.

According to some experts, the definition of higher order thinking skills, one of them from Resnick (1987), is a complex thought process in breaking down material, making conclusions, building representations, analyzing, and building relationships by involving the most basic mental activities. This skill is also used to underline various high-order processes according to Bloom's taxonomic level . According to Bloom , skills are divided into two parts. The first is the skill of a low level is important in the learning process, which is considering, remembering, understanding , and applying , and next are classified into high order thinking skills in the form of skill analyzes , evaluating , and creating.

2.3.2 High-order Thinking Skills as Critical and Creative Thinking

John Dewey argued that critical thinking is essentially as an active process, where one thinks things deeply, asking questions, finding relevant information rather than waiting for information passively (Fisher, 2009). Critical thinking is a process in which all knowledge and skills are mobilized in solving problems that arise, making decisions, analyzing all assumptions that arise and conducting investigations or research based on data and information that has been obtained to produce the desired information or conclusions

2.3.3 High-order Thinking Skills as Problem Solving

Higher-order thinking skills as problem solving are needed in the learning process, because learning that is designed with a learning approach oriented to high-order skills cannot be separated from a combination of thinking skills and creativity skills for problem solving. Problem solving skills are the skills of experts who have a strong desire to be able to solve problems that arise in life everyday . Individual students will have different problem solving skills and are influenced by several factors.

2.4 Difference Between High-order Thinking skills (HOTS) and High Order Thinking (HOT)

According to Brookhart (2010) notion to think level higher is as follows : Higher-order thinking conceived of as the top end of Bloom's cognitive taxonomy. The teaching goal behind any of the cognitive taxonomies is equipping students to be able to do the transfer. "Being able to think" means students can apply the knowledge and skills they developed during their learning to new contexts. "New" here means applications that the student has not thought of before, not necessarily something universally new. Higher-order thinking is conceived as students being able to relate their learning to other elements beyond those they were taught to associate with it.

Understanding at the top, explaining that the purpose of teaching is based on the taxonomy of cognitive Bloom wants the students to be able to apply the knowledge and skills to the context of the new, which students can apply the concepts that have not been thought of previously. In Taxonomy Bloom has revised the ability to think the level of high- involving process analysis (C4), evaluating (C5), and create (C6) (Andreson & Krathworl,

2001). Anderson conducted research and produced improvements to his understanding of Bloom's taxonomy.

Higher Order Thinking Skills different from high-level thinking(Higher Order Thinking), which refers to the drawing 2.1. If referring to the taxonomy of Bloom's revised, think -level high (HOT) associated with the ability of cognitive in analyzing, evaluating, and be creative. Meanwhile, higher-order thinking skills (HOTS) are related to problem-solving skills, critical thinking, and creative thinking. In general. Skills analysis of complex and analysis system is part of the problem solving that is not expressed in its own in the element main HOTS. Likewise, also the skills to think logically and evaluate is part of thinking critically, so that the element main of HOTS can be made more simple.

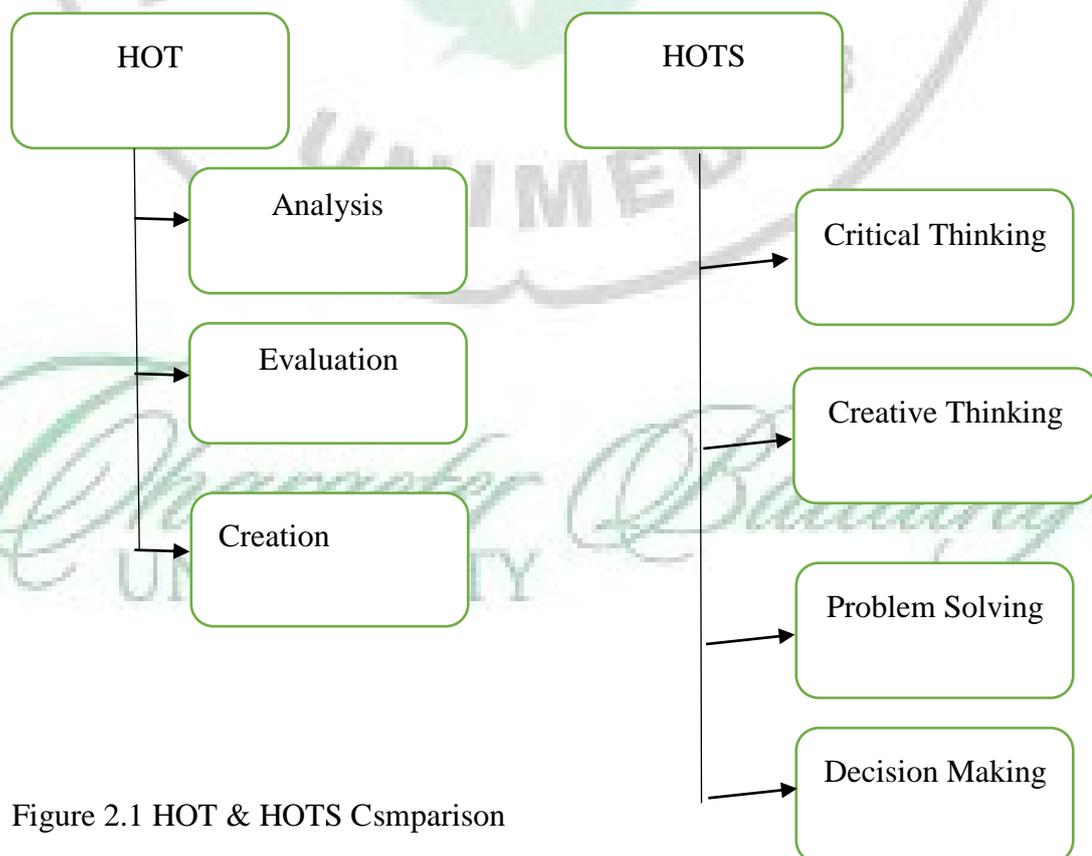


Figure 2.1 HOT & HOTS Comparison

2.5 Critical Thinking Ability

According Picket and Foster (in Susiyati , 2014), to think critically is the kind of thinking is high that not only memorize the material but the use and implement materials were studied in a new situation. Nugent and Vitale (in Susiyati , 2014) think critically involves purpose , goal directed thinking in the process of making decisions based on evidence and not guesswork in the process of solving scientific problems . From the definitions it can be concluded that to think critically is the ability to interpret , analyze , evaluate (an idea, the result of observation , information , or arguments), and make decisions that are based with their evidence.

Based on Ennis (in Julita ,2014) there are six elements of the base in thinking critically are known by the acronym FRISCO (Focus, Reason, Inference, Situation, Clarity, Overview) .

The explanation from FRSICO is as follows .
Focus (focus), means to focus the attention of the decision-making of the problems that exist.

1. *Reason* , Giving the reason rational against the decision that was taken.
2. *Inference (conclusion)*, Mae the conclusion based on the evidence that is convincing with a way to identify the various arguments or contention and seek an alternative solution, and fixed into consideration of the situation and evidence that exist.
3. *Situation*, Understanding the key of problem that led to a state or situation
4. *Clarity*, Provides an explanation of meaning of terms that are used.
5. *Overview (Re-check)*, Do the examination again as a whole to determine the accuracy of decision that has been taken.

To measure the ability to think critically needed indicators, as follow:

Table 2.1 indicator of critical thinking skills according to Ennis

Critical Thinking Skills	Sub Critical Thinking Skills	Indicator
1. Giving Simple Explanations (Elementary Clarification)	1. Focusing Questions	a. Identify or formulate questions . b. Identifying kriteria/kriteria to consider the answers that allow . c. Maintain a state of mind .
	2. Analyze the Arguments	a. Identifying conclusions b. Identifying the reason sare stated c. Identify reasons that are not stated d. Look for similarities and differences e. Identifying and addressing non relevansi an f. Looking for the structure of an opinion / argument g. Summarize
	3. Ask and answer questions of clarification and a statement that challenged	a. Why ? b. What that be the reason the primary ? c. What do you mean by ? d. What that be an example ? e. What is not an example ? f. Bangaimana apply the case that ? g. What that makes the difference ? h. What are the facts ? i . Is this what you said? j. Moreover, what would you say about it ?
2. Build Basic Skills (Basic Support)	4. Consider whether the source can be trusted or not .	a. Expertise b. Reducing conflict of interest c. Agreement between sources

Critical Thinking Skills	Sub Critical Thinking Skills	Indicator
		<ul style="list-style-type: none"> d. Reputation e. Using procedures that exist f. Know the risks g. Ability to give reasons h. Habit of caution
	5. Observe and consider the results of observations	<ul style="list-style-type: none"> a. Reducing the presumption of thought b. Shorten the time between observation and report c. The report is carried out by the observer himself d. Take note of things that are indispensable for reinforcement e. Possible in strengthening f. Conditions of access are good g. Competent in using technology h. Observer satisfaction with credibility
3. Making Conclusions (Inference)	6. Deducing and considering deductions	<ul style="list-style-type: none"> a. Logic class b. Conditioning logic c. Interpret statements
	7. Induce and consider the results of the induction	<ul style="list-style-type: none"> a. Generalizing b. Hypothesizing
	8. Creating and assessing the value of the consideration	<ul style="list-style-type: none"> a. Background behind the facts b. Consequences c. Applying concepts (principles , laws and principles) d. Considering alternatives

Critical Thinking Skills	Sub Critical Thinking Skills	Indicator
		e. Balance , weigh and decide
4. Make Explanation More Advanced (Advance Clarification)	9. Identify terms and consider definitions	There are 3 dimensions : a. Shape synonyms , clarification , range , expression of the same . Operational , examples and non examples b. Content definition strategy (content)
	10. Identify assumptions	a. The reason that is not otherwise b. The assumption that the necessary reconstruction of the argument
5. Set Strategy and Tactics (Strategy and Tactics)	11. Decide on an action	a. Defines the problem b. Selecting the criteria which may c. Formulate alternative solutions d. Decide what to do e. Review f. Monitor implementation
	12. Interact with other people	a. giving label b. Logical strategy c. Rhetorical strategy d. Presenting a position , whether oral or written

2.6 Critical Thinking Assessment

Critical thinking is not only developed in learning, but must also be supported by evaluations that are integrated with classroom learning. Education benchmarks can be known by the evaluation. This means that if students are expected to have critical thinking skills, then the types of evaluation provided must also be able to practice critical thinking skills as obtained by students during the learning process. The test can be divided into

various groups. When viewed from its construction, the test can be classified as follows: (a) according to its form, in general there are two forms of test, namely the test form of the description (essay test) and item test objective form. These two forms can be further divided into various types, (b) according to their form, the item description can be classified into two types, namely limited description (restricted essay) and free essay test (extended essay).

To determine students' critical thinking skills, it is necessary to develop an instrument for evaluating critical thinking skills, in this study researchers used objective form test items because they do not use too much time and cost more

2.7 Form of Assessment Instruments

The instrument is a measuring instrument used to collect data. The form of the assessment instrument consists of test and non-test instruments. Subali (2012: 51) is classified as a test when it involves right and wrong and non-test when it does not involve right and wrong. The form of assessment instruments developed in this study uses the form of test instruments.

The form of the instrument can be in the form of tests: written test, interview questionnaire, documentation, and observation (Suparno, 2010). According to Sukardi (2014), there are several ways to collect data or information, including :

1. The test is a tool or procedure used to measure something in an atmosphere, by means and rules that have been set (Arikunto, 2013).
2. Questionnaire or questionnaire is a data collection tool that is most widely used by evaluators. According to Sugiono (2015), questionnaires have many advantages, including: they can be created and duplicated at low cost, can be used quickly, reach large numbers of respondents, and

can reach the area of implementation of the program or project being evaluated.

3. Interviews are data collection tools in the form of questions compiled by evaluators. Interviews can be conducted in a structured and unstructured manner. Structured interview is an interview in which the questions in the data collection process have been prepared previously, while the unstructured interview is an interview that does not use interview guidelines that are arranged systematically and completely to collect the data (Sugiyono, 2015)
4. Observation is used to know firsthand the subject or object to be evaluated. According to Sugiono (2015), data collection techniques with observation are used when research is related to human behavior, work processes, natural phenomena, and the observed respondents are not too large.
5. Documentation is used to find information from relevant documents and support the observation activities.

2.8 Developing Critical Thinking Instrument

2.8.1 Developing Instrument Specifications

2.8.1.1 Determine test objectives

The test objectives are determined by the test maker. However, this study is a study of developing critical thinking instruments, so the aim is to find out how much critical thinking skills students have.

2.8.1.2 Constructing a test grid

Setting up a test grid (blueprint) is a very important step. Arrange test grids based on the indicators created.

2.8.1.3 Determine the length of the test

Of all the items made, you must pay attention to the length of each item to be tested. No more than half a page for one item.

2.8.2 Writing Test Instrument Questions

If the indicators have been determined and you know the length of the test instruments, then the next step is to write down the instruments. This instrument is made according to EYD, and should be reread after the instrument is made, with the aim of whether the writing, editorial, and sentence meanings are correct or not.

2.8.3 Examining the Test Instrument Questions

Review of this instrument question is carried out by experts / experts in mathematics lessons. This stage is called the expert validation process. The results of the review by the validator show the quality of the instruments made. If it is not valid, then it needs to be corrected / revised based on the suggestions given by the validator. After it has been repaired, the instrument is given back to the validator to be assessed for each item.

2.8.4 Assemble Test Instruments Questions

After all the items arranged are analyzed and corrected, the next step is to assemble the items into one instrument.

2.9 HOTS in Bloom Taxonomy

One of the main focuses of 21st Century thinking skills in achieving learning goals is Higher Order Thinking Skills (HOTS) (Saido, et al., 2015: 13). One of the taxonomies that is well known in education is Bloom. Function Taxonomy Bloom is a framework to think the achievement of the purpose of learning the teacher in analyzing the eyes of subjects and teaching

dimensions of knowledge as well as the dimensions of the process of cognitive that would be achieved by the students. Anderson & Krathwohl (2015: 43) state are included in the category of HOTS is Analyzing (C4), Evaluate (C5), and Creating (C6).

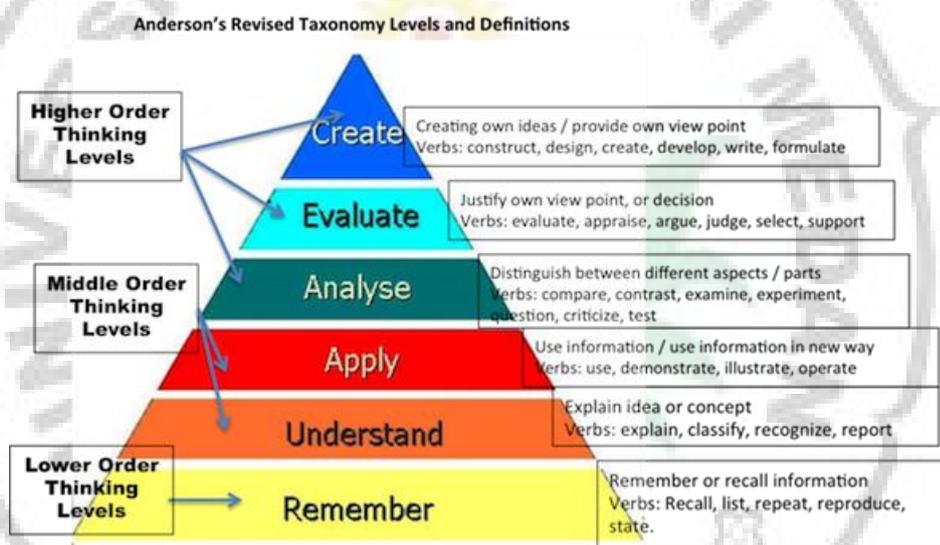


Image 2.1 Bloom Taxonomy

The level of thinking of Bloom's Taxonomy moves from things that are concrete to abstract and from things that are simple to more complex things. Because it is, to achieve the objectives in the Taxonomy of the need to associate things concrete and simple which are located in the surrounding environment of students. To achieve that, it is necessary to have a dimension of knowledge and cognitive processes. The dimension of knowledge includes conceptual, factual, procedural, and metacognitive knowledge. While the cognitive process dimension includes remembering, understanding, applying, analyzing, evaluating, and creating.

Table 2.2 Revision bloom taxonomy composition

Revised Bloom Taxonomy Composition	
Knowledge Dimensions	The Cognitive Process Dimension
1. Factual Knowledge A. Terminology Knowledge b. Knowledge of detail parts and elements. 2. Conceptual Knowledge A. Knowledge of classification and categories b. Knowledge of principles and generalizations. c. Knowledge of theories, models, and structures. 3. Procedural Knowledge A. Knowledge of specific skills related to a particular field and knowledge of algorithms. b. Technical knowledge and methods. c. Knowledge of the criteria for using a procedure. 4. Metacognitive Knowledge A. Strategy knowledge b. Knowledge of cognitive operations c. Self-knowledge	C.1 Remember Recognizing Remember (Recalling) C.2 Understand (Understand) Interpreting (Interpreting) Setting an example (Exemplifying) Summarize (Summarizing) Withdraw (Inferring) Comparing (Comparing) Explaining (Explaining) C.3 Applying (Apply) Running (Executing) Implementing (Implementing) C.4 Analyze (Analyze) Organizing Finding the implied meaning (Attributing) C.5 Evaluate (Evaluate) Checking Criticizing (Critiquing) C.6 Create (Create) Formulate (Generating) Planning (Planning) Producing (Producing)

Understanding the realm of cognitive analysis includes the skills to distinguish or break down a unit into parts and determine how these parts are connected to one another. Evaluation is related to the skills to form an opinion about something or several things along with the accountability of that opinion based on certain criteria by providing an assessment. Creating is defined as generalizing new ideas, products or new perspectives from events. The creation process is generally related to students' previous learning experiences.

The following is a table regarding the Revised Bloom's educational taxonomy which links the dimensions of knowledge and dimensions of cognitive processes in learning.

Table 2.3 Revised Bloom's educational taxonomy

Domain	Cognitive Dimensions					
	Remembering	Understanding	Implementing	Analysis	Evaluating	Creating
Factual						
conceptual				HOTS <i>(HIGHER ORDER THINKING SKILL)</i>		
Procedural						
Metakognitif						

2.10 Preparation and Development of Tests

According to Djaali (2004), the preparation and development of tests is intended to obtain valid tests, so that the size can accurately reflect learning outcomes or learning achievements achieved by each individual test participant after participating in teaching and learning activities, for that construction steps Tests taken are as follows :

1. Set test objectives. Learning achievement tests can be made for a variety of purposes, such as: (a) tests aimed at conducting national exams or other similar exams, (b) tests aimed at conducting a selection, for example SNMPTN, (c) tests aimed at diagnosing learning difficulties of students known as diagnostic tests.
2. Curriculum analysis. Curriculum analysis aims to determine the weight of each subject that will be used as a basis in determining the number of items or items for each subject matter objective or weight questions for the form of description, in the form of a test grid.
3. Analysis of textbooks and other learning material resources. This analysis has the same objective as curriculum analysis, which is to determine the weight of each subject based on the major pages contained in the textbook or other learning material resources.

4. Making a lattice. The benefit of the grid is to guarantee good questions, in the sense of covering all points in a proportional manner. So that the test items or items cover the whole material (the subject or sub-topic) proportionally, then before writing the test items we must first make the grid as a guide.
5. Writing special instructional goals (ICT). The writing of ICT must be in accordance with the stipulated provisions. ICTs must reflect student behavior, therefore they must be formulated operationally, and technically use operational words.
6. Writing questions. After the grids in the form of specification tables are available, we will make the question items. Some instructions that need to be considered in making the items - questions.
7. Study the questions. The questions made may occur deficiencies or errors regarding aspects of the specific ability measured. Material used, typos and so on. For this reason, before being reproduced, the questions must first be explored.
8. Limited reproduction tests. The ready-made test is reproduced in sufficient numbers according to the number of sample trials or the number of participants who will teach the test first in a pilot activity.
9. Trial test. Tests that have been reproduced will be tested - on a number of samples that have been determined. The trial sample must have characteristics that are approximately the same as the characteristics of the actual test taker.
10. Analysis of trial results. Based on the data of the results of the CPA test, an analysis is carried out, especially item analysis which includes item validation, level of difficulty and deception function. Based on the validation of the item, the item selection is held by using certain validation criteria.

11. Revision of questions. Valid questions based on empirical validation criteria are confirmed with the grid. If the questions have fulfilled the requirements and have represented all the material to be tested, the questions are then assembled into a test, but if the valid questions do not meet the requirements based on the results of the confirmation with the grid, improvements can be made regarding the questions is required.
12. Assemble the questions into a test. The order of questions in a test is done according to the level of difficulty from easy to difficult questions (Sudaryono, 2012)

2.11 Test Development Steps

Before determining the techniques and measuring instruments the constituent questions must determine the assessment objectives, competency standards, and basic competencies to be measured. After that the compiler of the new questions can determine the right instrument. The complete determination process can be seen in the following chart.

Important steps that can be taken to develop questions (Ministry of National Education, 2008: 7) are as follows.

1. Drafting the Problem Determining the Purpose of Assessment

The purpose of the assessment is very important because each goal has a different emphasis. For example, the objectives of learning achievement tests, diagnostics, or selection. Examples for the purpose of learning achievement, the scope of the material / competency asked / measured is adjusted as for the past quiz / asking material, oral questions in class, daily tests, individual or group assignments, semester tests, and so on.

2. Drafting Questions Taking into account Competency Standards (SK) and Basic Competencies (KD)

Competency standards are the main reference or target that must be met or must be measured through any existing basic competencies or through a combination of basic competencies.

3. Question Compiler Determine Types of Measurement Tools

Measuring instruments used in the form of tests / non-test or use both. The use of tests is needed to determine important material to support basic competencies. The requirements are that the material presented must consider urgency (must be mastered by students), continuity (constitutes continued material), relevance (beneficial to other subjects), and high level of use in daily life.

4. Next Steps Determine the Type of Test by Asking Whether the Material Is Exactly Tested in Written or Oral

If the answer is correct, then the material is appropriately tested with what questions, multiple choice or description. If the answer is not right, then the right type of test is a test of performance: performance, assignment (project), work (product), or others.

5. Drafting the Problem Preparing the Lattice and Writing the Item Question and its Scoping Guidelines

In writing questions, the question writer must pay attention to the rules of writing questions. The grid is a description of the competency and material to be tested. The purpose of preparing the grid is to determine the scope and as a guide in writing the questions. The grid can be either format or matrix.

CHAPTER III

RESEARCH METHOD

3.1 Definition of Research Method

In general, understanding **the research method** is a process or method chosen specifically to solve the problem raised in a research. While the understanding of research methodology is a science that explains how a study should be carried out.

Another opinion says that the understanding of research methodology is a series of systematic / structured steps taken by researchers to find the right answers to questions on the research object. The systematic steps are :

- The process of identifying and formulating problems
- Preparation of frame of mind
- Formulate a hypothesis
- Discussion of problems
- Make conclusions and suggestions

Research Methods According to Experts

In order to better understand what a research method is, we can refer to the opinions of the following experts :

1. According to Prof. Dr. Sugiyono, understanding the research method is a scientific way to obtain data with specific purposes and uses.
2. According to Muhiddin Sirat, the research method is a way to choose the topic of the problem and determine the title of a research.
3. According to Prof. ME Winarno, research methodology is a scientific activity carried out with careful and systematic techniques.

4. According to Heri Rahyubi , the research method is a model that can be done in teaching and learning activities for the achievement of a good learning process.
5. According to Muhammad Nasir, the understanding of research methods is the main method used by researchers to achieve goals and determine answers to problems raised.

3.2 Research Participant

It can be concluded that research participants are subjects involved in physical mental and emotional activities as participants in responding to activities carried out in the learning process and supporting the achievement of objectives and responsibilities for their involvement. In this study involving several participants, namely :

3.2.1 Public High School 3 Medan

Research activities require a place of research that will function as a background to obtain the data needed to support the achievement of research objectives. This research took place due to various considerations including :

- a. No previous study of research to be conducted now, the Development Instrument for Assessing Critical Thinking Skills High School Students on Materials sound and wave
- b. In accordance and in accordance with the conditions needed in this study (relevant)
- c. SMA Negeri 3 still uses simple assessment instruments.
- d. State High School 3 gives permission to researchers to conduct research .

3.2.2 The headmaster of Medan 3 High School

The principal is a leader who gives permission to researchers to conduct research on instrument development in Medan 3 high schools.

In this research helps the research process. With the consideration of the principal can provide information about school profiles, academic students, curriculum, facilities, and extracurricular student activities .

3.2.3 Teacher of SMA 3 Medan

This research activity requires knowledge of how interactions between teachers and students in the teaching and learning process, especially in this study focusing on the physics teacher at SMA Negeri 3 medan . To find out how the shape of the instruments used in physics materials in schools, researchers capture information in the form of good data from the interaction of teaching and learning activities or evaluating learning outcomes using instruments determined by the subject teacher .

3.2.4 Instrument Reviewer

Instrument reviewers will be conducted by 2 people, namely 2 lecturers, including 1 expert lecturer in physics education material and 1 lecturer in physics subject matter and subject teacher.

Instrument reviewers will carry out content validation which includes

- (a) the conformity of the items with the indicators,
- (b) the level of difficulty of the items (concept of questions),
- (c) use of language in items, and
- (d) the correctness of key answer concepts. In addition, content validation is also carried out to obtain advice on expert test items

3.2.5 High School Students 3 Medan

This research focuses on class XI students. The subject of this study is centered on the Natural Sciences class. Because in class XI the Natural Sciences Physics has been taught Sound Wave material making it easier for researchers to conduct trials .

3.3 Research Place and Time

3.3.1 Points Research

The place of research is in SMA Negeri 3 medan at Jl.Budi Community No. 3 Pulo Brayon city, medan baru district, medan city, North Sumatra

3.3.2 Time Research

The research was conducted in November to desember Year 2020.

3.4 Types of Research and Research Design

3.4.1 Types of Research

The Development Model used in this research is ADDIE Learning Design Model (*Analysis- Design- Develop - Implement - Evaluate*) which is combined according to the development research steps recommended by *Borg and Gall* on the basis that the model is suitable for developing instructional model products / learning is on target, effective and dynamic and is very helpful in the development of learning for teachers.

ADDIE's instructional design model (*Analysis- Design- Develop - Implement – Evaluate*) developed by Reiser and Mollenda (1990s) is a generic learning / training design model that serves as a guideline in building effective, dynamic and supporting training program tools and infrastructure training performance itself. Thus helping training instructors in managing training and learning (Pargito , 2010: 46.)

This ADDIE model uses 5 stages or steps of development as shown below :

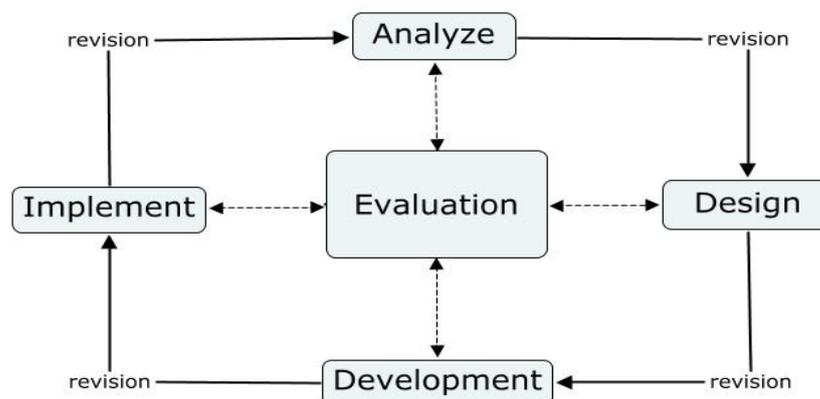


Figure 3.1 General Steps of ADDIE Learning Design

1. Step 1. Analysis (Analyze.)

Analysis stage is the most important phase in this process. When instructional designers do the analysis phase before creating the plan, developing, or even implementing, they really save huge amount of courses, effort, and time. In order to carry out the analysis phase we have to analyze four things, like we have to analyze the learners (where they are at, their skills and needs, etc.), develop an instructional analysis (to provide the necessary steps and present opportunities to learn and use new information in an instruction), create instructional goals (aimed at specifying the end desired result), and analysis's learning objectives (how to measure the attainment of goals). That means you have to be clear about your goals and where you want your learners to be.

- In analysis of the learner. We need to know what do the learner's know already about the topic, so we can build our plan on what they learned and know what information the audience needs and how much. We need to know the needs and problems of the learners. In order to identify that, we can do surveys, interviews, pretests, or pre-assessments of the audiences to collect data about them.

- In analysis of instructional goals. We have to identify obvious goals for the specific instruction. What do you want the learners learn? When you clearly identify your specific goals, you will save much in time and sources. In fact, you will create a very effective instruction design.
- Developing instructional analysis. Is very hard and complicated. When we identify specific goals we will start to write all the important steps and all the details that we need to achieve the goals. In fact, this phase is more visible from the instructional designer because we need to edit back and forth.
- In developing learning objectives. We have to be more specific. In this phase, we define what our learners should be able to do when the instruction is finished. Additionally, the formalized aspects are skills, behavior and knowledge. Objectives need to specify an observable measureable behavior that indicates attainment of the goal, that specify the level of accuracy that needs to be attained, and that describes the conditions under which the assessment is given (i.e., the materials or context). For example, we can write our learning objectives in this way: by the end of this instruction the audiences/learners (she or he) should be able to mark correct answers at an 80% accuracy level on a multiple choice test. In order to fill this blank you have to be very specific when you choose your verbs such as, explain, describe, demonstrate, etc.

2. Step 2. Design

This stage is known as making a design (blue print). This activity is a systematic process that starts from setting learning goals, designing scenarios or teaching and learning activities, designing learning tools, designing learning materials and evaluating learning outcomes. The design model / learning method is still conceptual and will underlie the next development process.

This phase is really about applying the instruction. In fact, the instructional designer in this step thinks about how design instruction can really be effective in

ways that facilitate people's learning and interaction with the materials you create and provide. Furthermore, in design phase the instructional designer evolves and focuses on designing assessment for (his/her) topic, select a form of the course, and creating their own instructional strategy.

- An assessment's design. Assessing your learner's outcomes on your subject is very necessary but before, that it is important to know how you will assess these outcomes when you are working on your instructional design. To do the assessment effectively, you must use the data that you already collected from the former stage, which is Analysis phase. Along with that, make sure that your assessment is strongly related to the content and context. Also, when you write your assessments make sure your tasks or questions are written well, so there is no mistake or misunderstanding that might lead to confusion by the learners.
- Select a form of the course. The second part of the form of your course is to choose a delivery system. Form's course means how you are going to represent your materials about the topic. In fact, there are many formats you can use in order to deliver the content; for instance, lecture in the classroom, online over the Internet, self-based workbook, etc. or in course that integrates many methods. That means you have to select the form of the course that match your design assessment. For example, if the learners are going to take tests by using their own laptop, the effective way then is to select the form of the course that allows the learners to use their own laptop.
- Creating instructional strategy. After you have finished the assessment's design and created the form for the class, we will start creating the strategies for the instructional design. Truly, the course strategy is a combination of many methods to help the learners understand the topic (for instance, lectures, discussions, reading, and activities, etc.).

3. Step 3. Development.

This phase depends on the first two phases, which are the analysis and the design phase. That mean, if we did these phases correctly the development will be easier. In this third phase, the instructional designers integrate the technology with the educational setting and process. Also, keep in mind the backup plan in case that the technology that we choose does not work. For example, if we consider Google research to find some information about what the word Ancient civilization means and the Internet does not work, we have a backup, which is PowerPoint presentation. Moreover, the instructional designer starts to develop and create a good quality factual sample for the instruction design, the materials of the course, and run through of the conduction of the course.

- Create factual sample for the instruction design. In this step we are going to create samples of our materials in order to show your work to your director and make sure that you are in the right track.
- Develop the materials of the course. After we are done from our sample and are satisfied with its design, it is time to start developing our course materials. From the activity we decide to include our instructional strategy along with our sample that we made before. Furthermore, we must pay attention to the advice and suggestions from our boss or supervisor in order to improve our materials. Moreover, we can give our review section of the course materials to a client or friend and see if there is any weakness or any comments, criticisms, and suggestions.
- Run through the conduction of the design. After we are done from developing course materials we are ready to start this step, which is a run through of the design, like a practice run or a pilot test. This step is the actual time to do rehearsal for our course using all materials we had created. We have to involve our friend in this step so we can treat our friend as a real learner and use the exact same conditions of the real-time as if we have to teach the learner. In this situation, it will be great if we

prepare an assessment for feedback in order to help us find out weaknesses and work hard to improve it.

4. Step 4. Implementation.

The Implementation is a concrete step to implement the learning system that we are making. That is, at this stage everything that has been developed is installed or set in such a way according to its role or function so that it can be implemented. After the product is ready, it can be tested through a large group then evaluated and revised. Then trials can be carried out on large groups and then re-evaluated and revised so as to produce a final product that is ready for dissemination.

5. Step 5. Evaluation

Evaluation is a process to see whether the learning system that is being built is successful, according to initial expectations or not. The evaluation phase can be carried out at each of the four stages above which are called formative evaluations, because the purpose is for revision needs. For example, at the design stage we need expert review to provide input on the design we are making.

The final process in ADDIE model is Evaluation phase. It is very important to evaluate each step in order to make sure that we achieve our goals using the instructional design and materials to meet the learner needs. Additionally, when we talk about evaluation, we talk about two types of evaluation, which are formative evaluation and summative evaluation. First, formative evaluation is a continuing process that we do as we are working on our instructional materials in each phase on ADDIE model. There are three basic processes of formative evaluation, which are one to one, small evaluation group, and trial in the field. When we evaluate, we want to choose learners that have similar features to our real learners and evaluate the materials based on that.

- One to one formative evaluation. This process of evaluation is based on evaluating each material we used in order to see if this material was

effective and identifying the strength and the weaknesses of our materials and working to improve it.

- Small evaluation group. When we are done from making changes based on what we discovered during one to one stage of evaluation, the next stage will be making a small group evaluation. This stage is evaluating the effectiveness and achievement of the changes that we made in the previous one to one stage. Another point as well, is the importance of observing if the activities work well for the group situation. Also, we are looking for the assessment of these activities to be lucid, effective, and practicable. Even more, to make this stage of evaluation more effective, we need to carefully choose different subpopulations that entirely represent our groups of learners in the course.
- Formative evaluation on trial in field. When we finished those two evaluation strategies, now we are ready for real-time rehearsal for all activities that we included in our instructional design. In this case, we need to prepare environments similar to the real environment of our course, as well as one to one and small evaluation of groups. This stage needs to be clear, effective, and practicable in order to finish this evaluation and the content and our instruction design be ready to deliver.
- The second type of evaluation is summative evaluation. It is very important to use summative because this type of evaluation helps us to see the real value for our instructional design when the whole instruction for the course is finished. With the summative evaluation we can evaluate the learners' outcomes as well as the effectiveness of all of the components of the design after the students complete the course or design. In fact, we can create specific assessment questions that make the students display how they classify the instruction from strongly disagree, disagree, natural, agree, to strongly agree.

- There is an important point we have to be sure we include it when we write the assessment, which is making the evaluation anonymous from the learners so they can give us a honest evaluation without being afraid from us and we can get real benefits in order to improve our instructional design and reach the instructional goals.

3.4.2 Design of the Validator

The research design used in this study was to use a validator in accordance with the product or instrument produced from this study which is shown in the table below.

The achievement of a research objective is carried out by applying several treatments to the sample during the course of the study, as follows:

1. Step 1. The needs analysis phase identifies problems (needs) that are found in the school
2. Step 2. Design It means Designing assessment instruments for students' critical thinking skills on Static Fluid material as well as designing assessment instruments with Critical Thinking Skills Indicators.
3. Step 3. Development This means that at this stage everything that is needed or that will support the learning process must all be prepared.
4. Step 4. Implementation Implementation is a concrete step to implement the learning system that we are making. That is, at this stage it is time to apply the instrument that was made after it was validated and discussed by the experts until the questions made were feasible to use or valid, after the product was finished the instrument could be applied in high school.
5. Step 5. Evaluation. Evaluation is a process to see whether the learning system that is being built is successful, according to initial expectations or not.

3.5. Research procedure

The ADDIE research model has the following stages of research as follow:

1. Start

2. Analysis

- a. Conduct initial identification in the form of :
 - Student characteristics
 - Teaching and learning process
 - E-learning that will be used
- b. Determine research problems.
- c. Determine the products to be developed to overcome research problems.
- d. Review the literature (pre-existing products).
- e. Conduct product evaluation and revision to the supervisor.

3. Design

- a. Preparation of research proposals.
- b. Determine the indicators for the Student Critical Thinking Skills Assessment Instrument and the problem solving process in the Static Fluid material
- c. Produce products in the form of instruments for the Assessment of Students' Critical Thinking Skills on Sound Wave material.
 - Arrange the problem grid
 - Arrange questions
 - Arrange answer keys
 - Design validation
- d. Evaluate point a-c revisions to the supervisor.

4. Development

- a. Validate the assessment instruments in the form of questions to the designated expert validator.
 - Limited scale trials
 - Large scale trials
 - Implementation phase

- b. Perform evaluation and revision of the Evaluation instrument in accordance with expert validator recommendations.
 - c. Repeat steps a-b until the test instrument is properly identified and qualified by the expert validator.
5. Implementation
- Field trials in class XI MIA who have studied Sound wave material to find out the validity and reliability of the students' critical thinking skills and student responses to the instrument.
6. Evaluate (Evaluate)
- a. Conduct evaluation according to the results of data from field trials.
 - b. Product has been produced.
7. Research complete.
- (Branch,dkk, 2017:)

3.6 Data Collection

The purpose of this study, namely to obtain appropriate data, we need a data collection tool called a research instrument. Research instruments are tools that are selected and used by researchers in data collection so that these activities become systematic and simplified.

Data collection techniques in a study are very necessary because the data taken by researchers is not only focused on one source as a reference, but consists of several sources. Based on consideration of the needs of the data that must be obtained in this study, the authors collect information and data using the methods, namely:

3.6.1 Questionnaire

Questionnaires are used at the product development stage to obtain data on readability and practicality of using critical thinking skills assessment instruments. The questionnaire was given to physics teachers, limited scale test objects and large scale trials. The type of questionnaire used was a closed questionnaire with

10 questions. The questionnaire was given at the end of the testing and implementation stages.

3.6.2 Documentation Study

The documentation study was conducted at the preliminary study stage both in the field study and literature study. The instrument used in the documentation study was a checklist sheet. Data obtained from documentation studies are types of assessment instruments used in schools and school conditions. Data collection was directly carried out by researchers at Public Highschool 3 Medan.

3.6.3 Essay tests

The form of tests in this study is the Essay Test. Essay Test is an open-ended question test that is used for data retrieval of critical thinking skills. Essay tests are tested on a limited scale and wide scale.

Table 3.1 Essay Test Construct According to Mehren

No	Factor	Check
1	Is the question restricted to measuring objectives that would not be assessed more efficiently by other item formats?	
2	Does each question relate to some instructional objective?	
3	Does the question establish a framework to guide the student to the expected answer? a. Is the problem delimited? b. Are descriptive words such as "compare," "contrast," and "define" used rather than words such as "discuss" or "explain"? c. For the restricted-response essay in particular, is the student "ai	
4	Are the questions novel? Do they challenge the student? Do they require the student to demonstrate originality of thought and expression?	
5	Are the questions realistic in terms of a. difficulty?	

No	Factor	Check
	b. time allowed the student to respond? c. complexity of the task?	
6	Are all students expected to answer the same questions?	
7	Is there a preponderance of short-answer (restricted-response) questions?	
8	Has a model answer been prepared for each question?	

3.7. Question Item Analysis

The research data collected is then processed in-depth study by looking at the type of research data. The data analysis techniques used in this study were qualitative and quantitative, namely

- (a) qualitative analysis was carried out descriptively according to the results of the questionnaire, documentation, and observation. In limited trials and extensive trials of data analysis conducted with a qualitative approach in order to evaluate the material design to assess weaknesses and shortcomings as a form of revision to improve material design and assess the achievement of the design of critical thinking skills assessment design.
- (b) quantitative analysis is used to determine the effect of the application of assessment instruments to learning outcomes and positive responses from students and teachers to the assessment instruments for critical thinking skills. The quality test of the instrument was carried out on the observation sheet questionnaire, the student's thinking activity test, the Multiple Choic Test, the test was in the form of validity and reliability.

The following describes the testing of the instrument quality and analysis of the research data conducted.

3.7.1 Data Analysis Techniques

3.7.1.1 Essay test

Essay Tests before use in research, reliability and validity analyzes are first performed.

3.7.1.2 Content Validity

Validity is a measure that shows the levels of validity or validity of an instrument (Suharsimi, 2002). Validity test conducted is divided into two, namely expert validity and content validity. Expert validation is used to test the logical validity or content and construct. The purpose of expert validation is to test the assessment instruments in terms of compatibility between competency standards, basic competencies, indicators of critical thinking skills, cognitive taxonomy and the material used with the questions. It also validated the language and writing and readability of the questions. Content validation is used to test the validity of the content, so if a correlation coefficient is obtained with sufficient to very high criteria, then the problem can be declared capable of measuring critical thinking skills.

After the test instrument has been validated by 2 predetermined validators, then the test instrument is given to students who have studied static fluid material, namely in class XI MIA at Public High School 3 Medan This activity is carried out in order to see whether the test instrument is valid or not. In this connection, the technique used to test the validation of the test is the Karl Pearson product moment correlation statistics. The formula is as follows:

$$r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{\{N \sum X^2 - (\sum X)^2 - (\sum Y)^2\}}}$$

Where : r_{xy} = Test validation coefficient

X = Test score

Y = Total test score

N = Number of students

The technique used to test the validation of the test is Karl Pearson's product moment correlation statistic, the researchers got valid results from 7 essay questions that were tested on XI grade students of SMA Negeri 3 Medan using Microsoft Excel as follows:

Table 3.2 Instrument Validity Interpretation

N	The Level of Significance		N	The Level of Significance	
	5%	1%		5%	1%
3	0.997	0.999	35	0.334	0.430
4	0.950	0.990	36	0.329	0.424
5	0.878	0.959	37	0.325	0.418
6	0.811	0.917	38	0.320	0.413
7	0.754	0.874	39	0.316	0.408
8	0.707	0.834	40	0.312	0.403
9	0.666	0.798	41	0.308	0.398
10	0.632	0.765	42	0.304	0.393
11	0.602	0.735	43	0.301	0.389

Standardized way to interpret r is by listing the product moment critique r tables. Correlated states if $r_{count} \geq r_{tabel}$

3.7.1.3 Construct Validity

Construct validity is one type of internal rational validity of an instrument which indicates the extent to which the instrument reveals a theoretical construct or trait it intends to measure. In this case, the construct is the framework of a concept. The definition of this construct is hidden and abstract so that it is associated with many empirical behavioral indicators that require analytical tests such as factor analysis.

3.7.1.4 User Validity

User validity is the validity intended for whom the instrument will be tested, for example, for students, students, and others.

3.7.1.5 Research Instrument Reliability

Reliability is the accuracy or the severity of a measuring instrument in measuring what is measured. This means that whenever the measuring instrument is used it will provide the same measurement results (Sudjana, 2001). Reliability refers to an understanding that an instrument can be trusted enough to be used as a data collection tool because the instrument is already good (Suharsimi, 2002). To test the reliability of the instrument the *Alpha Cronbach* formula is used (Suharsimi, 2002):

For the calculation of reliability can be determined by looking at the research instruments used. Because the test used as a research instrument is a Essay problem the formula used is the K-R.20 formula as follows:

$$r_{11} = \left[\frac{K}{K-1} \right] \times \left[1 - \frac{\sum s^2}{S^2} \right] \text{ with } s^2 = \frac{\sum x^2 - \frac{(\sum x)^2}{N}}{N}$$

$$q = 1 - p$$

Information:

- r_{11} = test reliability coefficient
- K = number of test items
- $\sum s^2$ = Total variance of each item
- S^2 = Variance total
- N = The number of students

To interpret the value of reliability of the questions, then the value is correlated to the product moment value table with $\alpha = 0.05$ if $r_{count} > r_{table}$ then the problem is reliable. As for the reliability criteria of a test are as follows:

The amount of data reliability is interpreted according to the criteria

Table 3.3 Instrument Reliability Interpretation

Correlation coefficient	Reliability Criteria
0,81 – 1,00	Very high
0,61 – 0,80	High
0,41 – 0,60	Enough

0,21 – 0,40	Low
0,00 – 0,20	Very low

3.7.1.6 Level of Difficulty

Numbers that show the characteristics (hard or easy) of a problem are called difficulty indexes. This difficulty index shows the level of difficulty of the questions. To determine the level of difficulty of the problem the following formula is used

$$P = \frac{B}{T}$$

Where: P = item difficulty index

B = Many students answered the items correctly

T = Number of all students participating in the test.

To calculate the level of difficulty for each item used the following steps (Arifin, 2009: 135)

1. Calculate the average score of each item using the formula:

$$\text{average} = \frac{\text{the number of learners' scores for each question}}{\text{number of students}}$$

2. Calculate the average score of each item using the formula:

$$\text{difficulty level} = \frac{\text{average}}{\text{maximum score of each question}}$$

3. Comparing the level of difficulty with the criteria

The greater the value P, the easier the item, conversely the smaller the P, the more difficult the item. A test item is said to be eligible if values range between:

Table 3.4 Table of Question Level of Difficulty

P	Criteria
0,00 – 0,30	Difficult test
0,31 – 0,70	Medium test
0,71 – 1,00	Easy test

3.7.1.7 Discriminating Power

The difference in power is the ability of a question to distinguish between high-ability respondents and low-ability respondents (Sugito. 'Et al 2015). The different power level formulas according to the Ministry of National Education (Kadir 15)

$$DP = \frac{\bar{X}_A - \bar{X}_B}{SMI}$$

Where :

DP : Discriminating Power

\bar{X}_A : Average top group score

\bar{X}_B : Average group score below

SMI : Ideal maximum score

Table 3.5 Differentiation Criteria in Test Instruments

Differentiation Criteria of Discriminating Power(DP)	
Bad	$0,00 \leq D < 0,20$
Enough	$0,21 \leq D < 0,40$
Well	$0,41 \leq D < 0,70$
Very well	$0,71 \leq D < 1,00$

3.7.2.8 Standard error measurement

Measurement standards can be calculated from standard deviation score tests and reliability estimates using the following formula:

$$SEM = S\sqrt{1 - r_{kx}}$$

With : SEM = Standard error measurement

S = standard deviation

r_{kx} = Reliability Test

3.8 Critical Thinking Level

By assessing critical thinking level using test, Researcher categorize student critical thinking level by the table below

$$\text{Percentage Score} = \frac{\sum n}{\sum N} 100\%$$

Table 3.6 Tabel critical thinking level

Level of Critical thinking skills	Range of Score
Poor	0-20
Below Average	21-40
Average	41-60
Above Average	61-80
Superior	81-100

CHAPTER IV

DISCUSSION AND RESULT

4.1 Research Result

4.1.1 Analysis result of ADDIE

A. Analyzing Learners

This step is the beginning on developing instrument to find out the problem in SMAN 3 Medan, after interviewing teacher that teaches physics in school, researcher found that Student rarely given any HOTS type question in any material, most of the question given were the LOTS or Low order thinking skill, The book given by the school does not meet the criteria of HOTS for the test. In the last chapter of the books the test used to evaluate student are far from requirement to be used as HOTS instrument test, because of that, researcher are making the HOTS instrument to be tested to student to train their Critical thinking abilities, so that cognitif process of student will increased from low level to higher level to be relevant in modern world.

In learning students are required to be able to answer the questions that will be given by the teacher, namely the questions in the student package book. The online teaching learning process also seems ordinary so that it reduces the level of curiosity and desire to learn from students which causes a lack of interest in student learning.

B. Analyzing Student Teaching and Learning process

In Analyzing teaching and learning precoss, the researcher analyze student material on sound topic as follows :

1. Sound as a Wave
2. Sound speed
3. Sound speed on solid and gas
4. Doppler effect
5. Sound Interference
6. Organ pipe
7. Open Organ pipe
8. Closed organ pipe
9. String
10. String and organ pipe frequency
11. Sound intensity
12. Intensity Level

Those materials have been taught by the teacher during Even Semester on 2021 in SMA N 3 medan, this material will be used as reference to design the test to asses the critical thinking level.

The instructional goals for teaching sound and wave material is as follows:

1. explain the characteristics of sound waves
2. use the equation for the speed of wave propagation in gases, solids, and liquids to solve problems.
3. Using the Doppler effect for problem solving
4. Describe the ear as a sound receiver
5. Explain the phenomenon of strings
6. Explain the phenomenon of the organ pipe
7. Explain the intensity of the wave
8. Explain the level of sound intensity
9. Conduct an experiment to calculate the speed of sound in air
10. Conduct an experiment to determine the Doppler principle
11. Conduct an experiment to determine the relationship between the length of the string (L), the tension of the string (F), the mass of the string (m), and the speed of propagation of the transversal wave on the string (v)

The books used for teaching and learning is FISIKA untuk Siswa SMA/MA kelas XI published by BSE

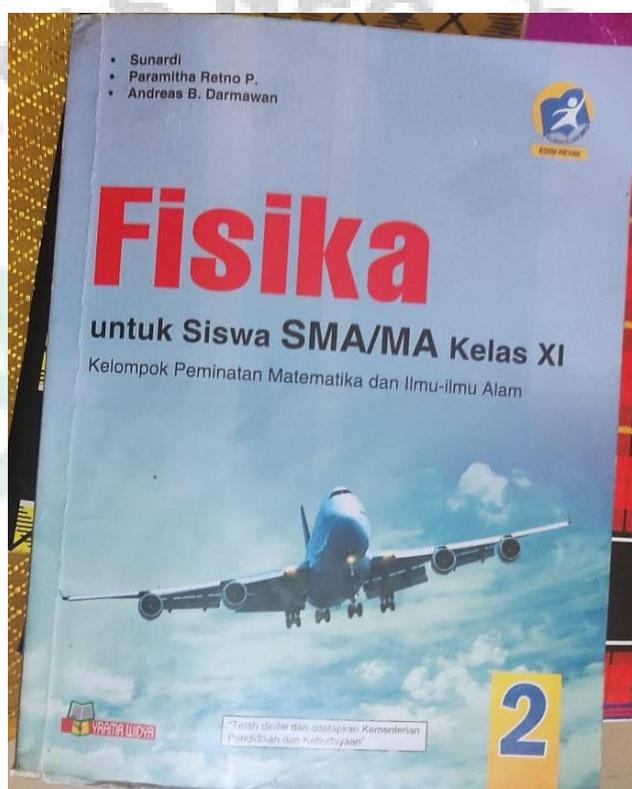


Image 4.1 Teaching material

Analysis carried out in the book above Researcher found that the book FISIKA untuk Siswa SMA/MA kelas XI published by BSE is too simple and not advanced enough to test student critical thinking level because the question contain in the book are too low level and may cause misjudgement.

There are different books for each school, so this book cover is the indicate that the book used to analyze is Physics book published by BSE.

C. Analyzing E-learning Moodle

E-learning that researcher will use is MOODLE. Moodle is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments.

Moodle that were analyzing is moodle vecrsion 3.10 which is the latest version avaiable at the time of research, this version provide stability and security for e-learning to be used on learner.

When conducting an analysis on Moodle, the researcher found a type of question called formula. This type of formula has good features to support physics questions, namely it has several very useful features including:

1. Questions that can be given several answers
2. The answer has a restative error system that can assess aproaching numbers but is still the correct answer if judged manually
3. The answer can be entered in units
4. The answer can also be standardized with SI units or CGS units
5. Reduced score for wrong units only

All of above advantage are crucial when creating online based test, as it reduce time to analyze score and increase scoring system to asses more variable.



Image 4.2 unit conversion and score deduction for wrong unit

Image 4.3 filling the question answer and unit placement

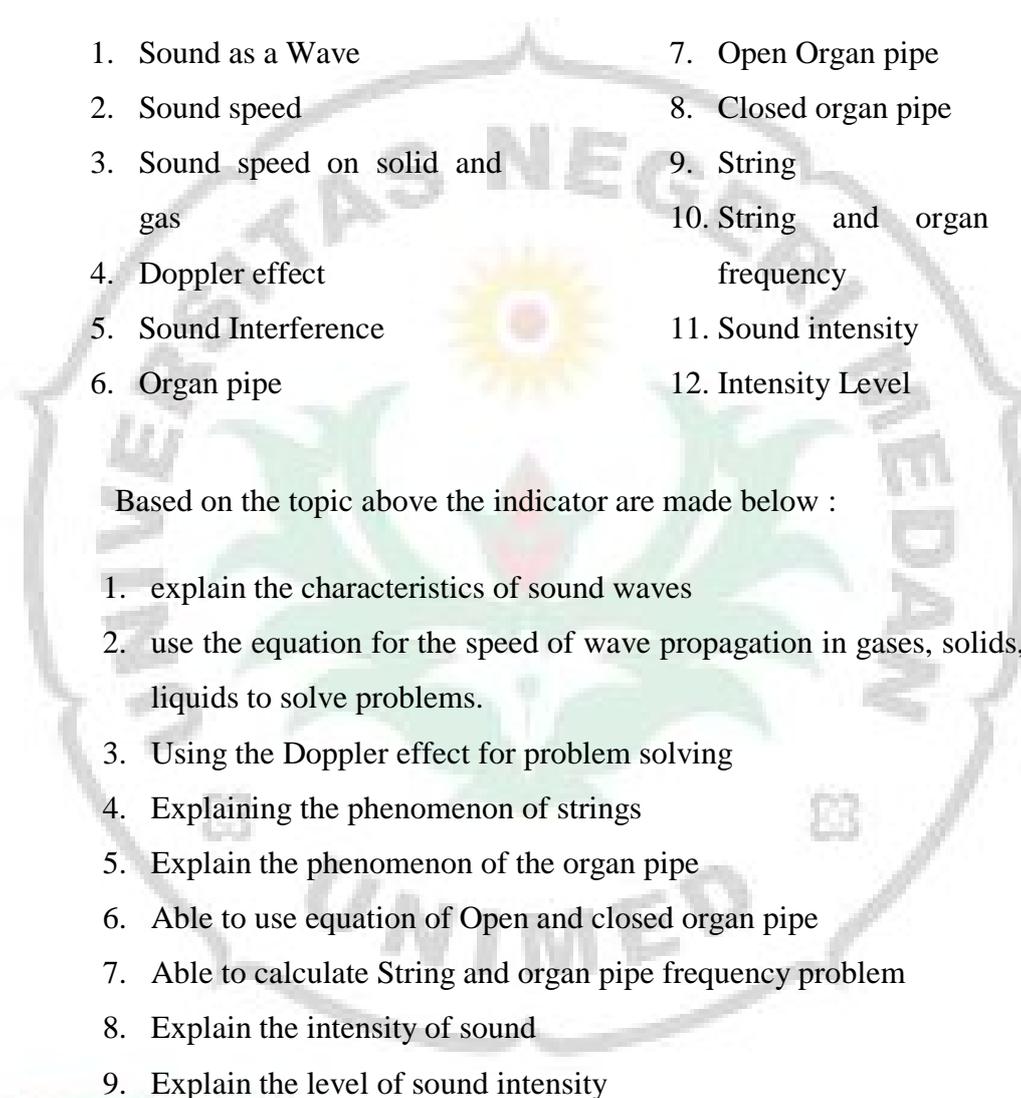
D. Evaluation of analysis

According to analyze above which is Analyzing Learner, Teaching and learning process , and analyzing E-learning we can evaluate that the research can be carried on, researcher evaluate that the learner are expected capable of answering LOTS type question, Critical thinking Skill level of the learner are expected in mediocre or low level. As for evaluation on teaching and learning process the student may thought that teaching process were boring but as they were expected to do question based on book we can use that as a reference that the student are capable of answering problem that were given.

The moodle LMS(Learning Management System) are evaluated as good and able to do the question that were focused on essay question, also automated scoring will make scoring faster and reducing teacher burden when assesing student test.

4.1.2 Design

Design, Contains activities to make designs for products that have been set. According to analyze that were conducted before researcher conclude that we make a problem design according to Lesson plan that is

- 
1. Sound as a Wave
 2. Sound speed
 3. Sound speed on solid and gas
 4. Doppler effect
 5. Sound Interference
 6. Organ pipe
 7. Open Organ pipe
 8. Closed organ pipe
 9. String frequency
 10. String and organ pipe frequency
 11. Sound intensity
 12. Intensity Level

Based on the topic above the indicator are made below :

1. explain the characteristics of sound waves
2. use the equation for the speed of wave propagation in gases, solids, and liquids to solve problems.
3. Using the Doppler effect for problem solving
4. Explaining the phenomenon of strings
5. Explain the phenomenon of the organ pipe
6. Able to use equation of Open and closed organ pipe
7. Able to calculate String and organ pipe frequency problem
8. Explain the intensity of sound
9. Explain the level of sound intensity

Based on the consultation with the design supervisor, the things made by the researchers were good and met the criteria for eligibility, and only needed the addition of a student rubric to assess this.

Rubric assessment must meet the following criteria. In the answer question, it is known that a maximum score of 10% will be obtained, if the wrong unit is given a 10% penalty. Small penalties are given to provide relief for students to answer questions. Teachers must avoid the guilt of punishment and generosity. That is, they must not be too strict or too lenient in their standards of judgment. So

the scoring for the essay is 10% known Question and 90% answers With a 10% score reduction penalty if there is an error in the use of units. The complete Rubric can be seen in Attachment 18.

4.1.3 Development

4.1.3.1. Expert Validation

Critical thinking test instrument on sound and wave material assessed and reviewed by expert lecturers. The following are the results of the validation of test instruments by experts contained in table 4.2 (contained in Attachment 10),According to analyze by 2 expert to test for the feasibility of the HOTS test instrument.

The selection of 7 questions given to students from 20 questions that have been designed is chosen based on the scope of indicators that have been discussed with expert lecturers.The researcher chose the 7 questions to be used as an instrument to assess the level of students' critical thinking skills

Table 4.2 Validation of Critical thinking test instrument on sound and wave material

Question	Validation Score		CVR	CVI	Category
	1	2			
1	4,89	5	1	1	Valid
2	4,84	4,89	1	1	Valid
3	5	5	1	1	Valid
4	4,84	4,89	1	1	Valid
5	5	5	1	1	Valid
6	5	5	1	1	Valid
7	5	5	1	1	Valid

As shown above the question have been chosen carefully before validated by validator, from the 20 question made and chosen 7 from the draft and being validated by expert

Based on the quantitative data described above, it can be seen that the validator has analyzed the questions using a scoring guideline with a scale of 1-5 which is declared valid and feasible to be tested and the results of the qualitative data are as shown in the table below:

Table 4.3 Qualitative expert Assessment

Assessed Aspect	Indicator	suggestion	
		1	2
Material	Questions according to Basic Competence	-	
	The content of the material asked is in accordance with the type of school or grade level	-	
	Questions according to the characteristics of critical thinking skills	-	
Construction	Questions according to the characteristics of critical thinking skills.	-	
	The formulation of the question is clear and concise	-	
	Tables, pictures, graphs, maps, or the like are presented clearly and legibly	-	
	Using question words or commands that require a descriptive answer	-	
Language/Culture	Using language that is in accordance with the rules of the Indonesian language	Pay attention to the details of the language used whether or not it is in accordance with the KBBI	
	Use communicative language		Revise complicated language on some question
	Do not use the local language / taboo	-	

According to expert the test based on the data above, the validator considers the questions valid and can be used for tests after making several revisions, some of these revisions will be described in the table attachment 10.

4.1.3.2 Small scale Instrument trial

After the product development passed expert validation, the next stage carried out by the researcher was the initial trial of the research product, namely a small group trial. Trials must be carried out because the product is still tentative or the product being developed is subject to change.

Researchers must make drafts or product usage guides to make it easier for research subjects to use during research. In terms of the feasibility test of a product, it is necessary to evaluate the effectiveness of the product. For the implementation of trials, things that need to be carefully planned are the instruments needed during the development and testing trials, both instruments for observation and measurement of results.

The trial was conducted on class XI students of SMA Negeri 3 Medan involving 9 students, the researchers got the highest value is 91 and the lowest value is 43, for the average small class value is 64.

Each respondent score can be seen in attachment 1

Table 4.4 Small scale trial Result

Resp	Score
1	44,3
2	43,6
3	57,1
4	41,4
5	80,0
6	70,0
7	72,1

Resp	Score
8	79,3
9	91,4
Average	64,4

A. Item Validaton of small scale trial

The technique used to test the validation of the test is Karl Pearson's product moment correlation statistic, the researchers got valid results from 7 essay questions that were tested on XI grade students of SMA Negeri 3 Medan

Table 4.5 Validity test result

Score	S.1	S. 2	S. 3	S. 4	S. 5	S. 6	S. 7
	0,76	0,76	0,70	0,81	0,86	0,70	-0,078
r _{xy}	Valid	Valid	Valid	Valid	Valid	Valid	Not Valid

According to the result above the question number 1 to 6 are considered valid to be used and question number 7 are to be revised. Item validation calculation can be seen in attachment 1.

B. Small Scale Reliability Test

For the calculation of reliability can be determined by looking at the research instruments used. Because the test used as a research instrument is a Essay problem the formula used is the K-R.20 formula

Reliability test calculation can be found in attachment 2 The amount of data reliability is interpreted according to the criteria

Table 4.6 Instrument Reliability Test result

S^2	3,444444
k	7
$\frac{k}{k-1}$	1,166667
$\sum s^2$	65,11806
S^2	165,9444
	0,708856
r11	High

The instrument is said to be reliable if it is tested repeatedly on the same subject the results will be consistently stable or relatively the same, by using Excel the researcher gets the results of R11 as high (0.7)

C. Difficulty level

Numbers that show the characteristics (hard or easy) of a problem are called difficulty indexes. This difficulty index shows the level of difficulty of the questions. Difficulty level score calculation can be found in attachment 3.

After testing the Critical Thinking Test instrument, the researcher found different levels of difficulty from the 7 questions using Microsoft Excel , the values are as follows:

Tabel. 4.7 Test instrument difficulty level

Question number	Difficulty Level score	Difficulty level Category		
		DL < 0,3	0,3 < DL < 0,7	DL > 0,7
1	0,82			Easy
2	0,73			Easy
3	0,64		Medium	
4	0,61		Medium	
5	0,55		Medium	
6	0,66		Medium	
7	0,47		Medium	

The result are Medium difficulty test. As mentioned in validity test the question number 7 are to be revised as it have a bad test result in every test The small scale test difficulty are considered medium-easy, the question number 1-2 area considered easy as for the question number 3 to 7 are considered medium. This is good but not the best test as we need to have at least 1 hard level question.

D. Discriminating Power Level

Discriminating power is the ability of question to distinguish between High-ability respondents and low-ability respondents, Complete calculation can be found in attachment 4.

Table 4.8 Result of Question Level of Discriminating Power

Test name	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7
Discriminating Power	0,3	0,55	0,3	0,325	0,6	0,375	-0,0625
	Enough	Good	Enough	Enough	Good	Enough	Bad

Based on test above, the large scale trial of Discriminating power is good, as the result are 0.3 to 0.55 , this is a good discriminating power, except question number 7, which have negative Discriminating Power, this question are bound to be revised in large scale trial.

E. Evaluation on Test instrument Development

After conducting the small scale trial Researcher make a revision based on result above

Based on Suggestions from Validator 1

- Fixed correct Doppler effect formula
- question no 1 to explain fishing boats and fish
- Fixed a typo
- Improved the calculation of the score for each question to 10

Validator 2

Mistake in the use of the Doppler effect formula, the Doppler effect formula must be replaced

From the results of the small scale test, it can be seen that question number 7 is invalid, so a new question must be made

Based on the results of the analysis of the small-scale test conducted on 8 students, the researcher concluded that question number 7 was invalid so it was not suitable for large-scale tests.

The researcher decided to change question number 7 so that the indicators and sub-indicators remain valuable

4.1.4 Implementation

Based on the results of the development of the questions above, the researcher implemented the questions developed in the form of an e-learning quiz formula Type question.

4.1.4.1 Question Made on formula Type question

The test instrument that has been developed in the form of an essay is converted into a formula-type question in Moodle. The question will be as follows

Image 4.4 Image of test developed in moodle

Sebuah kapal penangkap ikan mengapung tepat di atas sekumpulan ikan pada hari yang berakut. Tiba tiba, ledakan mesin terjadi pada kapal lain yang berjarak 1,55 km. Berapa lama waktu yang bertalu hingga ledakan terdengar (a) oleh ikan, dan (b) oleh nelayan ($v_{air} = 1560$ m/s dan $v_{udara} = 343$ m/s)

(b)

(a)

1.55 km

a) Dik : d =
1.55km

v_{air} =
1560m/s

v_{udara} =
343m/s

Dit :
a. t_{air} =
0.994s

b. t_{udara} =
4.52s

1.

Frekuensi sirine ambulans ketika diam adalah 1650 Hz. Berapa Frekuensi yang didengar jika bergerak dengan kecepatan 30 m/s (a) mendekati pendengar, dan (b) menjauhi pendengar? ($v_{udara} = 343$ m/s)

Dik :
 $f =$
1650Hz

$v_{sumber} =$
30m/s

$v_{udara} =$
343m/s

Dit :
 $f =$
1794.31Hz

2.

Sebuah peluit anjing memiliki gelombang 23,5 kHz, sementara yang lain (merek X) berfrekuensi yang tidak diketahui. Jika manusia tidak dapat mendengar satu pun peluit saat disuarakan secara terpisah, tetapi suara melengking dengan frekuensi 5000 Hz terjadi saat dimainkan secara bersamaan, perkirakan frekuensi pengoperasian merek X!

Kemungkinan f_x adalah (nilai kecil kemudian besar)

Dan

Maka gelombang f_x adalah

$f_x =$

3.

Sebuah peluit menghasilkan suara dengan metode pipa organa tertutup dengan panjang 7.1 cm. Jika peluit berada di kendaraan yg menjauh dengan kecepatan 25m/s berapa frekuensi nada dasar yg terdengar? ($v_{udara} = 343 \text{ m/s}$)

Dik :

$L =$

$v_s =$

Dit:

$f_1 =$

$f_p =$

4.

Pipa organa memiliki panjang 116 cm. Tentukan nada dasar dan nada atas pertama jika pipa (a) tertutup di salah satu ujungnya, dan (b) terbuka di kedua ujungnya. ($v = 343 \text{ m/s}$)

Dik :

$l =$

Dit :

a. $f_1 =$

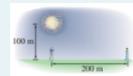
$f_2 =$

b.

$f_1 =$

$f_2 =$

5.



Perhatikan gambar diatas

Sebuah kembang api meledak 100 m di atas tanah, menciptakan bunga api yang berwarna-warni. Seberapa besar perbedaan tingkat suara ledakan untuk orang yang berada tepat di bawah ledakan dibanding orang yang berada pada jarak horizontal 200 m?

$r_1 =$

$r_2 =$

$\beta =$

6.

Sebuah penguat suara berdaya 225W, menghasilkan suara berfrekuensi 1000Hz. kemudian suara turun sebesar 12dB di 15kHz. Berapa daya penguat suara di 15kHz?

Dik:

$P_{1000\text{Hz}} =$

$\beta =$

Dit :

$P_{15\text{kHz}} =$

7.

7 The questions above have gone through the process of developing essay questions which have gone through a modification process so that they can be included in the Moodle type formula.

These questions have an answer with an error of 0.1 so that a value close to the original answer will be considered correct, for example question number 1 which has an answer of 0.994s, but if a student answers 1s then the answer will be considered correct by the system, thus facilitating automatic assessment.

In addition, automatic assessments can also calculate unit changes from kilograms to grams and vice versa, so the answer from 0.997s can also be written as 997ms and is still considered correct by the scoring system.

Table 4.9 Critical thinking Question indicator

No	Indicator of critical thinking	Sub-indicator of critical thinking	No Problem
1	Elementary clarification	1. Focusing Questions	1,2,3,4
		2. Analyze the Arguments	3,5
		3. Ask and answer questions of clarification and a statement that challenged	4,5,6
2	Basis for the decision or basic support	4. Consider whether the source can be trusted or not .	3,4
		5. Observe and consider the results of observations	6
3	Inference	6. Deducing and considering deductions	2,4,5
		7. Induce and consider the results of the induction	4,5
		8. Creating and assessing the value of the consideration	2,3
4	Advanced clarification	9. Identify terms and consider definitions	6,7

No	Indicator of critical thinking	Sub-indicator of critical thinking	No Problem
		10. Identify assumptions	5
5	Strategies and tactics	11. Decide on an action	4
		12. Interact with other people	-

4.1.4.2 Large-scale Instrument trials

The trial was conducted on class XI students of SMA Negeri 3 Medan involving 37 students, the researchers got the highest score of 67 while the lowest was 18 by using Microsoft Excel can be seen in Attachment 5.

4.1.4.3 Validity

The technique used to test the validation of the test is Karl Pearson's product moment correlation statistic, complete calculation can be found in attachment 5, the researchers got valid results from 7 essay questions that were tested on XI grade students of SMA Negeri 3 Medan using Microsoft Excel as follows :

Table 4.10 Intrument Validation Score

Test name	S.1	S. 2	S. 3	S. 4	S. 5	S. 6	S. 7
	0,74	0,76	0,63	0,72	0,77	0,44	0,32
rx _y	Valid						

As shown in table above the intrument is considered valid as they got score of 0.32 to 0.74

4.1.4.4 Reliability

For the calculation of reliability can be determined by looking at the research instruments used. Because the test used as a research instrument is a Essay problem the formula used is the K-R.20 formula

Table 4.11 Reliability test result

Test name	Score
r11	0,72
	High

The test result is considered as high, this result mean that the test is reliable and be able to test through many cases, complete calculation can be found in attachment 5

4.1.4.5 Dificulty Level

After testing the Critical Thinking Test instrument, the researcher found different levels of difficulty from the 7 questions using Microsoft Excel, Complete calculation can be found in in attachment 6, the values are as follows :

Tabel. 4.12 Test instrument difculty level

No	Dificulty Level	Dificulty level Category		
		TK < 0,3	0,3 < TK < 0,7	TK > 0,7
1	0,82			Easy
2	0,73		Medium	
3	0,64		Medium	
4	0,61		Medium	
5	0,55		Medium	
6	0,66		Medium	
7	0,47	Hard		

The questions are divided based on different levels of difficulty, namely easy, medium and difficult. There are 1 easy question, 5 medium questions and 1 difficult question. The questions were considered difficult because many respondents did not answer the questions and only answered what was known and only a few answered the questions.

4.1.4.6 Discriminating Power

The discriminating power is the ability of a question to distinguish between high-ability respondents and low-ability respondents, Complete calculation can be found in attachment 7.

Table 4.13 Result of Question Level of Discriminating Power

Test name	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7
	0,39	0,46	0,35	0,24	0,36	0,15	0,12
Discriminating Power	Enough	Good	Enough	Enough	Enough	Low	Low

Based on test above, the large scale trial of Discriminating power is good, as the result are 0.12 to 0.46 , this is a good discriminating power, different from the small scale trial. The large scale trial improve the test discriminating power

4.1.4.7 Critical thinking level

After passing the analysis and development stage, the critical thinking test is given to students and the level of critical thinking ability is assessed, the results can be seen in the following diagram :

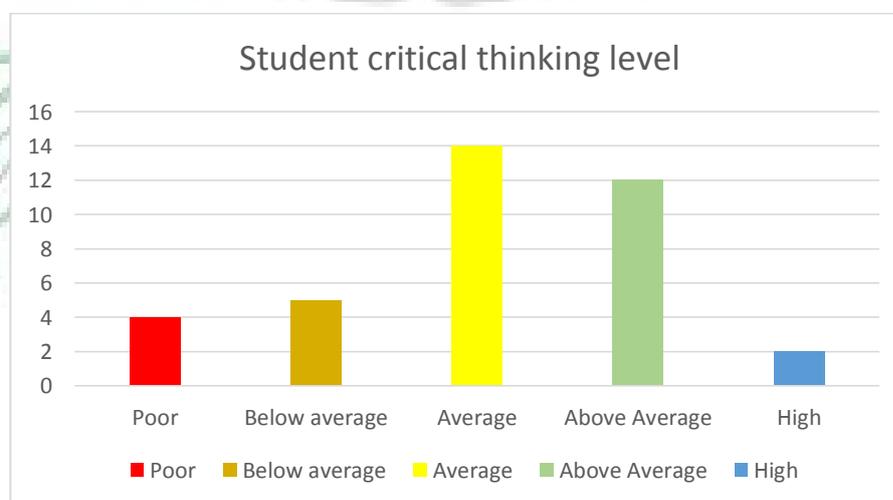


Image 4.5 Critical thinking level result

In the diagram above, there are 4 students with very low critical thinking abilities, 5 students with low critical thinking abilities, 14 students with medium critical thinking abilities, 12 students with high critical thinking abilities and 2 very high critical thinking abilities.

4.1.4.8 Evaluation on Implementation

Based on the analysis conducted by the researcher on the items in the large-scale test, the questions that were tested were valid. Reliability test results also show high reliability results, The level of difficulty also includes moderate, easy and difficult questions. Different power is also considered good and nothing is low.

4.1.4.9 Content validity

Content validity is determined by an expert validator who provides an assessment of whether or not a question instrument is appropriate to be tested, in this HOTS-based instrument research the two expert validators have analyzed each item and provided an assessment with very careful observations, corrected each item, and validated the questions in order to get The results are valid and feasible to be tested on the tenth grade students of SMA Negeri 3 Medan, of the ten questions proposed by the researcher to the 2 expert validators in the revision of 7 essay questions that have been validated by the validators are eligible to be tested. Previously, SMA Negeri 3 Medan had never worked on HOTS-based instruments, still using LOTS-based instruments with book teaching materials that also did not meet the K13 curriculum standards.

4.2 Resesearch discussion

Requirements A good test instrument includes validity, reliability, Discriminating Power and level of difficulty. Item analysis is also needed to examine the test questions in order to obtain a instrument that has adequate and reliable quality. The specific purpose of item analysis is to find good and adequate

items. Thus, the test instrument used was reviewed based on the validity and reliability of the item analysis, the level of difficulty of the instrument's test power.

Based on the results of the validation of the expert team of lecturers, it was found that 7 items developed were declared valid. As for a little input from the expert team of lecturers so that the instruments developed are even better.

Based on the results of the validation using the Karl Pearson product moment correlation formula, it was found that the 7 items developed were declared valid with the presentation for small-scale classes, namely: {0.76 ; 0.76 ; 0.70 ; 0.81 ; 0.86 ; 0.70 ; 0.07}. While the questions developed were declared valid with presentations for large-scale classes, namely: {0.74; 0.76 ; 0.63 ; 0.72 ; 0.77 ; 0.44 ; 0.22 }.

In the aspect of reliability, scores for small-scale classes are in the range: {0.7}, meaning that reliability is in the High category. While the reliability scores obtained from large-scale classes are in the range of {0.72} with reliability being in the high category.

Judging from the aspect of the level of difficulty, it was found that of the 7 questions that were tested on small-scale classes, they were in the range: {0,3; 0.55 ; 0.3 ; 0.32 ; 0.6 ; 0.375 ; 0.03 } . So it was obtained from small-scale classes that 71% of the questions were in the medium category, 29% of the questions were in the easy category and no questions were in the difficult category. While in the large-scale class obtained in the range: {0.71; 0.57 ; 0.57 ; 0.44 ; 0.50 ; 0.5 ; 0.3 } obtained 72% of the questions are in the medium category, 14% of the questions are in the difficult category and 14% of the questions are in the easy category.

Judging from the Discriminating Power of questions, in the small class group, data were obtained with scores in the range of {0.3; 0.55 ; 0.3 ; 0.32 ; 0.6 ; 0.375 ; 0.06 } . So that the data obtained in the small class 57% have Discriminating Power, 28% have good Discriminating Power and 14% have poor

Discriminating Power. While in the large class group, data obtained with scores in the range of {0.39; 0.46 ; 0.35 ; 0.24 ; 0.36 ; 0.15 ; 0.12 }. So that the data obtained in large classes 72% of questions have Discriminating Power, 14% questions have good Discriminating Power and 14% questions have poor Discriminating Power.

In conducting this research, it is undeniable that there are many obstacles experienced by researchers. Some of the obstacles faced by researchers when conducting this research, such as difficulty in doing questions because they forgot the material. So that researchers must review the material before students work on the problem. In addition, another obstacle faced was the difficulty of conducting the class so that students worked on the questions in a calm state and were able to work on the questions correctly. This is caused by the unfamiliarity of students in dealing with and working on *HOTS* questions. So, students have difficulty in understanding the questions and students are not conducive because they always ask about the questions in the questions. Therefore, researchers must guide and lead students in understanding the sentence questions and interpret each question item in the problem so that they can do it correctly and precisely. As well as obstacles that are also experienced by researchers, namely not all students participate and contribute in answering questions according to their own abilities. It is undeniable and unavoidable that there is cooperation between students in working on the *HOTS* Critical thinking questions given. This causes the level of difficulty and distinguishing power of the test instrument to be affected by the similarity of students in answering questions.

4.3 Comparison with other research

After conducting research there are comparison with other research with similar topic.

The critical thinking ability of the Pilot Project Junior High School students in Yogyakarta City is in the very high, high, medium, low and very low

categories, respectively 6.82%, 19.09%, 24.55%, 34.09% and 15.45% . This situation means that the students of the Yogyakarta City Pilot Project Junior High School have critical thinking abilities, mostly in the low and very low categories reaching 49.55%, followed by the high and very high categories 25.91% and the medium category 24.55%. (naomi:2016)

The profile of students' critical thinking skills based on each indicator that with high criteria that is in the aspects of elementary clarification and Basic Support 45 students obtained with a percentage of 54%(Hartanto 2019)

The critical thinking ability of the SMA N 3 Medan City is in the very high, high, medium, low and very low categories, respectively 10.81%, 13.51%, 37.84%, 32.43% and 5.41%



CHAPTER V

CONCLUSION AND SUGGESTION

5.1 Conclusion

The conclusion of this research according to the research result data, Systematic presentation is done according to the research purpose that have been formulated. The conclusion that have been obtained is as follows :

1. Test instrument have been made that based on E-learning on sound material, the test in developed using ADDIE method, where the step include Analyze, Design, Develop, Implement and Evaluate
2. The test instrument that have been developed have fullfilled the requirement of good test instrument include validity and item analysis. Means the test instrument is feasible to test the critical thinking skills on E-learning, and able to train student critical thinking skill.
3. Validity were declared valid with presentations for large-scale classes, namely: {0.74; 0.76 ; 0.63 ; 0.72 ; 0.77 ; 0.44 ; 0.22 }. the reliability scores obtained from large-scale classes are in the range of {0.72} with reliability being in the high category.
4. Dificulty level obtained in the range of: {0.71; 0.57 ; 0.57 ; 0.44 ; 0.50 ; 0.5 ; 0.3 } obtained 72% of the questions are in the medium category, 14% of the questions are in the difficult category and 14% of the questions are in the easy category. As for the Discriminating power data obtained with scores in the range of {0.39; 0.46 ; 0.35 ; 0.24 ; 0.36 ; 0.15 ; 0.12 }. So that the data obtained in large classes 72% of questions have Discriminating Power, 14% questions have good Discriminating Power and 14% questions have poor Discriminating Power.

5. The process of converting essay questions into question type questions in Moodle consists of several steps, namely:
 - a. Move all questions to Moodle
 - b. enter the results and units for each answer
 - c. Determine the value of each Answer and unit error
6. The result of critical thinking test is 9 student with high level thinking skill, 9 with low level thinking skills and 9 with Low level critical thinking skill.

5.2 Suggestion

According to the result and conclusion in this research, as the follow-up in this research there are several suggestion as follow :

1. For further researchers who want to conduct similar research, it is better if the research subjects used are students who have just studied the related material so that students are able to answer based on the results of their understanding of the material and students can be more conducive in working on the questions.
2. When conducting this type of research, further researchers are advised to accompany students when working on questions. This is because the online test are vulnerable to cheating.
3. Students are expected to practice working on Physics problems from HOTS type questions, especially questions with a creative level (C6) and in the form of contextual questions or questions relating to everyday life. This is so students are used to being able to solve various math problems. Students are expected to be accustomed to solving questions in a coherent way from understanding problems, planning solutions, implementing plans, and reviewing the truth of problem solving
4. The research can be further continued by analyzing answer sheet of every answer made.

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ATTACHMENT

Attachment 1

Small scale Validity test table calculation

Nama Depan	Q. 1 /10	Q. 2 /10	Q. 3 /10	Q. 4 /10	Q. 5 /10	Q. 6 /10	Q. 7 /10	Nilai/70
Euodia Pere Gaddrielsie Porie	6	3	3	4	2	3	10	31
Grace Natalia Anggelica	6	3	5	4	2	3	7,5	31
Bagas Prasetyo	6	3	8	6	2	10	5	40
Alifya Iswanti	8	8	3	4	2	4	0	29
Dafa Buchori Lubis	10	10	4	7	6	9	10	56
Aurel Chesya Putri Masayu	10	10	8	6	10	5	0	49
Septian Dwi saputra	10	9	7	4	8	10	2,5	51
Audrey Nikita	8	10	10	10	9	6	2,5	56
Aryo Togian H Sitorus	10	10	10	10	9	10	5	64
	74	66	58	55	50	60	43	406
rx_{xy}	0,76	0,76	0,70	0,81	0,86	0,70	-0,078	
	Valid	Valid	Valid	Valid	Valid	Valid	Not Valid	

Attachment 2
Table of Small scale reliability test

Nama Depan	Q. 1 /10,000	Q. 2 /10,000	Q. 3 /10,000	Q. 4 /10,000	Q. 5 /10,000	Q. 6 /10,000	Q. 7 /10,000	Nilai/70,000
Euodia Pere Gaddrielsie Porie	6,00	3,00	3,00	4,00	2,00	3,00	10,00	31,00
Grace Natalia Anggelica	6,00	3,00	5,00	4,00	2,00	3,00	7,50	31,00
Bagas Prasetyo	6,00	3,00	8,00	6,00	2,00	10,00	5,00	40,00
Alifya Iswanti	8,00	8,00	3,00	4,00	2,00	4,00	0,00	29,00
Dafa Buchori Lubis	10,00	10,00	4,00	7,00	6,00	9,00	10,00	56,00
Aurel Chesya Putri Masayu	10,00	10,00	8,00	6,00	10,00	5,00	0,00	49,00
Septian Dwi saputra	10,00	9,00	7,00	4,00	8,00	10,00	2,50	51,00
Audrey Nikita	8,00	10,00	10,00	10,00	9,00	6,00	2,50	56,00
Aryo Togian H Sitorus	10,00	10,00	10,00	10,00	9,00	10,00	5,00	64,00
	74,00	66,00	58,00	55,00	50,00	60,00	43,00	406,00
	0,76	0,77	0,71	0,81	0,86	0,71	-0,08	
rxy	Valid	Valid	Valid	Sangat Valid	Sangat Valid	Valid	Tidak Valid	

s^2	3,44	11,00	7,78	6,11	12,53	9,50	14,76
k	7,00						
k/k-1	1,17						
$\sum s^2$	65,12						
s^2	165,94						
	0,71	0,71	0,71	0,71	0,71	0,71	0,71
r11	High	High	High	High	High	High	High

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Attachment 3

Table of small scale difficulty level

Nama Depan	Q . 1 /10	Q . 2 /10	Q . 3 /10	Q . 4 /10	Q . 5 /10	Q . 6 /10	Q . 7 /10	Nil ai/70
Euodia Pere Gaddrielsie Porie	6	3	3	4	2	3	10	31
Grace Natalia Anggelica	6	3	5	4	2	3	7,5	31
Bagas Prasetyo	6	3	8	6	2	10	5	40
Alifya Iswanti	8	8	3	4	2	4	0	29
Dafa Buchori Lubis	10	10	4	7	6	9	10	56
Aurel Chesya Putri Masayu	10	10	8	6	10	5	0	49
Septian Dwi saputra	10	9	7	4	8	10	2,5	51
Audrey Nikita	8	10	10	10	9	6	2,5	56
Aryo Togian H Sitorus	10	10	10	10	9	10	5	64
Total	74	66	58	55	50	60	43	406
Maximum score	90							
Difficulty level	0,82	0,73	0,64	0,61	0,55	0,66	0,47	
	Easy	Easy	Medium	Medium	Medium	Medium	Medium	

Attachment 4

Table of Small scale discriminating power score

Nama Depan	Q. 1 /10	Q. 2 /10	Q. 3 /10	Q. 4 /10	Q. 5 /10	Q. 6 /10	Q. 7 /10	Nilai/70
Alifya Iswanti	8	8	3	4	2	4	0	29
Grace Natalia Anggelica	6	3	5	4	2	3	7,5	31
Euodia Pere Gaddrielsie Porie	6	3	3	4	2	3	10	31
Bagas Prasetyo	6	3	8	6	2	10	5	40
Aurel Chesya Putri Masayu	10	10	8	6	10	5	0	49
Septian Dwi saputra	10	9	7	4	8	10	2,5	51
Audrey Nikita	8	10	10	10	9	6	2,5	56
Dafa Buchori Lubis	10	10	4	7	6	9	10	56
Aryo Togian H Sitorus	10	10	10	10	9	10	5	64
Total	74	66	58	55	50	60	43	406
Xa	10	10	8	8	8	9	5	
Xb	6,5	4,25	4,75	4,5	2	5	5,625	
Discriminating Power	0,3	0,55	0,3	0,325	0,6	0,375	-0,0625	
	Enough	Good	Enough	Enough	Good	Enough	Bad	

Attachment 5
Table of Large scale Reliability test

Nama Responden	S. 1/10	S. 2/10	S. 3/10	S. 4/10	S. 5/10	S. 6/10	S. 7/10	Nilai/70
Resp 1	6	10	10	10	9	1	10	56
Resp 2	10	9,5	7	2	8	10	6	52,5
Resp 3	10	10	10	10	9	10	1	60
Resp 4	10	3	4	6	10	7	9,5	49,5
Resp 5	3	3	2	5	1	10	1	25
Resp 6	3	3	2	5	1	10	9,5	33,5
Resp 7	10	6,5	4	10	5	2,5	9	47
Resp 8	10	10	10	10	10	7	2	59
Resp 9	10	3	4	6	5	2,5	2	32,5
Resp 10	10	10	5	10	10	7	1	53
Resp 11	10	10	8	5,5	10	1	1	45,5
Resp 12	3	2	4	2	2	-	2	15
Resp 13	3	2	4	2	2	2	1	16
Resp 14	3	2	4	2	1	2	1	15
Resp 15	3	2	4	2	2	2	10	25
Resp 16	3	3	4	2	1	1	2	16
Resp 17	3	3	3	2	1	1	2	15
Resp 18	6	10	10	5	8	5	2	46
Resp 19	10	3	4	5,5	8	2,5	2	35
Resp 20	9,3	8,5	4	4	8	6,5	1	41,3
Resp 21	9,7	6,5	10	5	8	10	2	51,2
Resp 22	10	3	4	2	5	4	10	38
Resp 23	10	3	4	2	5	4	1	29
Resp 24	6	5	5	2	6	1	2	27
Resp 25	9,2	3	7	5	3	7	2	36,2
Resp 26	5,7	6,5	4	5	6,5	7	1	35,7
Resp 27	5,7	6,5	3	4,5	7	7	2	35,7
Resp 28	5,7	6,5	4	5	4	7	1	33,2
Resp 29	5,4	6	4	3,5	5	2	1	26,9
Resp 30	3	3	2	2	5	7	1	23
Resp 31	3	3	4	4	1	4	2	21

Nama Responden	S. 1 /10	S. 2 /10	S. 3 /10	S. 4 /10	S. 5 /10	S. 6 /10	S. 7 /10	Nilai/70
Resp 32	10	3	10	2	1	7	1	34
Resp 33	10	10	10	7,5	10	7	2	56,5
Resp 34	10	10	10	2	1	4	2	39
Resp 35	9,3	10	10	2	1	4	1	37,3
Resp 36	9,3	10	10	2	1	4	2	38,3
rata-rata	7,14	5,79	5,77	4,48	5,01	5,02	3	36,10
s ²	9,25	10,29	8,46	7,53	11,46	9,05	9,92	178,91
k	7							
k/k-1	1,16							
$\sum s^2$	65,99							
s ²	173,94							
	0,72							
r11	High							

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Attachment 6

Table of Large scale Difficulty level

Nama Responden	S. 1 /10	S. 2 /10	S. 3 /10	S. 4 /10	S. 5 /10	S. 6 /10	S. 7 /10	Nilai/70
Resp 1	6	10	10	10	9	1	10	56
Resp 2	10	9,5	7	2	8	10	6	52,5
Resp 3	10	10	10	10	9	10	1	60
Resp 4	10	3	4	6	10	7	9,5	49,5
Resp 5	3	3	2	5	1	10	1	25
Resp 6	3	3	2	5	1	10	9,5	33,5
Resp 7	10	6,5	4	10	5	2,5	9	47
Resp 8	10	10	10	10	10	7	2	59
Resp 9	10	3	4	6	5	2,5	2	32,5
Resp 10	10	10	5	10	10	7	1	53
Resp 11	10	10	8	5,5	10	1	1	45,5
Resp 12	3	2	4	2	2	-	2	15
Resp 13	3	2	4	2	2	2	1	16
Resp 14	3	2	4	2	1	2	1	15
Resp 15	3	2	4	2	2	2	10	25
Resp 16	3	3	4	2	1	1	2	16
Resp 17	3	3	3	2	1	1	2	15
Resp 18	6	10	10	5	8	5	2	46
Resp 19	10	3	4	5,5	8	2,5	2	35
Resp 20	9,3	8,5	4	4	8	6,5	1	41,3
Resp 21	9,7	6,5	10	5	8	10	2	51,2
Resp 22	10	3	4	2	5	4	10	38
Resp 23	10	3	4	2	5	4	1	29
Resp 24	6	5	5	2	6	1	2	27
Resp 25	9,2	3	7	5	3	7	2	36,2
Resp 26	5,7	6,5	4	5	6,5	7	1	35,7
Resp 27	5,7	6,5	3	4,5	7	7	2	35,7
Resp 28	5,7	6,5	4	5	4	7	1	33,2
Resp 29	5,4	6	4	3,5	5	2	1	26,9
Resp 30	3	3	2	2	5	7	1	23
Resp 31	3	3	4	4	1	4	2	21

Nama Responden	S. 1 /10	S. 2 /10	S. 3 /10	S. 4 /10	S. 5 /10	S. 6 /10	S. 7 /10	Nilai/70
Resp 32	10	3	10	2	1	7	1	34
Resp 33	10	10	10	7,5	10	7	2	56,5
Resp 34	10	10	10	2	1	4	2	39
Resp 35	9,3	10	10	2	1	4	1	37,3
Resp 36	9,3	10	10	2	1	4	2	38,3
Rata-rata	7,14	5,79	5,77	4,48	5,01	5,02	3	36,10
Maximum score	10							
Difficulty level	0,71	0,57	0,57	0,44	0,50	0,50	0,3	
	mudah	Sedang	Sedang	Sedang	Sedang	Sedang	Sulit	

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Attachment 7

Table of Large scale discriminating power score

Nama Siswa	S. 1 /10	S. 2 /10	S. 3 /10	S. 4 /10	S. 5 /10	S. 6 /10	S. 7 /10	Nilai/70
Resp 12	3	2	4	2	2	-	2	15
Resp 14	3	2	4	2	1	2	1	15
Resp 17	3	3	3	2	1	1	2	15
Resp 13	3	2	4	2	2	2	1	16
Resp 16	3	3	4	2	1	1	2	16
Resp 31	3	3	4	4	1	4	2	21
Resp 30	3	3	2	2	5	7	1	23
Resp 5	3	3	2	5	1	10	1	25
Resp 15	3	2	4	2	2	2	10	25
Resp 29	5,4	6	4	3,5	5	2	1	26,9
Resp 24	6	5	5	2	6	1	2	27
Resp 23	10	3	4	2	5	4	1	29
Resp 9	10	3	4	6	5	2,5	2	32,5
Resp 28	5,7	6,5	4	5	4	7	1	33,2
Resp 6	3	3	2	5	1	10	9,5	33,5
Resp 32	10	3	10	2	1	7	1	34
Resp 19	10	3	4	5,5	8	2,5	2	35
Resp 26	5,7	6,5	4	5	6,5	7	1	35,7
Resp 27	5,7	6,5	3	4,5	7	7	2	35,7
Resp 25	9,2	3	7	5	3	7	2	36,2
Resp 35	9,3	10	10	2	1	4	1	37,3
Resp 22	10	3	4	2	5	4	10	38
Resp 36	9,3	10	10	2	1	4	2	38,3
Resp 34	10	10	10	2	1	4	2	39
Resp 20	9,3	8,5	4	4	8	6,5	1	41,3
Resp 11	10	10	8	5,5	10	1	1	45,5
Resp 18	6	10	10	5	8	5	2	46
Resp 7	10	6,5	4	10	5	2,5	9	47
Resp 4	10	3	4	6	10	7	9,5	49,5
Resp 21	9,7	6,5	10	5	8	10	2	51,2
Resp 2	10	9,5	7	2	8	10	6	52,5

Nama Siswa	S. 1 /10	S. 2 /10	S. 3 /10	S. 4 /10	S. 5 /10	S. 6 /10	S. 7 /10	Nilai/70
Resp 10	10	10	5	10	10	7	1	53
Resp 1	6	10	10	10	9	1	10	56
Resp 33	10	10	10	7,5	10	7	2	56,5
Resp 8	10	10	10	10	10	7	2	59
Resp 3	10	10	10	10	9	10	1	60
rata-rata	7,14	5,79	5,77	4,48	5,01	5,02	3	36,10
Xa	9,13	8,13	7,55	5,69	6,83	5,77	3,63	
Xb	5,15	3,44	4	3,27	3,194	4,23	2,36	
	0,39	0,46	0,35	0,24	0,36	0,15	0,12	
Discriminating Power	Cukup	Baik	Cukup	Cukup	Cukup	Rendah	Rendah	

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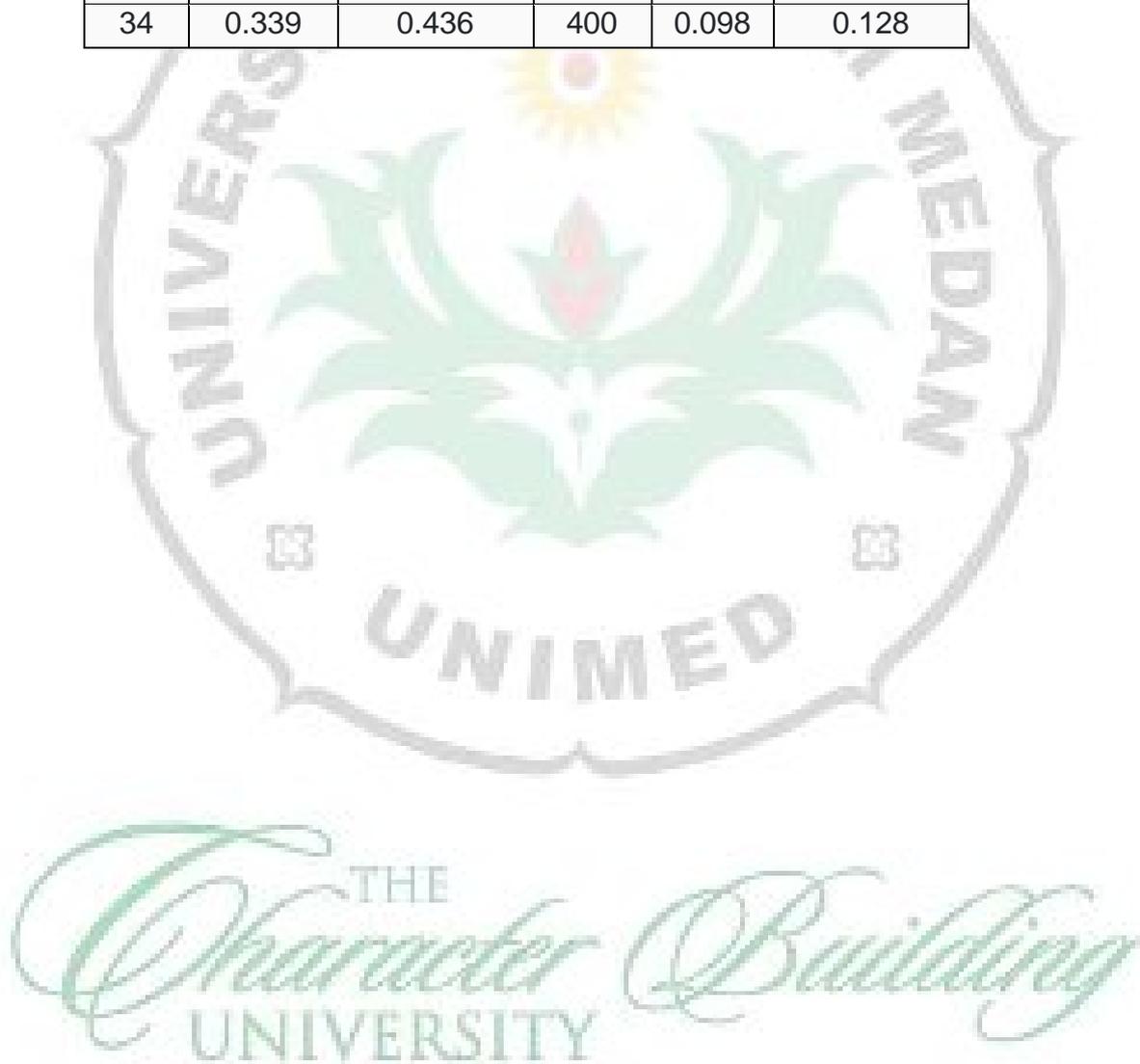
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Attachment 8

R table

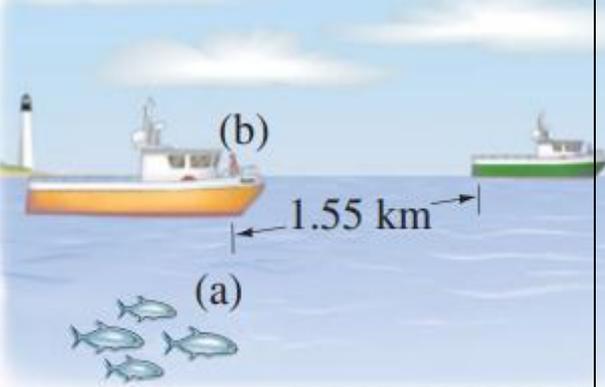
N	The Level of Significance		N	The Level of Significance	
	5%	1%		5%	1%
3	0.997	0.999	35	0.334	0.430
4	0.950	0.990	36	0.329	0.424
5	0.878	0.959	37	0.325	0.418
6	0.811	0.917	38	0.320	0.413
7	0.754	0.874	39	0.316	0.408
8	0.707	0.834	40	0.312	0.403
9	0.666	0.798	41	0.308	0.398
10	0.632	0.765	42	0.304	0.393
11	0.602	0.735	43	0.301	0.389
12	0.576	0.708	44	0.297	0.384
13	0.553	0.684	45	0.294	0.380
14	0.532	0.661	46	0.291	0.376
15	0.514	0.641	47	0.288	0.372
16	0.497	0.623	48	0.284	0.368
17	0.482	0.606	49	0.281	0.364
18	0.468	0.590	50	0.279	0.361
19	0.456	0.575	55	0.266	0.345
20	0.444	0.561	60	0.254	0.330
21	0.433	0.549	65	0.244	0.317
22	0.432	0.537	70	0.235	0.306
23	0.413	0.526	75	0.227	0.296
24	0.404	0.515	80	0.220	0.286
25	0.396	0.505	85	0.213	0.278
26	0.388	0.496	90	0.207	0.267
27	0.381	0.487	95	0.202	0.263
28	0.374	0.478	100	0.195	0.256
29	0.367	0.470	125	0.176	0.230
30	0.361	0.463	150	0.159	0.210

N	The Level of Significance		N	The Level of Significance	
31	0.355	0.456	175	0.148	0.194
32	0.349	0.449	200	0.138	0.181
33	0.344	0.442	300	0.113	0.148
34	0.339	0.436	400	0.098	0.128



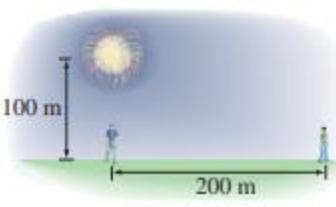
Attachment 9
Test Prototype

No	Soal	Jawaban	Skor
	<p>Hitung panjang gelombang di udara di suhu 20°C untuk suara dalam jangkauan maksimum pendengaran manusia, 20 Hz hingga 20.000 Hz. (b) Berapa panjang gelombang dari gelombang ultrasonik 18-MHz?</p>	<p>a.</p> $\lambda_{20 \text{ Hz}} = \frac{v}{f} = \frac{343 \text{ m/s}}{20 \text{ Hz}} = 17 \text{ m}$ $\lambda_{20 \text{ kHz}} = \frac{v}{f} = \frac{343 \text{ m/s}}{2.0 \times 10^4 \text{ Hz}} = 1.7 \times 10^{-2} \text{ m}$ <p>1.7 cm hingga 17 m;</p> <p>b. $\lambda = \frac{v}{f} = \frac{343 \frac{\text{m}}{\text{s}}}{18 \times 10^6} = 1.9 \times 10^{-5} \text{ m}$</p>	10

No	Soal	Jawaban	Skor
2	<p>Sebuah kapal penangkap ikan di lautan mengapung tepat di atas sekumpulan ikan pada hari yang berkabut. Tiba tiba, ledakan mesin terjadi pada kapal lain yang berjarak 1,55 km. Berapa lama waktu yang berlalu sebelum ledakan terdengar (a) oleh ikan, dan (b) oleh nelayan ($v_{\text{air}} = 1560 \text{ m/s}$ dan $v_{\text{udara}} = 343 \text{ m/s}$)</p> 	<p>(a) 0.994 s; (b) 4.52 s</p> $d = vt \rightarrow t = \frac{d}{v} = \frac{1550\text{m}}{1560\text{m/s}} = 0.994\text{s}$ $d = vt \rightarrow t = \frac{d}{v} = \frac{1550\text{m}}{343\text{m/s}} = 4.52\text{s}$	2
3	<p>Jika dua petasan menghasilkan suara sebesar 85 dB saat ditembakkan secara bersamaan, berapakah intensitas suara jika</p>	$85\text{dB} - 3\text{dB} = 82\text{dB}$	1

No	Soal	Jawaban	Skor
	hanya satu yang meledak?	Intensitas berkurang setengah maka suara berkurang 3 Db	
4	<p>Satu CD player dikatakan memiliki rasio signal-to-noise 82 dB, sedangkan untuk pemutar CD kedua adalah 98 dB. Berapa rasio intensitas sinyal dan kebisingan latar belakang untuk setiap perangkat?</p>	<p>82-dB player: 1.6×10^8</p> <p>98-dB player: 6.3×10^9</p> $82 \text{ dB} = 10 \log \left(\frac{I_{\text{signal}}}{I_{\text{noise}}}_{\text{tape}} \right) \rightarrow \left(\frac{I_{\text{signal}}}{I_{\text{noise}}}_{\text{tape}} \right) = 10^{8.2} = 1.6 \times 10^8$ $98 \text{ dB} = 10 \log \left(\frac{I_{\text{signal}}}{I_{\text{noise}}}_{\text{tape}} \right) \rightarrow \left(\frac{I_{\text{signal}}}{I_{\text{noise}}}_{\text{tape}} \right) = 10^{9.8} = 6.3 \times 10^9$	4
5	<p>Pada konser rock, pengukur dB menunjukkan nilai 130 dB ketika ditempatkan 2,5 m di depan Speaker di atas panggung.</p> <p>(a) Berapakah output daya dari pengeras suara, dengan asumsi</p>	<p>(a) 790 W</p> $\beta = 130 \text{ dB} = 10 \log \frac{I_{2.5m}}{I_0} \rightarrow I_{2.5m} = 10^{13} I_0 = 10^{13} (1.0 \times 10^{-2} \text{ W/m}^2) =$	5

No	Soal	Jawaban	Skor
	<p>penyebaran suara bulat yang seragam dan mengabaikan penyerapan di udara? (b) Seberapa jarak agar tingkat suara menjadi 85 dB?</p>	<p>10 W/m^2</p> $P = IA = 4\pi r^2 I = 4\pi r (2.5\text{m})^2 \left(\frac{10\text{W}}{\text{m}^2}\right) = 785.4 \text{ W} = 790 \text{ W}$ <p>(b) 440 m</p> $\beta = 85 \text{ dB} = 10 \log \frac{I}{I_0} \rightarrow I = 10^{8.5} I_0 = 10^{8.5} \left(10 \times \frac{10^{-12}\text{W}}{\text{m}^2}\right) = 3.162 \times \frac{10^{-4}\text{W}}{\text{m}^2}$ $P = 4\pi r^2 I \rightarrow r = \sqrt{\frac{P}{4\pi I}} = \sqrt{\frac{785.4 \text{ W}}{4\pi (3.162 \times \frac{10^{-4}\text{W}}{\text{m}^2})}} = 444.6\text{m} = 440\text{m}$	

No	Soal	Jawaban	Skor
6	Jika amplitudo gelombang suara dibuat 3,5 kali lebih besar, (a) berapa kali lipat intensitas akan meningkat? (b) Berapa dB kenaikan suaranya?	(a) 12; (b) $\beta = 10 \log \frac{I}{I_0} = 10 \log 12.25 = 10.88 \text{ dB} = 11 \text{ dB}$ 11 dB.	4
7	Sebuah kembang api meledak 100 m di atas tanah, menciptakan bunga api yang berwarna-warni. Seberapa besar tingkat suara ledakan untuk orang yang berada tepat di bawah ledakan daripada orang yang berada pada jarak horizontal 200 m? 	$\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2} = \left[\frac{\sqrt{5}(100\text{m})}{100\text{m}} \right]^2 = 5, \beta = 10 \log \frac{I_1}{I_2} = 10 \log 5 = 6.99 \text{ dB} = 7 \text{ dB}$	2

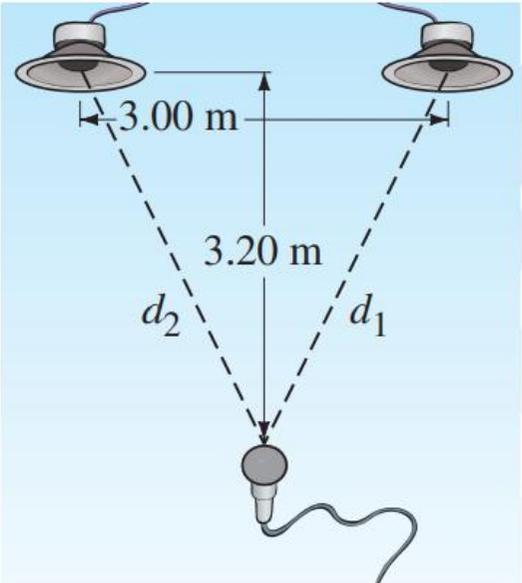
No	Soal	Jawaban	Skor
8	Penguat suara mahal A berdaya 220 W, sedangkan penguat B yang lebih murah memiliki daya 45 W. (a) Perkirakan tingkat suara dalam desibel pada titik 3,5 m dari loudspeaker yang terhubung secara bergantian ke setiap penguat suara. (b) Akankah penguat suara mahal berbunyi dua kali lebih keras dari yang lebih murah?	$I_{220} = \frac{220W}{4\pi(3.5m)^2} = 1.429W/m^2 \quad I_{45} = \frac{45W}{4\pi(3.5m)^2} = 0.292 W/m^2$ $\beta_{220} = 10\log \frac{I_{220}}{I_0} = 10\log \frac{1.429W/m^2}{1.0 \times 10^{-12}W/m^2} = 121.55dB = 122dB$ $\beta_{45} = 10\log \frac{I_{45}}{I_0} = 10\log \frac{0.292 W/m^2}{1.0 \times 10^{-12}W/m^2} = 114.66dB = 115dB$	3
9	Pipa organ memiliki panjang 116 cm. Tentukan nada dasar dan tiga nada tambahan pertama jika pipa (a) tertutup di salah satu ujungnya, dan (b) terbuka di kedua ujungnya.	$f_n = \frac{nv}{4l} = nf_1, n = 1,3,5, \dots \rightarrow f_1 = \frac{v}{4l} = \frac{343m/s}{4(1.16m)} = 73.9Hz$ $f_3 = 3f_1 = 222Hz \quad f_5 = 5f_1 = 370Hz \quad f_7 = 7f_1 = 517Hz$ $f = \frac{nv}{2l} = nf_1, n = 1,3,5, \dots$	2
10	Sebuah peluit anjing memiliki gelombang 23,5 kHz, sementara yang lain (merek X) berfrekuensi yang tidak diketahui. Jika manusia tidak dapat mendengar satu pun peluit saat disuarakan secara terpisah, tetapi suara melengking dengan frekuensi 5000 Hz terjadi saat dimainkan secara bersamaan, perkirakan	Gelombang 5kHz muncul setelah terjadinya pelayangan dari kedua gelombang, sehingga pluit x harus 5kHz lebih tinggi atau lebih rendah dari pluit bermerk.	3

No	Soal	Jawaban	Skor
	frekuensi pengoperasian merek X	<p>Jadi ada 2 kemungkinan yaitu $23.5+5 = 28.5$ kHz atau $23.5-5 = 18.5$ kHz</p> <p>Tapi kedua pluit tidak dapat didengar sehingga pluit tidak bisa bergelombang</p> <p>18.5</p> <p>Maka pluit x beroperasi dengan gelombang 23.5</p>	
11	<p>Frekuensi sirine ambulan ketika diam adalah 1650 Hz. Berapa Frekuensi yang didengar jika bergerak dengan kecepatan 30 m/s (a) ke arah truk pemadam kebakaran, dan (b) menjauh darinya?</p>	$f' = \left(1 + \frac{v_{obs}}{v_{snd}}\right) f = \left(1 + \frac{\frac{30.0m}{s}}{343m/s}\right) (1650Hz) = 1790Hz$ $f' = \left(1 + \frac{v_{obs}}{v_{snd}}\right) f = \left(1 - \frac{30.0m/s}{343m/s}\right) (1650Hz) = 1510Hz$	2

No	Soal	Jawaban	Skor
12	Kelelawar yg diam memancarkan gelombang ultrasonic dengan frekuensi 50kHz dan menerima pantulan dari benda yg bergerak menjauh. Berapa frekuensi gelombang yg diterima apabila benda tersebut bergerak dengan kecepatan 27.5 m/s?	$f'_{object} = f'_{bat} \left(1 - \frac{v_{object}}{v_{snd}}\right)$ $f'_{bat} = \frac{f'_{object}}{\left(1 - \frac{v_{object}}{v_{snd}}\right)} = f'_{bat} \frac{\left(1 - \frac{v_{object}}{v_{snd}}\right)}{\left(1 + \frac{v_{object}}{v_{snd}}\right)} = f'_{bat} = \frac{(v_{snd} - v_{object})}{(v_{snd} + v_{object})}$ $= (5.00 \times 10^4 \text{Hz}) \left(\frac{343 \text{m/s} - 27.0 \text{m/s}}{343 \text{m/s} + 27.0 \text{m/s}}\right) = 4.27 \times 10^4 \text{Hz}$	2
13	Sebuah speaker diletakkan sejauh 8.5 m di luar ruangan menghasilkan suara sebesar 115dB. Berapa daya speaker jika suara menyebar ke segala arah?	$115 \text{dB} = 10 \log \frac{1}{10} \rightarrow i = 10^{11.5} (1.0 \times 10^{-12} \text{W/m}^2) = 3.162 \times 10^{-1} \text{W/m}^2$ $I = \frac{P}{A} = \frac{P}{4\pi r^2} \rightarrow P = 4\pi r^2 I = 4\pi (8.25 \text{m})^2 (3.162 \times 10^{-1} \text{W/m}^2) = 270.45 \text{W}$ $= 270 \text{W}$	3

No	Soal	Jawaban	Skor
14	Sebuah pengeras suara berdaya 225W di frekuensi 1000Hz. Dan suara turun sebesar 12dB di 15kHz. Berapa daya pengeras suara di 15kHz?	$-12\text{dB} = 10 \log \frac{P_{15\text{kHz}}}{225\text{W}} \rightarrow -1.2 = \log \frac{P_{15\text{kHz}}}{225\text{W}} \rightarrow 10^{-1.2}$ $= \frac{P_{15\text{kHz}}}{225\text{W}} \rightarrow$ $P_{15\text{kHz}} = (225\text{W})(10^{-1.2}) = 14\text{W}$	2
15	Sebuah peluit menghasilkan suara dengan metode pipa organa tertutup dengan panjang 7.1 cm. Jika pluit berada di kendaraan yg menjauh dengan kecepatan 25m/s berapa frekuensi yg terdengar?	$f_1 = \frac{v_{snd}}{4l}$ $f' = \frac{f'_{object}}{\left(1 + \frac{v_{source}}{v_{snd}}\right)} = \frac{v_{snd}}{4l \left(1 + \frac{v_{source}}{v_{snd}}\right)} = \frac{\frac{343\text{m}}{s}}{4(7.10 \times 10^{-2}\text{m}) \left(1 + \frac{25\text{m}}{\frac{343\text{m}}{s}}\right)}$ $= 1127\text{Hz} = 1130\text{Hz}$	3
16	Seekor nyamuk sejauh 5m memngeluarkan suara diambang batas pendengaran manusia (0 dB), berapa besar suara apabi/ada 200 ekornyamuk terbang bersamaan?	$I = 100I_0 \beta = 10 \log \frac{200I_0}{I_0} = 10 \log 200 = 23\text{dB}$	2

No	Soal	Jawaban	Skor
17	2 buah amplifier masing masing punya daya 120W dan 75 W, berapa perbedaan tingkat suara(dB) bila keduanya dinyalakan dengan suara maksimum?	$\beta = 10 \log \frac{P_{120}}{P_{75}} = 10 \log \frac{120W}{75W} = 2dB$	1
18	Seorang nelayan memukul permukaan air laut kemudian menerima gelombang balik dari dasar laut dalam 2s. Berapa kedalaman laut apabila kecepatan suara di air laut adalah 1520m/s?	$d = vt = (1560m/s)(1.0s) = 1560m$	1
19	Hitunglah frekuensi layangan dari nada C (262 Hz) dan C# (277 Hz) ketika dimainkan secara bersamaan!	$277Hz - 262Hz = 15Hz$ $\frac{1}{4}(15Hz) = 3.75Hz = 3.8Hz$	1
20	Dua loudspeaker diletakkan bersebelahan sejauh 3m seperti gambar dibawah. Keduanya mengeluarkan suara 474-Hz yang se fase. Sebuah microphone diletakkan 3.2m dari titik tengah	$d_2 - d_1 = \frac{1}{2}\lambda \rightarrow$	5

No	Soal	Jawaban	Skor
	<p>kedua speaker dimana intensitas suara maximum direkam.</p> <p>a) berapa jauh microphone digerakkan ke kanan untuk mendapat suara minimum pertama?</p> <p>b) jika speaker di pasang ulang sehingga kedua suara menjadi tepat tidak sefase. Dimana posisi suara maximum dan minimum?</p> 	$\sqrt{\left(\frac{1}{2}d + x\right)^2 + l^2} - \sqrt{\left(\frac{1}{2}d - x\right)^2 + l^2} = \frac{1}{2}\lambda \rightarrow$ $\sqrt{\left(\frac{1}{2}d + x\right)^2 + l^2} = \frac{1}{2}\lambda + \sqrt{\left(\frac{1}{2}d - x\right)^2 + l^2}$ $\left(\frac{1}{2}d + x\right)^2 + l^2 = \frac{1}{4}\lambda^2 + 2\left(\frac{1}{2}\lambda\right)\sqrt{\left(\frac{1}{2}d - x\right)^2 + l^2} + \left(\frac{1}{2}d - x\right)^2 + l^2$ $2dx - \frac{1}{4}\lambda^2 = \lambda\sqrt{\left(\frac{1}{2}d - x\right)^2 + l^2} \rightarrow 4d^2x^2 - 2(2dx)\frac{1}{4}\lambda^2 + \frac{1}{16}\lambda^4$ $= \lambda^2\left[\left(\frac{1}{2}d - x\right)^2 + l^2\right]$ $4d^2x^2 - dx\lambda^2 + \frac{1}{16}\lambda^4 = \frac{1}{4}d^2\lambda^2 + d^2l^2 \rightarrow x = \lambda\sqrt{\frac{\left(\frac{1}{4}d^2 + l^2 - \frac{1}{16}\lambda^2\right)}{4d^2 - \lambda^2}}$	

No	Soal	Jawaban	Skor
54		$d = 3.00m \quad l = 3.20m \quad \lambda = \frac{v}{f} = \left(\frac{343m}{s}\right)(474Hz) = 0.7236$ $x = (0.7236 m) \sqrt{\frac{\left(\frac{1}{4}(3.00m)^2 + (3.20m)^2 - \frac{1}{16}0.7236^2\right)}{4(3.00m)^2 - (0.7236 m)^2}} = 0.429m$	
Total Skor			49

e	5	5	1	5	5	1	5	5	1	5	5	1	5	5	1	5	5	1	5	5	1
f	4	5	1	4	5	1	5	5	1	4	5	1	5	5	1	5	5	1	5	5	1
g	5	5	1	5	5	1	5	5	1	5	5	1	5	5	1	5	5	1	5	5	1
CVI			1			1			1			1			1			1			1
Description	Valid		Valid																		

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**PEMERINTAH PROVINSI SUMATERA UTARA
DINAS PENDIDIKAN
SEKOLAH MENENGAH ATAS NEGERI 3 MEDAN**

Jl. Budi Kemasyarakatan No. 3, Telp. 6619128, Fax. 061-6643316 Medan – 20116
e-mail : mail@smn3medan.sch.id – website : www.sman3medan.sch.id



Nomor : 070 / 2021 / SMAN.3 / 2021
Lamp : -
Hal : Selesai Penelitian

Medan, 20 April 2021

Kepada Yth :
**WAKIL DEKAN BIDANG AKADEMIK
FMIPA- UNIMED**
di -
Tempat

Dengan hormat, berdasarkan Surat dari an. Dekan, Wakil Dekan Bidang Akademik, Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Negeri Medan. Nomor : 3759/UN33.4.1/PG/2020, tanggal 11 Nopember 2020, Perihal : Izin Melaksanakan Penelitian. Kepala SMA Negeri 3 Medan, Kecamatan Medan Barat, Kota Medan, Provinsi Sumatera Utara dengan ini menerangkan bahwa nama yang tersebut dibawah ini :

Nama : **TUMPAL LEONARDO H SINURAT**
NIM : 4163121018
Program Studi : S-1 Pendidikan Fisika Bilingual
Judul Penelitian : *“ Development of E-Learning Based Test Instrument to Asses Critical Thinking Skills on Sound Material. “*

Benar telah Selesai melakukan Penelitian di Lingkungan SMA Negeri 3 Medan terhitung mulai dari tanggal 22 Februari s/d 17 April 2021.

Demikian Surat Keterangan Selesai Penelitian ini diperbuat, agar dapat dipergunakan seperlunya.



PEYSAHARA S.Pd M.SI
Pemula TK 1
NIB 19720312 199702 2 002



PEMERINTAH PROVINSI SUMATERA UTARA
DINAS PENDIDIKAN

Jalan Teuku Cik Ditiro No. 1-D Telepon (061) 4537828, Fax (061) 4537828
Website : <http://www.disdik.sumutprov.go.id> E-mail : disdiksu@sumutprov.go.id
MEDAN

Medan, 04 Desember 2020

Nomor : 071/9966/Subbag Umum XI/2020
Sifat : Biasa
Lampiran : -
Hal : Izin Penelitian

Kepada Yth :
Wakil Dekan Bidang Akademik
FMIPA Universitas Negeri Medan
Jl. Willem Iskandar Psr V
Medan

Menindaklanjuti surat Wakil Dekan Bidang Akademik FMIPA Universitas Negeri Medan No. 3759/UN.33.4.1/LT/2020 tanggal 11 Nopember 2020 tentang Izin Penelitian dengan ini kami sampaikan bahwa pada prinsipnya kami memberikan izin penelitian kepada Mahasiswa/i dibawah ini :

Nama : TUMPAL LEONARDO H SINURAT
NIM : 4163121018
Jurusan : Pendidikan Fisika Bilingual
Program Studi : Pendidikan Fisika S1 Bilingual
Tujuan : SMA Negeri 3 Medan
Judul Penelitian : Development of E-Learning Based Test Untuk Mengetahui Efektivitas Penggunaan Soal to Asses Critical Thinking Skills on Sound Me

Adapun ketentuan untuk melaksanakan penelitian dimaksud adalah sebagai berikut:

1. **Tidak mengganggu** proses belajar mengajar di sekolah;
2. **Tidak membebankan biaya apapun** kepada Sekolah dan Siswa;
3. Setelah selesai melaksanakan penelitian, diharapkan melaporkan hasil penelitian tersebut kepada Dinas Pendidikan Provinsi Sumatera Utara dan Kepala Bidang Pembinaan Sekolah Menengah Atas.

Demikian disampaikan atas perhatian dan kerjasamanya yang diucapkan terima kasih.

a.n. KEPALA DINAS PENDIDIKAN
PROVINSI SUMATERA UTARA
Sekretaris

Drs. ALFIAN HUTAURUK, M.Pd.
Pembina Utama Muda
NIP.196912211994121001

Tembusan :

1. Kepala Dinas Pendidikan Provinsi Sumatera Utara (sebagai laporan).
2. Kepala Cabang Dinas Pendidikan Kab/Kota
3. Kepala SMA Tujuan
4. Yang bersangkutan
5. Arsip



KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
UNIVERSITAS NEGERI MEDAN
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN
Jl. Willem Iskandar Psr V - Medan Estate, Kotak Pos No. 1589 Medan 202
Laman : fmipa.unimed.ac.id

Nomor : 3759 /UN33.4.1/PG/2020 Medan, 11 No
Lampiran : 1 (satu) berkas Proposal Penelitian
Perihal : Izin Melaksanakan Penelitian

Yth. Kepala SMA Negeri 3 Medan
di
Tempat

Bersama ini kami mohon dengan hormat bantuan Saudara agar dapat memberikan izin
Penelitian di instansi yang Saudara pimpin kepada mahasiswa kami tersebut di bawah ini

Nama : Tumpal Leonardo H Sinurat
NIM : 4163121018
Program Studi : S-1 Pendidikan Fisika Bilingual
Dosen Pembimbing : Sabani, S.Pd., M.Si.
Judul Penelitian : Development of E-Learning Based Test Instrument to A
Thinking Skills on Sound Material

Perlu diketahui bahwa kegiatan ini dilaksanakan untuk memperoleh data yang akan digu
penyusunan skripsi mahasiswa tersebut guna memenuhi salah satu syarat memperoleh
Pendidikan (S.Pd) di FMIPA Unimed.

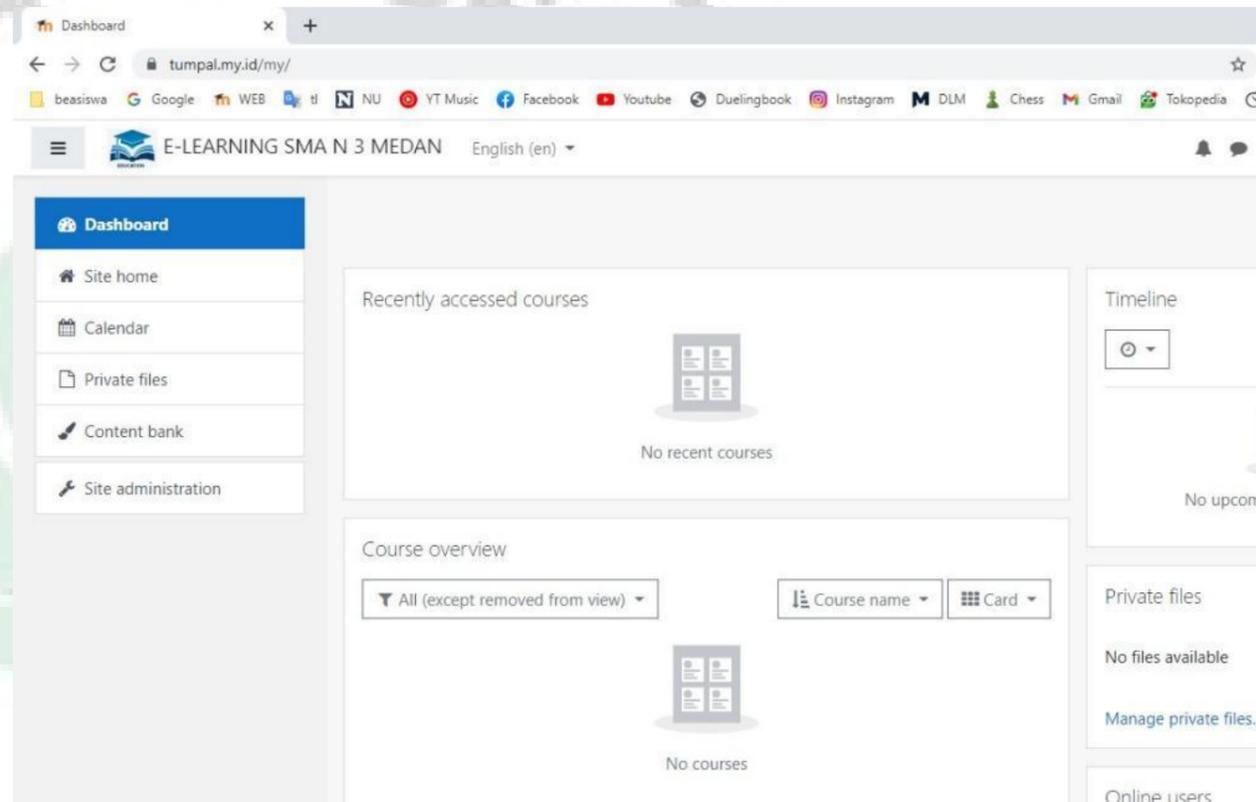
Demikian kami sampaikan, atas perhatian dan kerja sama yang baik diucapkan terima ka



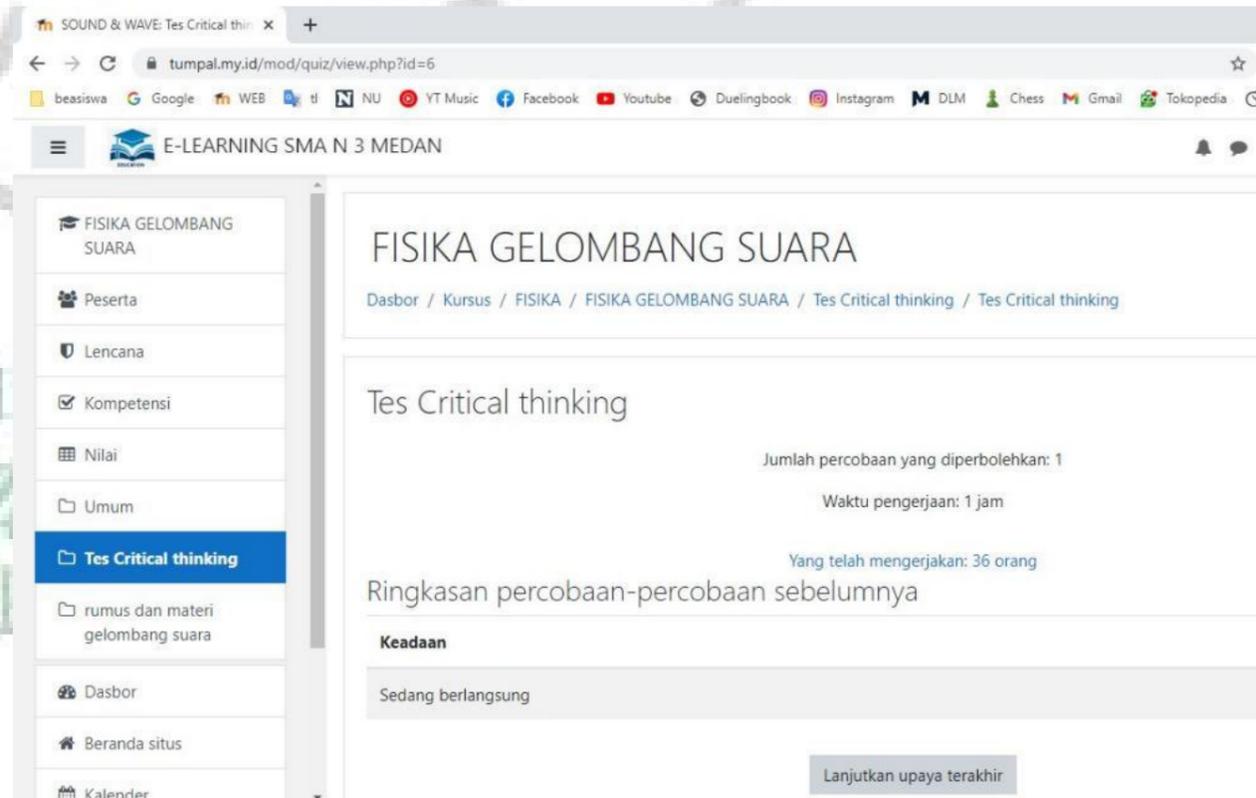
an Dekan,
Wakil Dekan Bidang Akademik

Prof. Dr. Herbert Sipahutar, M.S.,
NIP. 19610626198710 1 001

Attachment 14
Moodle Front page



This screenshot shows the Moodle front page dashboard for 'E-LEARNING SMA N 3 MEDAN'. The browser address bar shows 'tumpal.my.id/my/'. The dashboard includes a left-hand menu with options like 'Dashboard', 'Site home', 'Calendar', 'Private files', 'Content bank', and 'Site administration'. The main content area features 'Recently accessed courses' (No recent courses), 'Course overview' (No courses), and a 'Timeline' section. The top navigation bar includes various social media and utility icons.



This screenshot shows a Moodle quiz page titled 'FISIKA GELOMBANG SUARA'. The browser address bar shows 'tumpal.my.id/mod/quiz/view.php?id=6'. The page includes a left-hand menu with options like 'FISIKA GELOMBANG SUARA', 'Peserta', 'Lencana', 'Kompetensi', 'Nilai', 'Umum', 'Tes Critical thinking', 'rumus dan materi gelombang suara', 'Dasbor', 'Beranda situs', and 'Kalender'. The main content area displays the quiz title, breadcrumb navigation, and quiz details: 'Tes Critical thinking', 'Jumlah percobaan yang diperbolehkan: 1', 'Waktu pengerjaan: 1 jam', and 'Yang telah mengerjakan: 36 orang'. A 'Kedaaan' section shows 'Sedang berlangsung' and a 'Lanjutkan upaya terakhir' button.

Realtime Test monitoring using moodle

Kupu Kupu Malam - YouTube | What Is A Totally Wrong Thing T | Soal no 7 baru

tumpal.my.id/mod/quiz/report.php?id=8&mode=overview

E-LEARNING SMA N 3 MEDAN

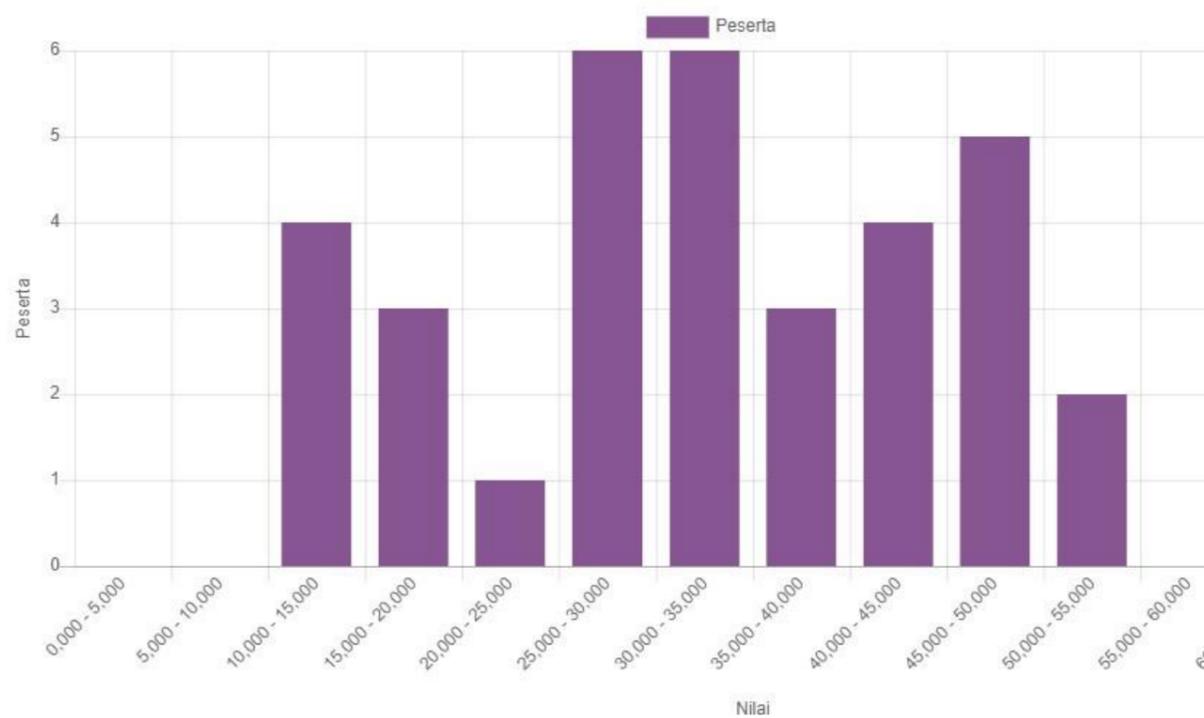
<input checked="" type="checkbox"/>		Euodia Pere Gaddrielsie Porie XI MIA 3 Review attempt	euodia@tumpal.my.id	Selesai	24 Mei 2021 23:15	24 Mei 2021 23:26	11 min 3 detik	7,00	
<input type="checkbox"/>		Rabiah Adawiyah Siregar XI MIA 3 Review attempt	rabiah@tumpal.my.id	Selesai	24 Mei 2021 23:18	24 Mei 2021 23:27	8 min 41 detik	10,00	
<input type="checkbox"/>		Alifya Iswanti XI MIA 3 Review attempt	alifyaiswanti@tumpal.my.id	Selesai	24 Mei 2021 23:19	24 Mei 2021 23:27	8 min 40 detik	10,00	
<input type="checkbox"/>		Dafa Buchori Lubis XI MIA 3 Review attempt	dafa21@tumpal.my.id	Sedang berlangsung	24 Mei 2021 23:23	-	-	-	
<input type="checkbox"/>		Aurel Chesya Putri Masayu XI MIA 3 Review attempt	aurelchesya@tumpal.my.id	Sedang berlangsung	24 Mei 2021 23:23	-	-	-	
<input type="checkbox"/>		Muhammad Raihan XI MIA 3 Review attempt	raihan12@tumpal.my.id	Sedang berlangsung	24 Mei 2021 23:24	-	-	-	
<input type="checkbox"/>		Muhammad Farhan Alwi XI MIA 3 Review attempt	farhanalwi@tumpal.my.id	Sedang berlangsung	24 Mei 2021 23:25	-	-	-	
Rata-rata keseluruhan								8,75 (4)	

Nilai ulang upaya terpilih Hapus upaya terpilih

Jumlah rentang capaian nilai keseluruhan siswa

Moodle automatic grading

Jumlah rentang capaian nilai keseluruhan siswa



Attachment 15

Expert validation sheet 1

LEMBAR VALIDASI SOAL

Judul skripsi : DEVELOPMENT OF TEST INSTRUMENT TO ASSES
CRITICAL THINKING SKILLS ON SOUND
MATERIAL USING E-LEARNING

Nama Mahasiswa : Tumpal Leonardo H. Sinurat

NIM : 4163121018

Program Studi : Pendidikan Fisika Bilingual

Petunjuk :

Berilah nilai 1-5 sesuai dengan penilaian Bapak/Ibu terhadap soal *essay*
(terlampir) dengan skala peniliran berikut :

1. Tidak baik.
2. Kurang baik.
3. Cukup baik.
4. Baik.
5. Sangat baik.



A. Saran

- Perbaiki Rumus ejaan dappet yang benar.
- Perbaiki soal no.1 untuk menjelaskan kapal nelayan ikan.
- Perbaiki salah ketik.
- Perbaiki perhitungan skor setiap soal menjadi 10

B. Simpulan Validator/Penilai

Mohon diisi dengan melingkari jawaban berikut ini sesuai dengan Kesimpulan E

1. Dapat digunakan tanpa revisi
- ② Dapat digunakan dengan revisi revisi

Medan, A


Dr. Nurdin Siregar
NIP. 1958060819

LEMBAR VALIDASI SOAL

Judul skripsi : DEVELOPMENT OF TEST INSTRUMENT TO
CRITICAL THINKING SKILLS ON SOUND
MATERIAL USING E-LEARNING

Nama Mahasiswa : Tumpal Leonardo H. Sinurat

NIM : 4163121018

Program Studi : Pendidikan Fisika Bilingual

Petunjuk :

Berilah nilai 1-5 sesuai dengan penilaian Bapak/Ibu terhadap soal *essay*
(terlampir) dengan skala penilain berikut :

1. Tidak baik.
2. Kurang baik.
3. Cukup baik.
4. Baik.
5. Sangat baik.

A. Saran

Keliru dalam penggunaan rumus efek dopler.
Rumus efek doplerna supaya diganti

B. Simpulan Validator/Penilai

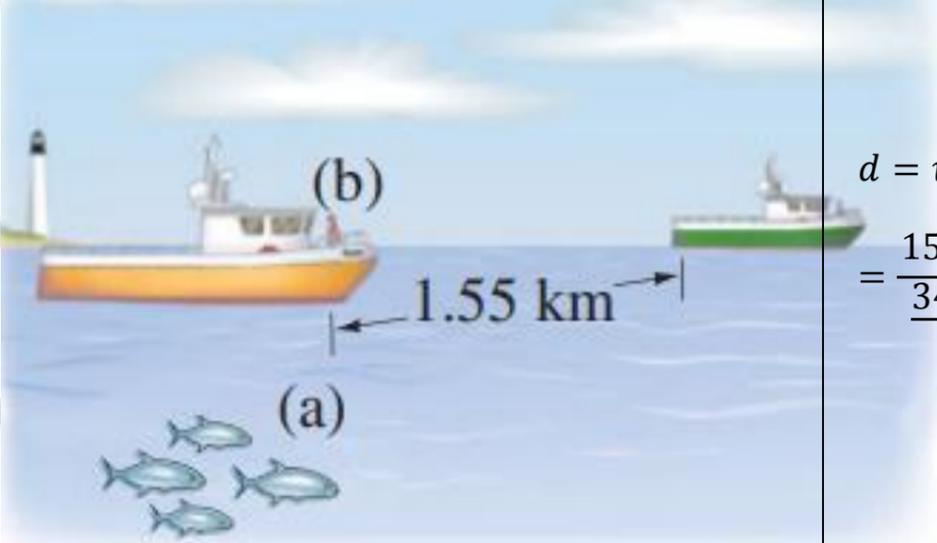
Mohon diisi dengan melingkari jawaban berikut ini sesuai dengan Kesimpulan Bapak

1. Dapat digunakan tanpa revisi
- ② Dapat digunakan dengan revisi revisi

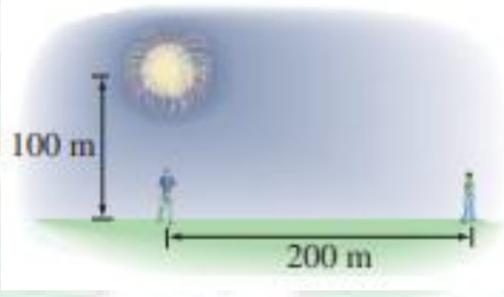
Medan, April
Val



Drs. Juniar Hutahaean.
NIP. 1970071420080

No	Soal	Jawaban
1	<p>Sebuah kapal penangkap ikan mengapung tepat di atas sekumpulan ikan pada hari yang berkabut. Tiba tiba, ledakan mesin terjadi pada kapal lain yang berjarak 1,55 km. Berapa lama waktu yang berlalu hingga ledakan terdengar (a) oleh ikan, dan (b) oleh nelayan ($v_{\text{air}} = 1560 \text{ m/s}$ dan $v_{\text{udara}} = 343 \text{ m/s}$)</p> 	<p>(a) 0.994 s</p> $d = vt \rightarrow t = \frac{d}{v} [1]$ $= \frac{1550\text{m}}{1560\text{m/s}} [2]$ $= 0.994\text{s}[2]$ <p>(b)</p> $d = vt \rightarrow t = \frac{d}{v} [1]$ $= \frac{1550\text{m}}{\frac{343\text{m}}{\text{s}}} [2] = 4.52\text{s}$
2	<p>Frekuensi sirine ambulan ketika diam adalah 1650 Hz. Berapa Frekuensi yang didengar jika bergerak dengan kecepatan 30 m/s (a) mendekati pendengar, dan (b) menjauhi pendengar? ($v_{\text{udara}} = 343 \text{ m/s}$)</p>	$f' = \left(1 + \frac{v_{\text{obs}}}{v_{\text{snd}}}\right) f [1]$ $= \left(1 + \frac{30.0\text{m}}{\frac{343\text{m}}{\text{s}}}\right) (1650\text{Hz}) [2]$ $= 1790\text{Hz}[2]$ $f' = \left(1 + \frac{v_{\text{obs}}}{v_{\text{snd}}}\right) f [1]$ $= \left(1 + \frac{30.0\text{m}}{\frac{343\text{m}}{\text{s}}}\right) (1650\text{Hz}) [2]$

No	Soal	Jawaban
		<p>Jadi ada 2 kemungkinan yaitu $23.5+5 = 28.5 \text{ kHz}$ atau $23.5-5 = 18.5 \text{ kHz}$[3]</p> <p>Tapi kedua pluit tidak dapat didengar manusia sehingga pluit tidak bergelombang 18.5</p> <p>Maka pluit x beroperasi dengan gelombang 23.5[4]</p>
4	<p>Sebuah peluit menghasilkan suara dengan metode pipa organa tertutup dengan panjang 7.1 cm. Jika pluit berada di kendaraan yg menjauh dengan kecepatan 25m/s berapa frekuensi nada dasar yg terdengar?</p>	$f_1 = \frac{v}{4l}$ $f_1 = \frac{343 \text{ m}}{4(7.1)}$ $f_1 = 12.077 \text{ Hz}$ $f_p = \left(\frac{v \pm v_p}{v \pm v_s} \right) f_s$ $f_p = \left(\frac{343 \text{ m/s}}{343 \pm 25 \text{ m/s}} \right) 12.077$ $f_p = 11.256 \text{ Hz}$
5	<p>Pipa organa memiliki panjang 116 cm. Tentukan nada dasar dan nada atas pertama jika pipa (a) tertutup di salah satu ujungnya, dan (b) terbuka di kedua ujungnya.</p>	$f_n = \frac{nl}{4l} = nf_1, n$ $= 1,3,5, \dots \rightarrow f_1 = \frac{v}{4l}$ $\frac{343 \text{ m}}{4l}$

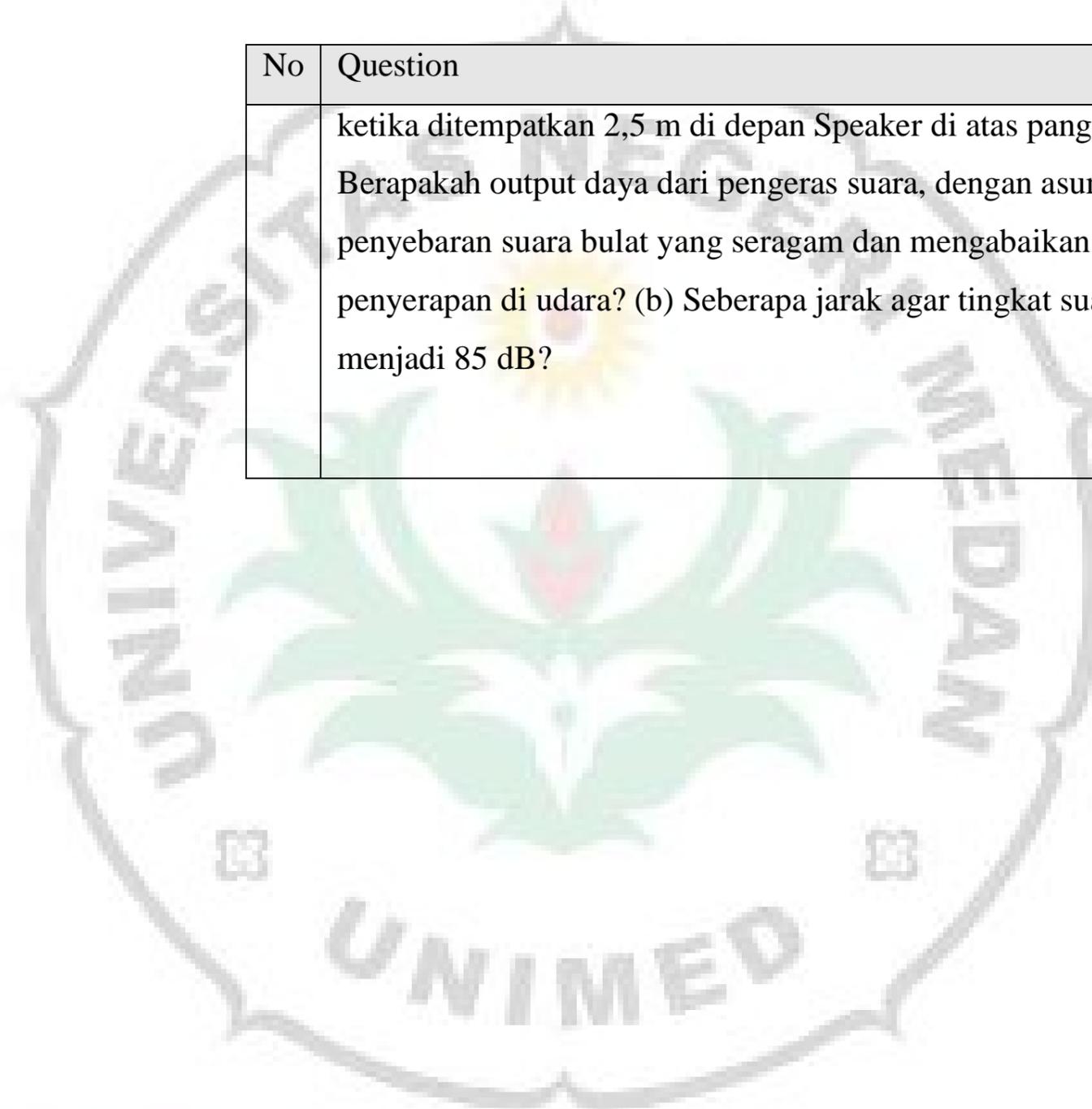
No	Soal	Jawaban
6	<p>Sebuah kembang api meledak 100 m di atas tanah, menciptakan bunga api yang berwarna-warni. Seberapa besar tingkat suara ledakan untuk orang yang berada tepat di bawah ledakan daripada orang yang berada pada jarak horizontal 200 m?</p> 	$\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$ $= \left[\frac{\sqrt{5}(100m)}{100m} \right]^2 [4]$ $= 5, \beta [3]$ $= 10 \log \frac{I_1}{I_2} = 10 \log 5 [1]$ $= 6.99 dB = 7 dB [3]$
7	<p>Pada konser rock, pengukur dB menunjukkan nilai 130 dB ketika ditempatkan 2,5 m di depan Speaker di atas panggung. (a) Berapakah output daya dari pengeras suara, dengan asumsi penyebaran suara bulat yang seragam dan mengabaikan penyerapan di udara? (b) Seberapa jarak agar tingkat suara menjadi 85 dB?</p>	<p>(a) 790 W $\beta = 130 \text{ dB}$</p> $= 10 \log \frac{I_{2.8m}}{I_0} \rightarrow I_{2.8m}$ $= 10^{13} I_0 [1]$ $= 10^{13} \left(1.0 \times \frac{10^{-2} W}{m^2} \right)$ $= 10 W/m^2 [2]$ $P = IA = 4\pi r^2 I [1]$ $= 4\pi r (2.5m)^2 \left(\frac{10W}{m^2} \right)$ $= 785.4 W = 790 W [1]$ <p>(b) 440 m $\beta = 85 \text{ dB} = 10 \log \frac{I}{I_0}$</p> $= 10^{8.5} I_0 [2]$ $= 10^{8.5} \left(10 \times \frac{10^{-12} W}{m^2} \right)$ $= 3.162 \times \frac{10^{-4} W}{m^2} [1]$ $P = 4\pi r^2 I \rightarrow r$

Attachment 18

Rubric Score

No	Question	Answer
1	Sebuah kapal penangkap ikan mengapung tepat di atas sekumpulan ikan pada hari yang berkabut. Tiba tiba, ledakan mesin terjadi pada kapal lain yang berjarak 1,55 km. Berapa lama waktu yang berlalu hingga ledakan terdengar (a) oleh ikan, dan (b) oleh nelayan ($v_{\text{air}} = 1560 \text{ m/s}$ dan $v_{\text{udara}} = 343 \text{ m/s}$)	$d = 1.55 \text{ km}$ $V_{\text{air}} = 1560 \text{ m/s}$ $V_{\text{udara}} = 343 \text{ m/s}$ $t_{\text{air}} = 1560 \text{ m}$ $T_{\text{udara}} = 1560$
2	Frekuensi sirine ambulan ketika diam adalah 1650 Hz. Berapa Frekuensi yang didengar jika bergerak dengan kecepatan 30 m/s (a) mendekati pendengar, dan (b) menjauhi pendengar? ($v_{\text{udara}} = 343 \text{ m/s}$)	$f = 1650 \text{ Hz}$ $V_{\text{sumber}} = 30$ $v_{\text{udara}} = 343$ $f = 1794.31$
3	Sebuah peluit anjing memiliki gelombang 23,5 kHz, sementara yang lain (merek X) berfrekuensi yang tidak diketahui. Jika manusia tidak dapat mendengar satu pun peluit saat disuarakan secara terpisah, tetapi suara melengking dengan frekuensi 5000 Hz terjadi saat dimainkan secara bersamaan, perkiraan frekuensi pengoperasian merek X	$f = 18.5 \text{ kHz}$ 28.5 kHz 28.5 kHz
4	Sebuah peluit menghasilkan suara dengan metode pipa organa tertutup dengan panjang 7.1 cm. Jika pluit berada di kendaraan yg menjauh dengan kecepatan 25m/s berapa frekuensi nada dasar yg terdengar?	$L = 7.1 \text{ cm}$ $V_s = 25 \text{ m/s}$ $f_1 = 12.077$ $f_2 = 11.256$
5	Pipa organa memiliki panjang 116 cm. Tentukan nada dasar dan nada atas pertama jika pipa (a) tertutup di salah satu ujungnya, dan (b) terbuka di kedua ujungnya.	$l = 116 \text{ cm}$ $f_1 = 73.9 \text{ Hz}$ $f_2 = 222 \text{ Hz}$

No	Question	Answer
	ketika ditempatkan 2,5 m di depan Speaker di atas panggung. (a) Berapakah output daya dari penguat suara, dengan asumsi penyebaran suara bulat yang seragam dan mengabaikan penyerapan di udara? (b) Seberapa jauh agar tingkat suara menjadi 85 dB?	$\beta = 12 \text{ dB}$ $P_{15 \text{ kHz}} = 14 \text{ W}$



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