ASEAN Journal for Science Education

Journal homepage: https://ejournal.bumipublikasinusantara.id/index.php/ajsed

How to Make a Cognitive Assessment Instrument in the Merdeka Curriculum for Vocational High School Students: A Case Study of Generating Device Materials About the Stirling Engine

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ABSTRACT

Instruments in education are devices used by teachers to collect data, analyze, measure, and implement various information obtained in learning activities to determine the level of achievement of learning objectives competencies as the scope of competence for each student. However, so far there is still no article that discusses the steps in making instruments especially measuring students' cognitive abilities. Thus, this article was created to present the steps for making an evaluation instrument in measuring students' cognitive abilities. This article presents an example of making a test instrument on the engineering of a power generation device that is applied to a Stirling engine prototype. Here, the instrument questions made are adapted to the implementation of the Merdeka curriculum which is intended for class XI vocational students majoring in electrical engineering. Examples of questions presented are 20 multiple choice questions with varying degrees of difficulty based on Bloom's taxonomy cognitive level (C1-C5). To execute the Merdeka curriculum, it is intended that this article will provide teachers with more resources for creating cognitive assessment tools, particularly in the subject of science.

ARTICLE INFO

Article History:
Submitted/Received 10 May 2023
First Revised 02 Jul 2023
Accepted 07 Aug 2023
First Available online 08 Aug 2023
Publication Date 01 Mar 2024

Keyword:
Assessment,
Cognitive,
Case,
Generating device,
Merdeka curriculum,
Stirling engine,
Student,
Study,
Vocational schools.

1. INTRODUCTION

Learning assessment is a series of activities carried out to evaluate and analyze and measure students' abilities systematically and continuously (Cope & Kalantzis, 2016; Riyanto *et al*., 2021; Pebrianti & Salamah, 2021; Ramdhani & Nandiyanto, 2021; Ekamilasari & Pursitasari, 2021; Isa *et al*., 2021). The goal is that the level of success of a learning process can be seen. The aspects that are assessed in the learning process are the cognitive, affective, and psychomotor aspects of students. The cognitive aspect focuses on the assessment process to measure students' knowledge, while the affective aspect is to measure students' attitudes and personality while psychomotor is to measure students' expertise and skills (Fadillah & Maryanti, 2021; Anggraeni & Maryanti, 2021; Andhini & Shakti, 2021; Sabila *et al*., Ihechu *et al*., 2023; Kantroo *et al*., 2022; Sheng *et al*., 2023; Abulude *et al*., 2023; Irawan, 2021; TThapwiroch *et al*., 2021; Sambudi, *et al*., 2021; Wijaya *et al*., 2022; Mighat *et al*., 2022; Nuhu *et al*., 2023; Andika & Valentina; 2016; Amelia *et al*., 2019; Riza *et al*., 2021; Sabbahi *et al*., 2021; Nandi & Dede, 2022). Learning assessment activities in the educational process must be carried out because, with this assessment process, an educator can see the extent to which the success of the learning process is carried out (Castellanos *et al*., 2011; Pittaway & Edwards, 2012).

The success of a test is determined by the quality of the instrument. Instruments should cover every eventuality and avoid misunderstandings. Therefore, the preparation of evaluation instruments must be correct and mature (Nangle *et al*., 2018). The importance of the rules for preparing evaluation instruments, especially for measuring students' cognitive levels, has made many researchers write ways to make cognitive assessments such as Guyatt *et al*., (2006) present a way of making quick cognitive judgments of students' knowledge structures. Benedict *et al*., (2012) present an international standard for cognitive assessment validation. In addition, there are many other similar studies. Even so, articles about making instruments to evaluate students' cognitive abilities, especially about the Stirling engine, have never been done. In addition, there are still no articles that make instruments for implementing the new curriculum, namely the Merdeka curriculum. The Merdeka curriculum is a curriculum with various intra-curricular learning where the content will be more optimal so that students have enough time to explore concepts and strengthen competence. Teachers have the flexibility to choose various teaching tools so that learning can be adapted to the learning needs and interests of students (Zidan & Qamariah., 2023; Nursaniah, 2023).

Therefore, this article aims to present step-by-step in making students' cognitive evaluation instruments. Here, is an example of making an evaluation instrument in the form of a multiple-choice test about the Stirling engine in the implementation of the independent curriculum. This article was conducted by analyzing the literature on making cognitive questions to measure student knowledge. Hopefully, the article can help teachers in making questions on cognitive assessment, especially its application to the Merdeka curriculum.

2. LITERATURE REVIEW

2.1. Merdeka Curriculum

Merdeka Curriculum is an educational curriculum development program designed and implemented in Indonesia. This program was launched in 2021 by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) to improve the quality of education in Indonesia through a more contextual, inclusive, and student-centered approach. The Merdeka Curriculum offers a new approach to the development of the education curriculum in Indonesia, which previously seemed too rigid and inflexible (Pertiwi & Pusparini, 2021).

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

There are several differences between the independent curriculum and the previous curriculum (curriculum of 2013) (Fathurrahman *et al*., 2022; Nursaniah, 2023):

(i) The curriculum of 2013 design is the main foundation, namely the goals of the National Education System and National Education Standards only, while in the basic framework, the Merdeka curriculum adds the development of a Pancasila student profile to students.
(ii) The curriculum of 2013 implements Lesson Hours (JP) which are regulated weekly, while the Merdeka curriculum implements Lesson Hours (JP) which are regulated annually.
(iii) The curriculum of 2013 regulates the allocation of learning time regularly every week in each semester, while the Merdeka Curriculum can adjust the allocation of learning time flexibly to achieve predetermined lesson hours (JP).
(iv) The curriculum of 2013 further strengthens the implementation of authentic assessment in each subject, while the Independent Curriculum, namely strengthens the implementation of authentic assessment, especially in projects to strengthen the profile of Pancasila students.
(v) The curriculum of 2013 applies an assessment system that is divided into 4 points, namely the assessment of attitudes, knowledge, behavior, and skills, while the Merdeka curriculum prioritizes projects to strengthen the Pancasila profile and intracurricular and extracurricular activities.
(vi) The curriculum of 2013 uses the terms KI and KD, while the independent curriculum uses the terms learning outcomes and learning objectives.
(vii) The curriculum of 2013 does not divide classes, some phases are divided based on educational units. Meanwhile, the independent curriculum divides classes based on learning outcomes for educational units into several phases, namely Foundation Phase (for PAUD), Phase A: grades 1-2 elementary school, Phase B: grades 3-4 elementary school, Phase C: grades 5– 6 elementary school, Phase D: grades 7–9 junior high school; Phase E: class 10 senior high school/vocational school; Phase F: grades 11–12 senior high school/vocational school.

2.2. Instrument

The type of assessment instrument can be adjusted to the aspect to be measured. There are various types of assessments including (Boesen *et al*., 2010).

2.2.1. Writing test

Writing tests are the most common form of testing. There are many kinds of written tests. Based on the form, the written test is divided into two, namely,

(i) Essay questions (description test)

In general, essay questions are questions that require students to answer in the form of describing, explaining, discussing, comparing, giving reasons, and other similar forms according to the demands of the question using their own words and language. Thus, the test requires the ability of students to generalize their ideas through written discussion. thus, the type of essay test is more of a power test. The form of the essay test (description) is divided into three, namely (Maryani *et al*., 2021):

(a) Free questions. The form of questions is directed at free questions and the testee's answers are not limited, depending on the testee's view.
(b) Limited Questions. Questions on certain matters or there are certain restrictions. Restrictions can be seen in terms of scope, point of view of the answers, and indicators.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

(c) Structured questions. It is a form between objective questions and essays. Questions in this form are a series of short answers even though they are open and free of answers.

(ii) Objective questions

This test is newer than the essay test, but this test is widely used in assessing student learning outcomes. This is due, among other things, to the breadth of subject matter that can be achieved in the test and the ease with which it is possible to assess test answers. This test is categorized as always producing the same score even though it assesses different teachers or the same teacher at different times. Test objectives are more categorized in speed tests (Aronowitz et al., 2017). There are four types of objective questions, namely:

(a) True-false, the question is in the form of question sentences containing two possible true-false. Students are asked to determine which sentences are considered true and false.

(b) Matching-test consists of two groups. The first group contains question words, where these words have a mate or partner in the second group.

(c) Fill-in test, students are asked to fill in the blank sentences. Sometimes in the form of stories, important parts are omitted.

(d) Multiple choice. This test provides 3,4,5 alternative answers for each question. For this reason, students are asked to choose the most correct answer from the alternative answers.

2.2.2. Oral test

In simple terms, oral tests are tests that are carried out orally between students and teachers (educators). This test is very useful for testing students on aspects related to communication, this test can also be done individually and in groups. The advantages of oral tests include being able to find out students' abilities directly, both their ability to master the subject matter and their ability to express opinions; There is no opportunity for cheating because students answer directly; The test results can be known to students directly (Chen & Gon, 2011). While the disadvantages of the oral test include the examiner having the opportunity to deviate from the material or teaching materials that are being tested; It is more likely that there will be injustice between students, because of the subjectivity of the assessment; Requires a relatively longer implementation time; and students are less free in expressing opinions (Bani *et al*., 2019).

2.2.3. Assignments

Assignments are when students are given assignments to measure students' abilities to increase student knowledge. Assignments made before the learning process aim to increase student knowledge, and assignments made after the learning process aim to find out how far students understand the material (Ong-Dean *et al*., 2011). The advantages of assignments include knowledge that is understood by students and can last longer because it is possible for students to discover new things when doing assignments given by the teacher; and students have the opportunity to foster development and courage in taking initiative, being responsible and standing alone. The drawback of the assignment is that there is an opportunity to imitate the work of others; sometimes tasks are done by other people without supervision; and there are opportunities for students to work together.

3. METHOD

This article presents the steps for making an instrument to measure student cognitive. The stages of making instruments for measuring cognitive include determining test objectives,

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

arranging test grids, writing questions, and determining scores. This article also presents an example of an instrument developed for generating device material through a class XI Stirling engine prototype at a vocational school majoring in electrical power-generating engineering. The instrument developed in the form of a written test is an objective multiple-choice test. The questions developed were 20 questions. The development of the questions varied based on the cognitive level of Bloom's taxonomy, namely from cognitive level 1 (C1) to cognitive level 5 (C5). The preparation of questions is adjusted to the learning outcomes demanded by the independent curriculum in Indonesia.

4. RESULTS AND DISCUSSION

4.1. Step 1: Determining Test Objectives

The objectives of the test are very important because each objective have a different emphasis. In teaching programs, competency standards are of course the target of learning outcomes. The purpose of this test is to measure the cognitive dimensions of vocational school students for power plant engineering majors in power plant engineering material. Here, students are assessed for their understanding of the prototype of the power generator, namely the Stirling engine.

4.2. Step 2: Arrange Test Grids

After knowing the purpose of the test, then prepare the grid. In preparing the grid several points must be done:

(i) The first step is to determine the competency to be measured. This study uses competence in an independent curriculum. To be able to access the Merdeka curriculum, see the page: guru.kemendikbud.go.id. In the Merdeka curriculum, there are learning outcomes which are learning competencies achieved at the developmental stage, starting from the basic stages of early childhood education. Learning outcomes include a set of skills and a breadth of material presented comprehensively in narrative form. Based on the provisions of the Ministry of Education and Culture, the general achievement of the electricity generation engineering vocational school is at stage F which is used for classes XI and XII. The general achievements and achievements per element for the Electrical Power Generating Engineering major are presented in **Tables 1** and **2**. Here the instruments were made to measure students' cognitive abilities on the achievement elements, namely generating tools.

(ii) After determining the achievements per element. Next, the second step is to formulate indicators. Making indicators must be based on learning outcomes per element. In the Merdeka curriculum, the indicator is the learning objectives presented in the learning objectives flow. The flow of learning objectives is a series of learning objectives that are arranged systematically and logically in all phases and accordance with the learning sequence from the beginning to the end of a phase. In writing the flow of learning objectives there is some information that must be considered, namely identity, elements, learning outcomes, learning objectives, material/content, estimated hours, and Pancasila profiles. There are several steps taken in formulating the flow of learning objectives: (1) analyzing learning outcomes to identify competencies in each element; (2) formulating learning objectives based on competence which must contain knowledge, skills, and content related to the core knowledge/main concepts by taking into account the cognitive bloom level taxonomy; and (3) dividing learning outcomes per element based on class. The flow of Phase F learning objectives for vocational school majoring in Electrical Power Generating Engineering is presented in **Table 3**.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 1. General achievement at phase f for the electrical power generating engineering vocational school.

General achievement	At the end of phase F students have technical competence in power generation consisting of soft skills and hard skills. Thus, they can carry out work in the electricity sector. Students can apply electrical installations for their use (PS); understand the devices and systems of electric power generation; operate and maintain electric machines; operate, maintain instrumentation and maintenance controls; operate, maintain, and test electrical protection machines; install and maintain solar electricity maintenance; and understand and operate cooling and lubricating systems.

Table 2. Achievement per element at phase f for the electrical power generating engineering vocational school.

Achievement per Element	Description
Self-Use Electrical Installation (PS)	Includes the application of regulations and the installation of electrical installations in electrical installation work at power plants with due regard to Electricity Safety (K2) and Occupational Health and Safety (K3).
Generating Device	Covers the concept of energy conversion, types of energy, basic principles in power generation systems, types of turbines, cycles, main and supporting equipment, and symbols of power plant components.
Power Generation Machines	Covers basic concepts (mechanical and electrical), operation and maintenance of electrical equipment (electric motors, generators, transformers, switchgear), and mechanical equipment (pumps, turbines, compressors, valves).
Generator Instrumentation and Control	Covers the basic concepts, operation, and maintenance of sensors and transducers (pressure, flow, temperature, level), DC Power, electromagnetic-based control systems, pneumatic and hydraulic-based actuator systems, PLC (Programmable Logic Control) control systems, DCS (Distributed Control System) and SCADA (Supervisory Control and Data Acquisition).
Protection of Power Plant Machines	Covers basic concepts, types of disturbances and their consequences, types of equipment, operation, maintenance, and protection testing of electrical equipment (for transformers, motors, generators), and protection for mechanical equipment (overspeed, low-level water, vacuum protection, pressure protection).
Solar Power Plant	Covers the concept of energy conversion, technology systems (solar panels, batteries, inverters, system protection, and control), and installation and maintenance of Solar Power Plants.
Cooling and Lubricating System	Covers the concept of thermal energy coating, types, components, working principles of cooling systems, and operation of cooling and lubricating equipment in power plants.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 3. The flow of learning objectives at phase f for electrical power generating engineering vocational schools.

Identity					
Education Level		Vocational School			
Subject		Power Generation Engineering			
Phase		F			
Curriculum		Merdeka			
Class XI					
Element	**Learning achievement**	**Content**	**Learning objectives**	**Lesson Hours**	**Pancasila profile**
Self-Use Electrical Installation (PS)	Includes the application of regulations and the installation of electrical installations in electrical installation work at power plants with due regard to Electricity Safety (K2) and Occupational Health and Safety (K3).	Electrical installation in power plants with attention to safety Electricity (K2) and Safety And Occupational Health (K3).	Students can: 1.1 Understand the application of PUIL for electric power in power plants 1.2 Understand the installation of electrical installations at low voltage 220 to 380 V on the power plant. 1.3 Understand the operation of electricity 1.4 Understand the testing and maintenance of medium voltage electrical installations up to 6kV in power plants	8	Independent, cooperative, and creative.
Generating Device	Covers the concept of energy conversion, types of energy, basic principles in power generation systems, types of turbines, cycles, main and supporting equipment, and symbols of power plant components.	Conversion, principles, types, and sources of energy as well as generating device	Student can: 2.1 Explain the meaning of energy 2.2 Explain the concept of energy conversion in a system 2.3 Explain the types of energy 2.4 Classifying energy sources 2.5 Explain the various types of power plants 2.6 Identify the basic principles in power generation systems 2.7 Explain the working principle of the energy conversion device 2.8 Applying concepts related to the power plant 2.9 Evaluate the work of the power plant 2.10 Distinguish between the various types of energy conversion devices (steam engines, turbines, generators, dynamos, etc.).	8	Independent, cooperative, and creative.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 3 (Continue). The flow of learning objectives at phase f for electrical power generating engineering vocational schools.

Element	Learning achievement	Content	Learning objectives	Lesson Hours	Pancasila profile
Power Generation Machines	Covers basic concepts (mechanical and electrical), operation and maintenance of electrical equipment (electric motors, generators, transformers, switchgear), and mechanical equipment (pumps, turbines, compressors, valves).	The basic concept of a power plant	Student can: 3.1 Understand the operation of electric motors, generators, transformers, and sweat equipment. 3.2 Understand the operation of the equipment mechanics: pumps, turbines, compressors, and valves. 3.3 Understand the maintenance of electric motors, generators, transformers, and sweat gear. 3.4 Understand equipment maintenance mechanics	8	Independent, cooperative, and creative.
Generator Instrumentation and Control	Covers the basic concepts, operation, and maintenance of sensors and transducers (pressure, flow, temperature, level), DC Power, electromagnetic-based control systems, pneumatic and hydraulic-based actuator systems, PLC (Programmable Logic Control) control systems, DCS (Distributed Control System) and SCADA (Supervisory Control and Data Acquisition).	Maintain instrumentation and controls generator system	Student can: 4.1 Understand the operation of the equipment generator instrumentation and control including sensors and transducers, DC Power, based control system electromagnetic, actuator system pneumatic and hydraulic-based systems PLC, DCS and SCADA control 4.2 Understand equipment maintenance generator instrumentation and control (can include: sensors and transducers, DC Power, based control system electromagnetic, actuator system pneumatic and hydraulic based systems PLC, DCS, SCADA control).	10	Independent, critical thinking, cooperative, and creative.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 3 (Continue). The flow of learning objectives at phase f for electrical power generating engineering vocational schools.

Element	Learning achievement	Content	Learning objectives	Lesson Hours	Pancasila profile
			Class XII		
Protection of Power Plant Machines	Covers basic concepts, types of disturbances and their consequences, types of equipment, operation, maintenance, and protection testing of electrical equipment (for transformers, motors, generators), and protection for mechanical equipment (overspeed, low-level water, vacuum protection, pressure protection).	Maintain protection and operation of power generator engines	Student can: 5.1 Understand the protection system and the types of disturbances in generating units' electricity 5.2 Understand the operation of protection electrical equipment (transformers, motors, generators) and mechanical equipment (over speed, low-level water, vacuum protection, pressure protection) 5.3 Understand equipment maintenance protection for electrical equipment (transformer, motors, generators) and equipment mechanics (overspeed, low-level water, vacuum protection, pressure protection). 5.4 Understand testing on protection electrical equipment (transformers, motors, generators) and mechanical equipment (over speed, low-level water, vacuum protection, pressure protection).	10	Independent, critical thinking, cooperative, and creative.
Solar Power Plant	Covers the concept of energy conversion, technology systems (solar panels, batteries, inverters, system protection, and control), and installation and maintenance of Solar Power Plants.	Maintain generators solar electricity	Student can: 6.1 Understanding the application of technology to solar power plants (panel solar, battery, inverter, protection, and system control). 6.2 Understanding the installation of Solar power plant 6.3 Understand equipment maintenance in Solar Power Plants	10	Independent, critical thinking, cooperative, and creative**.**

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 3 (Continue). The flow of learning objectives at phase f for electrical power generating engineering vocational schools.

Element	Learning achievement	Content	Learning objectives	Lesson Hours	Pancasila profile
Cooling and Lubricating System	Covers the concept of thermal energy coating, types, components, working principles of cooling systems, and operation of cooling and lubricating equipment in power plants.	System operation cooling and lubrication	Student can: 7.1 Understand the operation of the system cooler in the power plant electricity 7.2 Understand the operation of the system lubricants for the power plant's electricity.	8	Independent, cooperative, and creative.

4.3. Step 3: Preparations of Questions

After making arrangements, the grid is presented in the flow of learning objectives. The next stage is compiling questions. Based on the results of the preparation of the grid in stage 2, the questions were made in the form of multiple choice as many as 20 questions on generating device material for class XI vocational schools majoring in electrical power generating engineering. The following are the steps taken in compiling multiple-choice questions, namely:

(i) The first step is to make indicator questions. Indicator questions need to be made to describe knowledge because of the achievement of the basic competencies demanded in the curriculum. Making the indicator questions based on the learning objectives that were made late in step 2 by paying attention to the material and the cognitive level of Bloom's taxonomy. In addition, making indicators must include four components, namely ABCD, with A = Audience, B = Behaviour, C = Condition, and D = Degree. Audience (A) is the target or test participant, Behaviour (B) is behavior that must appear or appear in its formulation using operational verbs, condition (C) is giving conditions when measuring student behavior, not when studying, and Degree (D) is the level of success on certain acceptable behaviors. **Table 4** is the compilation of the preparation of question material questions for generating devices. **Table 4** presents the indicators of the questions, one of which is the example in number 1 which states that given the discourse on energy, students are expected to be able to explain the meaning of energy correctly. From the indicators of question number 1, it includes components, namely, A = students, B = expected to be able to explain the meaning of energy, C = given a discourse on energy, and D = correctly.

(ii) After creating the question indicators, the next step is compiling the questions. In compiling questions, it must be based on question indicators and must be following the material. In addition, the answer choices must be homogeneous and logical, which means that all answer choices must come from the same material as the subject matter. For answers must have one correct answer. In addition, in preparing questions the language used must use language that is communicative, clear, and firm. For example, in **Table 4**, sample question number 1, the question indicators are related to the meaning of energy so the questions that are made must be related to energy as well as the answers. To construct another question, the same steps are used.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

4.4. Step 4: Determine the Score

The next step is to determine the score. For determining multiple-choice scores using scoring in a way that each item answered correctly gets a value of one (depending on the weight of the item), so that the total score obtained by students is by counting the number of items answered correctly. Here, there are 20 questions made, so that 1 correct question is given a score of 5 (see **Table 4**). The maximum total score obtained by answering all the questions correctly is 100. The formula for calculating the score is presented in equation (1) (Nandiyanto *et al*., 2022; Ragadhita *et al*., 2023).

$$\text{Score\%} = \frac{score\ obtained\ by\ student}{maximum\ score} \times 100\% \quad (1)$$

Table 4. Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

Educational level			Vocational School	
Major			Power Generation Engineering	
Class			XI	
Curriculum			Merdeka	
Phase			F	
Number of questions			20	
Question Form			Multiple choice	
No	**Indicators**	**Level Cognitive**	**Question**	**Score**
1	Given a discourse on energy, students are expected to be able to explain the meaning of energy correctly	C1	**Pay attention to the discourse below to be able to answer questions no. 1-3!** Energy in nature is a conserved quantity (first law of thermodynamics). Energy can neither be created nor destroyed but can be changed from one form to another. For example, in the phenomenon of boiling water using a kerosene stove, the energy stored in kerosene is converted into fire. Furthermore, the fire is used to heat the water in the pot so that the water is cooked. In this context, heat energy is transferred (fire in the stove) and transformed into motion energy which is indicated by the bubbles of water molecules in the pot so that the water becomes cooked. Changes in the form of heat energy into motion occur due to the transfer of heat energy due to temperature differences. Based on the discourse above, energy is... a. An eternal quantity can change form and can move from one system to another, but the total amount remains b. An eternal quantity can change form, and cannot be transferred from one system to another, but the total amount remains the same c. An eternal quantity can change form, and cannot be transferred from one system to another, but the total amount is not fixed d. An eternal quantity, cannot change its form, and cannot be transferred from one system to another, but the total amount is not fixed	5

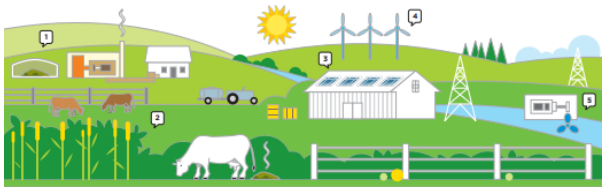
DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 4 (Continue). Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

No	Indicators	Level Cognitive	Question	Score
2	Given a discourse on energy, students are expected to be able to explain the meaning of energy conversion in a system correctly	C1	In the previous discourse, it was said that '...In this context, heat energy (fire in the stove) changes form again into motion energy which is indicated by the bubbles of water molecules in the pot so that the water becomes cooked. Changes in the form of heat energy into motion occur due to the transfer of heat energy due to temperature differences. Based on the discussion above, it can be concluded that when water is heated using fire, there is a change from heat energy to motion energy which is marked by the presence of bubbles. The change of energy from one form to another is called... a. Conduction b. Heat c. Radiation d. Conversion	5
3	Given a discourse on energy, students are expected to be able to explain the meaning of heat in a system correctly	C1	In the previous discourse, it was said that '…In this context, heat energy (fire in the stove) changes form again into motion energy which is indicated by the bubbles of water molecules in the pot so that the water becomes cooked. The change in the form of heat energy into motion occurs due to the transfer of heat energy due to temperature differences … Based on the discourse above it is said that the change in the form of heat energy into motion occurs due to the transfer of heat energy due to temperature differences. The transfer of heat energy due to a temperature difference is called… a. Conduction b. Heat c. Radiation b. Conversion	5
4	Given the discourse, students are expected to be able to explain non-renewable energy sources correctly	C1	**Pay attention to the discourse below to be able to answer question no. 4-5!** In 2010, many countries realized the importance of utilizing renewable energy sources as a substitute for non-renewable energy such as oil, coal, and gas which have had a very damaging impact on the earth. With the depletion of reserves of non-renewable energy sources, the costs of mining them will increase, which will have an impact on increasing the selling price to the public. At the same time, non-renewable energy will release carbon emissions into the atmosphere, which is a major contributor to global warming. In addition, non-renewable energy sources cannot be replaced in a short time. Non-renewable energy sources are not environmentally friendly; because it causes air, water, and soil pollution which has an impact on decreasing health levels and living standards. From the discourse above, which is the correct understanding of non-renewable energy? a. The energy that cannot be replaced in a short time, is not environmentally friendly and is abundant b. The energy that can be replaced in a short time, is not environmentally friendly and is not abundant c. The energy that can be replaced in a short time, is environmentally friendly, and abundant d. The energy that cannot be replaced in a short time, is not environmentally friendly and is not abundant	5

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 4 (Continue). Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

No	Indicators	Level Cognitive	Question	Score
5	Given the discourse, students are expected to be able to explain renewable energy sources correctly	C2	**Pay attention to the discourse below!** Renewable energy has been widely used and developed. This is because energy sources are abundant, replaceable, and environmentally friendly. There are various types of renewable energy, but not all of them can be used in remote and rural areas. Solar, wind, biomass, steam, and hydropower are the most suitable technologies for providing energy in remote and rural areas. Other renewable energies including geothermal and tidal energy are technologies that cannot be done everywhere. This is because the energy technology for geothermal and tidal energy is still in the development stage. From the discourse above the notion of renewable energy is... a. The energy that cannot be replaced in a short time, is not environmentally friendly and is abundant b. The energy that can be replaced in a short time, is not environmentally friendly and is not abundant c. The energy that can be replaced in a short time, is environmentally friendly, and abundant d. The energy that cannot be replaced in a short time, is not environmentally friendly and does not overflow	5
6	Presented pictures of energy sources, Students can identify renewable energy sources correctly	C2	**Look at the picture below!**  From the picture above, help renewable energy types from no 1-5.... a. 1 = steam, 2 = biomass, 3 = solar photovoltaics, 4 = wind power, and 5 = hydropower b. 1 = biomass generator, 2 = biomass, 3 = solar photovoltaic, 4 = wind power, and 5 = hydropower c. 1 = biodiesel, 2 = biomass, 3 = solar photovoltaic, 4 = wind power, and 5 = hydropower d. 1 = Combustion, 2 = biomass, 3 = solar photovoltaics, 4 = wind power, and 5 = hydropower	5

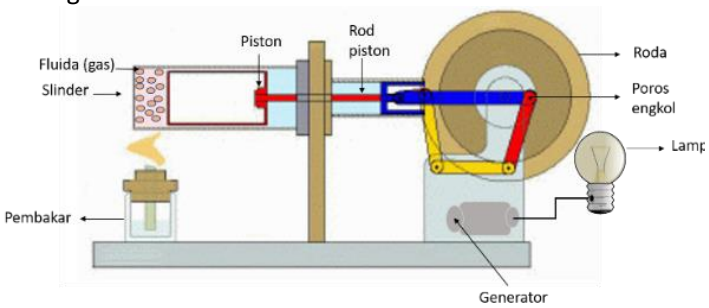
DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 4 (Continue). Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

No	Indicators	Level Cognitive	Question	Score
7	Given insights, students can identify reasons for renewable sources of solar power correctly	C2	**Read the discourse below!** The Province of East Nusa Tenggara (NTT), is the future of Indonesia and the world in the development of solar electric energy. This new renewable energy source is cheap, reliable and sustainable. NTT is the future of Indonesia and even the world for solar electric energy because according to research by experts, the best intensity of sunlight in Indonesia is on the islands of Sumba and Timor. Sugeng revealed that Indonesia's current electricity needs are around 62 gigawatts or 62,000 megawatts. Meanwhile, the potential for solar energy on Timor Island and Sumba Island can reach 60 gigawatts. How great is the potential for solar energy, it can meet most of the national electricity needs. Therefore, this potential must turn into an action plan by taking into account the technical, economic, and social dimensions. We cannot invest economically profitably, while not socially. This great solar energy potential must be optimally developed. Based on the text above, the reasons for the province of East Nusa Tenggara being suitable for the use of solar cells are... a. the confluence of the west monsoon and east monsoon b. surface currents are very high every year c. hot weather lasts quite a long time in a year d. the wind blows all year round	5
8	Given the discourse, students are expected to be able to understand texts regarding renewable energy sources correctly	C2	Solar heat is an abundant renewable energy. The heat energy radiated to the earth can be used to generate electricity by collecting solar heat using a concave mirror. Solar heat is collected to heat the tubes and drive the pistons. Engines that move in this way are known as Stirling engines. The important information in this paragraph is… a. radiation, medium, heat, Stirling engine, convex mirror b. displacement, heat, radiation, Stirling engine, convection c. energy, radiation, convection, conduction, Stirling engine d. heat, energy, radiation, sun, Stirling engine, conduction	5

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 4 (Continue). Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

No	Indicators	Level Cognitive	Question	Score
9	Students can identify the components contained in the Stirling engine correctly	C2	**Read the discourse below carefully to be able to answer questions no 9-10!** In addition to the wind power plant (PLTB), there is a steam power plant (PLTU). Generally, in Indonesia, steam power plants use coal. However, due to limited energy sources derived from coal, we must look for new energy sources. One of them is the Stirling Engine. Look at the picture of the Stirling machine below  The Stirling engine is an old technology that was developed back n this era. This machine utilizes temperature differences, pressure changes, and changes in working fluid volume in a closed system. Beginning with the combustion that occurs outside the Stirling engine. The heat generated heats the fluid (gas) that is on the cylinder wall. This heat will heat the fluid in the cylinder wall and make the pressure increase so that it will push the first piston down to rotate the crankshaft. Then the crankshaft will move the first piston back up due to the momentum of the flywheel. The piston that returns to the top will push the pressurized fluid to flow into the cold cylinder chamber and push the second piston. In this cold cylinder space, the fluid will shrink. When the second piston returns to the top easily due to the momentum of the flywheel and the pressure is small because the volume of fluid has decreased After the fluid returns to the hot cylinder chamber, the cycle will repeat itself and produce rotary motion on the crankshaft. This rotary motion is continued to rotate the generator as in the usual generator set. This rotary motion will later be converted into electrical energy. From the discourse and picture above, the Stirling engine components consist of …. a. Burners, cylinders, pistons, piston rods, turbines, lights, wheels, generators, and transformers b. Burners, cylinders, pistons, piston rods, crankshafts, lights, wheels, and generators c. Burners, cylinders, pistons, piston rods, turbines, wheels, generators, and lights d. Burners, cylinders, pistons, piston rods, turbines, wheels, boilers, and lights	5

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 4 (Continue). Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

No	Indicators	Level Cognitive	Question	Score
10	Students can explain the work of one of the components of a power plant correctly	C2	From the discussion above, the function of the generator on the Stirling engine is... a. Converts wind power into motion energy b. Converts motion energy into electrical energy c. Converts wind power into steam energy d. Converts motion energy into heat energy	5
11	Students can classify renewable energy sources based on regional conditions correctly	C3	The following is an overview of environmental conditions in several areas. 1) The sunshine all year round is stable. 2) High wind speed. 3) High daily temperature. 4) The coast is steep. 5) The temperature is below zero degrees Celsius. Renewable energy is suitable for development in areas with the conditions shown in Figure... a. 1), 4), 5) b. 1), 2), 3) c. 2), 3), 5) d. 3), 4), 5)	5
12	Students can apply renewable energy systems to the use of Stirling engines correctly	C3	Limited energy sources require us to look for alternative energy sources. The Stirling engine is the right choice of alternative energy source because it has a good working reputation and a long service life (over 20 years). The working principle of the Stirling engine is focused on... a. Changes in pressure and volume of the gas in a closed system by utilizing heat from outside the working system b. Changes in pressure and volume of the gas in an open system by utilizing heat from outside the working system c. A decrease in temperature causes the gas volume to decrease and the system receives compression work in a closed system d. The temperature increase causes the gas volume to decrease and the system receives compression work in an open system	5
13	Students can classify steam engines based on how they work correctly	C3	Based on how the Stirling engine works, the Stirling engine is classified as a…. a. External combustion engine where heat is obtained from outside the system b. Internal combustion engine where heat is obtained from within the system c. Mixed combustion engine between external and internal (combustion outside and inside the engine) d. Diesel engine	5

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 4 (Continue). Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

No	Indicators	Level Cognitive	Question	Score
14	Students are expected to be able to apply the concept of the thermodynamic cycle correctly	C3	Based on the thermodynamic cycle, the work done by the Stirling engine is the result of…. a. The heat resulting from the combustion of fuel is directly converted into mechanical energy through the conducting medium, which is then converted into mechanical energy b. The heat resulting from the combustion of fuel is not directly converted, but through the conducting medium first, and then converted into mechanical energy c. The heat from burning fuel is directly converted into mechanical energy d. The heat from burning fuel is not directly converted into mechanical power	5
15	Students are expected to be able to sequence the Stirling engine thermodynamic cycle correctly	C3	The stringing machine works by utilizing heat from outside its working system which is called a thermodynamic cycle which follows several stages until it finally produces energy. The correct order of the stages of the thermodynamic cycle in a Stirling engine is... a. Expansion stage – heating stage – compression stage – cooling stage b. Compression stage – heating stage – cooling stage – expansion stage c. Heating stage – expansion stage – cooling stage – compression stage d. Cooling stage – compression stage – heating stage – expansion stage	5
16	Students can apply the concept of energy to the Stirling engine experiment correctly	C3	In the experiment that we have done, the stages of energy conversion to produce energy from the Stirling engine experiment are…. a. Radiation energy due to the temperature difference outside the system then turns into motion / mechanical energy that moves the piston on the Stirling engine and then turns into electrical energy b. Motion/mechanical energy turns into electrical energy and then into heat energy c. Heat energy due to the temperature difference outside the system which then turns into motion/mechanics and then turns into electrical energy d. Radiation energy turns into motion/mechanical energy and then turns into heat energy	5

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Table 4 (Continue). Preparation of questions and scoring for generating device for class XI vocational schools of electrical power generating engineering.

No	Indicators	Level Cognitive	Question	Score
17	Students can apply the properties of gases in the operation of the Stirling engine correctly	C3	The Stirling cycle involves a series of events that change the gas pressure inside an engine so that the engine can do work. The properties of gases that are very important for the operation of the Stirling engine are... a. Having a variable amount of gas in a fixed volume of space and increasing the temperature of that gas so that the pressure will increase b. Having a variable amount of gas in a variable volume in the chamber and increasing the temperature of that gas so that the pressure will increase c. Having a fixed amount of gas in a variable volume in the chamber and increasing the temperature of that gas so that the pressure will increase d. Having a fixed amount of gas in a fixed volume of space and increasing the temperature of that gas causes the pressure to increase	5
18	Students can apply the properties of gases in the operation of the Stirling engine correctly	C3	The Stirling cycle involves a series of events that change the gas pressure inside an engine so that the engine can do work. Another gas property that is very important for the operation of the Stirling engine is... a. Have a fixed amount of gas and compress it so that the temperature of the gas will increase b. Has a variable amount of gas and compresses so that the temperature of the gas will decrease? c. Increase the amount of gas in the chamber and compress it so that the temperature of the gas will increase d. Reducing the amount of gas in its chamber and compressing it so that the temperature of the gas will increase	5
19	Students can analyze the difference in heat on the Stirling engine operation correctly	C4	The Stirling engine operates only from a temperature difference. The temperature difference occurs due to… a. There is a combustion process in the heating device which is carried out by combustion gas produced from burning fuel inside so that it can transfer heat which can move the piston. b. There is a combustion process outside the heater which is carried out by combustion gas produced from burning fuel inside so that it can generate heat that can move the piston. c. There is a combustion process outside the heating device which is carried out by combustion gas produced from burning fuel outside so that it can transfer heat which can move the piston d. There is a combustion process in the heating device which is carried out by combustion gas produced from burning fuel outside so that it can transfer heat which can move the piston.	5
20	Students are expected to be able to evaluate the working principle of the Stirling engine correctly	C5	The presence of heat insulation on the working principle of the Stirling engine is due to…. a. The heat from an object with a higher temperature will flow through that substance to another part with a lower temperature. b. The heat separation is when a liquid or gas with a higher temperature flow to an area with a lower temperature c. The heat from a heat source to another object in the form of electromagnetic waves and without the need for an intermediary substance d. The heat from a source from one part to another is in the form of electromagnetic waves and requires an intermediary substance	5

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

5. CONCLUSION

This article succeeded in creating an instrument to evaluate students' cognitive abilities on generator material in detail starting from determining test objectives, arranging test grids, and determining scores. Even though the instrument has been successfully made, there are limitations to this article, namely the instrument that has been made has not been validated, reliability, item selection questions, and trials have not been carried out. In the next article, these limitations will be refined. Even so, it is hoped that the article can be used as a reference in making cognitive assessment instruments, especially in the fields of knowledge that are applied to the Merdeka curriculum.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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DOI:
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