



## HIGHER ORDER THINKING SKILLS (HOTS)-BASED STUDENTS' WORKSHEETS IN THERMODYNAMICS MATERIALS

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### ABSTRACT

This study aims to produce a Higher Order Thinking Skills (HOTS)-based Student Worksheet on Thermodynamic Material and determine the feasibility of the product. The method used is Research and Development (R&D). Product validation was carried out by 2 material expert and 2 media expert. The study was conducted at SMAN 1 Sukoharjo, SMAN 1 Adiluwih, MA Ma'arif Keputran with the research subjects are students in grade XI. Data collection was carried out using a non-test instrument in the form of a questionnaire. The rating scale uses a Likert scale, 5 highest values to 1 lowest value. The results of the material expert validation were 92% with the Very Eligible criteria and the media expert was obtained 100% with the Very Eligible criteria. LKPD was tested through 2 stages, small group trials and field trials. The results obtained were 73% for small group trials, 89% for field trials. So that the HOTS-based LKPD is feasible to use with good interpretation.

## LEMBAR KERJA PESERTA DIDIK BERBASIS *HIGHER ORDER THINKING SKILLS* (HOTS) PADA MATERI TERMODINAMIKA

### ABSTRAK

#### Kata Kunci:

*Higher Order Thinking Skill*  
 Lembar Kerja Peserta Didik  
 Termodinamika

Penelitian ini bertujuan menghasilkan produk Lembar Kerja Peserta Didik (LKPD) Berbasis *Higher Order Thinking Skill* (HOTS) pada Materi Termodinamika dan mengetahui kelayakan produk yang dikembangkan. Metode yang digunakan adalah *Research and Development* (R&D). Validasi produk dilakukan oleh 2 validator ahli materi dan 2 validator Ahli media. Penelitian dilaksanakan di SMAN 1 Sukoharjo, SMAN 1 Adiluwih, MA Ma'arif Keputran dengan subjek penelitian adalah peserta didik kelas XI. Pengumpulan data dilakukan dengan instrument non-tes berupa angket. Skala penilaian menggunakan skala *Likert*, 5 nilai tertinggi hingga 1 nilai terendah. Hasil validasi ahli materi didapatkan 92% dengan kriteria Sangat Layak dan ahli media didapatkan 100% dengan kriteria Sangat Layak. LKPD di uji coba melalui 2 tahap, uji coba kelompok kecil dan uji coba lapangan. Hasil yang diperoleh 73% untuk uji coba kelompok kecil, 89% untuk uji coba lapangan. Sehingga LKPD berbasis HOTS layak digunakan dengan interpretasi baik.

## 1. INTRODUCTION

Nowadays, education in Indonesia applies a 2013 curriculum that uses knowledge (cognitive), attitude (affective) and skill (psychomotor) as the indicators [1]. So, to ensure all three indicators are owned by students, the ideal learning activities must be student-centered [2]. Student-center learning activities make students learn more independently by finding problems and then finding solutions to those problems by themselves. Students can develop their thinking strategies with the steps of the problem solving process [3]. Critical thinking is also needed in the process of solving a problem with cognitive competence and life skills [4].

Life skills in the 21st century are very necessary. Problem solving skills are closely related to higher order thinking skills (HOTS) [5]. The 2013 curriculum with HOTS will make students have the competence of creativity, problem solving and critical analysis [6]. Higher-order thinking skills can also improve students' ability to analyze, evaluate and create, not just limited to memorization [7]. Higher order thinking (HOT) is included in scientific reasoning. HOT also involves high-level cognitive skills, from critical and evaluative thinking, decision making and problem solving [8]. HOTS also consists of critical thinking, evaluation, and decision making [9]. But, learning patterns that are widely used today are only learning in one direction. While education today needs more than that, cognitive skills with high understanding are needed. How to learn and how to analyze information in the right way [10]. Learning in Indonesia at this time only emphasizes the ability to memorize. Students are not required to understand the concept, but rather focus on the prediction of questions and answer techniques to get good scores [11]. The tasks given by teachers actually have an impact on students to complete the task by remembering and memorizing only, without understanding the real concept [12].

Physics Learning is a product of the use of one-way learning patterns that causes students' higher order thinking skills to become low. This is because when learning, HOTS was not trained properly [13]. The use of conventional methods that are not interesting and not varied also have an impact on the lack of experience of students to show the facts of a theory [14]. Through conventional learning, students are also not given the opportunity to develop independently through the process of thinking and discovery [15]. Learning assessments given to students have not been designed to improve students' higher-order thinking skills. Tasks sourced from available student worksheet only test students' memorization and the application of physics equations [16].

Physics Learning consists of the dimensions of the process of thinking ability, the dimensions of outcomes (products), and the dimensions of attitude development [17]. These dimensions are obtained through minds on and hands on. The way to realize minds on and hands on is by providing teaching materials that can meet these needs and obtain information and scientific insights [18]. The results of previous studies have explained that students are able to improve their higher order thinking skills, both individually and in groups using systematically arranged learning resources [19]. One of the teaching materials and learning resources that can be used is student worksheet.

Students often explain natural phenomena with inappropriate physics concepts [20]. Thermodynamics is one example of a lesson that according to students is very difficult to explain conceptually [21]. Student learning outcomes in thermodynamics are still relatively low. This happens because students find it difficult to understand thermodynamic concepts that are abstract and macroscopic that cannot be clearly described [22]. So it is necessary to understand thermodynamic material in a visual way, both with learning media and through a learning project [23].

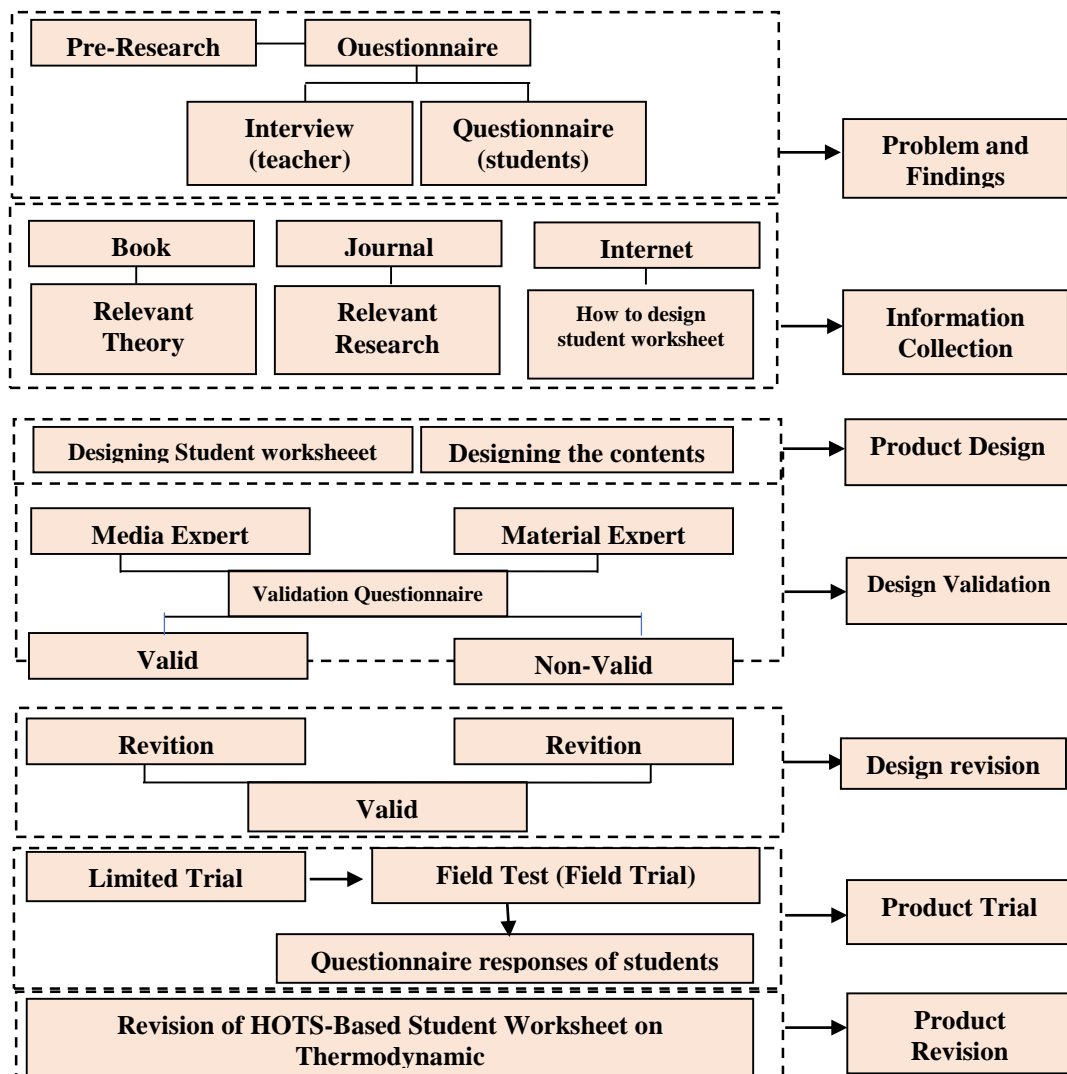
Previous research states that HOTS-based student worksheet can improve student learning outcomes. Student worksheets also have appropriate interpretation for use in education [24]. Other research states that learning by using student worksheet with PBL learning models can increase students' HOTS [25]. The study also stated that the student worksheet that was designed with problem solving steps was feasible and effective to use. The development of student worksheet that are arranged according to HOTS indicators is very needed in the learning process of thermodynamic. The preparation of student worksheet not only contains summary of the theory and tasks but also the theory is prepared by integrating HOTS indicators, such as analyzing, differentiating, organizing, connecting, and evaluating. So that students can understand the material independently and get a meaningful learning.

**2. METHOD**

The Research and Development design used modifies the Borg & Gall Model. This research was conducted at SMAN 1 Sukoharjo, SMAN 1 Adiluwih, and MA MA'arif Keputran, from August to September 2018. Subjects in this study were students of class XI of SMAN 1 Sukoharjo, SMAN 1 Adiluwih, and MA MA'arif Keputran.

**2.1 Development Procedure**

Development is done in 7 steps. We present the following development flow chart.



Gambar 1. Siklus Penelitian dan Pengembangan LKPD Berbasis HOTS

**2.2 Data, Instruments, and Data Collection Techniques**

The data used in this research development is qualitative data that is processed quantitatively. The instruments used to measure the validity of student worksheet include media expert validation instruments, material expert validations and student instruments to see whether the product is valid and good for students to use or not. Data collection was carried out qualitatively then converted to quantitative data obtained from the development product evaluation questionnaire that was compiled using a scaling and the results were presented in qualitative data. This qualitative data is in the form quality of HOTS-based student worksheet on Thermodynamics with a Likert Scale scoring, which is 5 = very feasible, 4 = feasible, 3 = moderate, 2 = less feasible, 1 = worst. The score of each statement for all validation results is calculated and expressed in percentage using this equation:

$$\%SS = \frac{\overline{SS}}{S_m} \times 100\% \tag{1}$$

Explanation:

$\overline{SS}$  = Average Score

$S_m$  = Maximum Score

To interpret the results of the validation test and the attractiveness test the criteria in the following table 1 are used:

**Table 1.** Interpretation of The Validation Assessment Score

Interval	Criteria
81% - 100%	Vert Good/Very Feasible
61% - 80%	Good/Feasible
41% - 60%	Moderate
21% - 40%	Less Good/Less Feasible
0% - 20%	Worst

[18]

If the results show a percentage of less than 61% then the product will be revised or improved according to the advice. If the results show more than 61% then the product is declared suitable for use in learning process.

**3. RESULTS AND DISCUSSION**

Based on the development procedure, this development research consists of three main stages. The results of each stage are:

**3.1 Preliminary Study Stage**

Literature review. After examining various relevant sources, it can be concluded that the problem of higher order thinking skills in students is still low. Supported by facts of the unavailability of student worksheet that can practice analytical skills, evaluation and creating.

Work plans in this study are (a) choosing the basis used; (b) choosing teaching materials to be developed; (c) choosing basic competencies to be developed; (d) choosing a development model; (e) developing research instruments to assess the validity and attractiveness of the product; (f) making a validation sheet of research instruments; (g) do the validation, limited trials, and field trials.

### 3.2 Product Design Stage

The product developed is teaching material that is able to train students' higher order thinking skills (HOTS) in the form of student worksheet. In general, there are three main topics in this student worksheet.

#### 3.2.1 Analyzing section

The first cognitive level in HOTS is analyzing (C4). The analyzing trained students to understand problems in the surrounding environment. Understanding not only raises a hypothesis without foundation, but the hypothesis that is raised is in accordance with the students' initial understanding. The hypothesis obtained can also be justified. Although there are mistakes or errors, students will get the answer in the next session

#### 3.2.2 Evaluating section

The next cognitive level in HOTS is evaluating (C5). The evaluating section teaches students to test the truth of hypotheses. Evaluating also provides answers to hypotheses according to theory. Therefore, theories and statements must be compatible and not contradictory. In this section, students not only see an explanation, but students are also involved in finding the formula as the principal in theory.

#### 3.2.3 Creating section

The next cognitive level in HOTS is creating (C6). The creating section is the part where students try to apply an understanding of the theory they learn by making a simple tool. This simple tool can be used as a practicum tool in school and used in the next practicum. This creating section is the final stage in HOTS on a cognitive level. So, at this section, students are expected to have HOTS in themselves.

### 3.3 Development and Evaluation Stage

The completed student worksheet was then validated by material and media experts, and the attractiveness test was carried out with a limited group test and a field test.

### 3.4 Data Analysis Results

The results of data analysis from each testing stage, are described as follows.

#### 3.4.1 Media Expert Validation

The results of the media expert validation on the products are presented in Table 2:

**Table 2.** Media Validation Results By Media Expert Validator

No	Aspects	Average Score	Percentage	Criteria
1	Size	4,50	90%	Very Feasible
2	Cover Design	4,35	87%	Very Feasible
3	Content Design	4,11	82%	Very Feasible
	Average	3,33	86%	Very Feasible

Based on Table 2 it can be seen that the size of the student worksheet obtains an average score of 4.50 or 90%. The cover design aspect obtained an average score of 4.35 or 87% and the content design aspect obtained an average score of 4.11 or 82%. From table 2 it is known that the average score of the media is 4.32 or 86% with the category of "Very Feasible".

The following graph is the result of product evaluation. This graph is presented to see a comparison of the results of the assessment by media experts from each aspect.

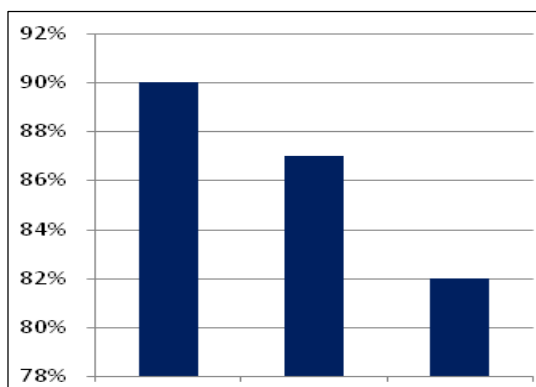


Figure 2. Graph of Media Expert Validation Result

### 3.4.2 Material Expert Validation

The results of the expert material validation assessment on the products are presented in Table 3.

Table 3. Results of Material Validation by Material Expert

No	Aspects	Average Scores	Percentage	Criteria
1	Content	4,63	93%	Very feasible
2	Display	4,95	99%	Very feasible
3	Language	5,00	98%	Very feasible
4	Context	4,58	92%	Very feasible
	Average	4,79	96%	Very feasible

Based on Table 3, it is known that the feasibility aspect obtained an average score of 4.63 or 93%. The feasibility aspect of the presentation obtained an average score of 4.95 or 99%. Aspects of language worthiness get an average score of 5.00 or 100%. The contextual feasibility aspect obtained an average score of 4.58 or 92%. From table 4 it is known that the average score of material worth is 4.79 or 96% with the category “Very feasible”.

The following graph is the result of product evaluation. This graph is presented to see a comparison of the results of the assessment by material experts from each aspect.

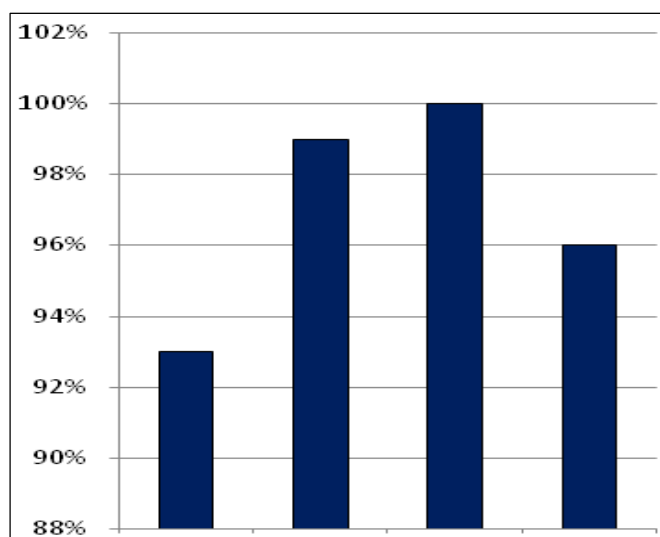


Figure 3. Graph of Material Expert Validation Result

3.4.3 Student Responses

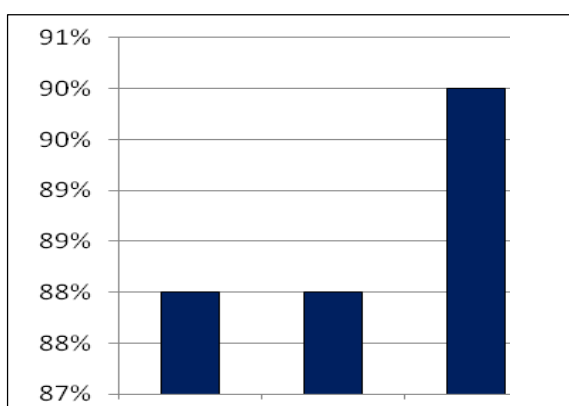
The results of students’ responses to the product are presented in Table 4:

Table 4. Student Response to Field Trials

No	Aspects	Average Score	Percentage	Criteria
1.	Interest	4,42	80%	Very Good
2.	Content	4,42	80%	Very Good
3.	Language	4,51	90%	Very Good
	Average	4,45	89%	Very Good

Based on Table 4, the interest aspect gets an average score of 4.42 or 80%. The content aspect gets an average score of 4.42 or 80% and the language aspect gets an average score of 4.51 or 90%. From table 4 it is known that the average score of the three aspects of a large group trial is 4.45 or 89% with the category “Very Good”.

The following graph is the result of student response. This graph is presented to see a comparison of the results of the assessment by student response from each aspect.



Gambar 4. Graph of Student Responses Result

Based on the stages carried out in this study, this student worksheet has very good quality and is suitable for use in SMA/SMK for students in class XI. This student worksheet has been integrated with HOTS indicators. This student worksheet can be used in the learning process as teaching material, both in the classroom and outside the classroom and helps students get a meaningful learning. The results of this study are supported by previous research which stated that student worksheet can help students in achieving learning indicators [25]. Previous research also mentioned that HOTS-based student worksheet was suitable for use in education and supported students in achieving learning outcomes [16].

4. CONCLUSION

HOTS-based student worksheets in thermodynamic have been tested through a media validation questionnaire with a very feasible category, based on the results of material validation with an average of 97% categorized as very feasible. HOTS-based student worksheets in thermodynamic have been through students’ response tests on product trials at SMAN 1 Sukoharjo, SMAN 1 Adiluwih, and MA Ma’arif Keputran and received an average of 73% in limited trial groups with good categories and field trials in SMAN 1 Sukoharjo, SMAN 1 Adiluwih, and MA Ma’arif Keputran with an average of 89% with a very good category.

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