Eurasian Journal of Educational Research 96 (2021) 14-29

Eurasian Journal of Educational Research
www.ejer.com.tr

Design of Student Worksheets Oriented to Higher Order Thinking Skills (HOTS) in Physics Learning

Muhammad Syahrul KAHAR[1*], Ramadoni SYAHPUTRA[2], Rahmatullah Bin ARSYAD[3], Nursetiawan NURSETIAWAN[4], Mujiarto MUJIARTO[5]

ARTICLE INFO

Article History:
Received: 17 September 2021

Received in revised form: 25 October 2021

Accepted: 10 December 2021

DOI: 10.14689/ejer.2021.96.2

Keywords
Worksheet; Higher order Thinking Skills, Learning outcomes

ABSTRACT

Purpose: This research aimed to: (1) measure out the validity level of the developed Student Worksheets, (2) explain the students' responses and learning motivation in using Higher Order Thinking Skills (HOTS) -based worksheets, and (3) find the effect of the HOTS-based worksheet on learning outcomes. **Methodology**: The study employed the Research and Development (R&D) approach with the following steps: (1) preliminary study, (2) development, and (3) implementation. The population was all second-semester students (Classes A, B, and C) in 2020/2021. Samples were 30 students of the Informatics Engineering Study Program at the Universitas Muhammadiyah Sorong. The data was collected from learning outcomes, validated worksheets, and student response and learning motivation instruments. Subsequently, the data were analyzed using learning outcomes data, expert validation, and regression analysis.
Findings: The results showed that the design of student worksheets could effectively improve students' high order thinking skills, as indicated from their learning results in the good category. On the other hand, the design can also motivate students and activate their responses following the lesson. **Implications to Research and Practice**: HOTS-based worksheets encouraged students to understand the material and stimulate their thinking-frame to the maximum. Besides, the worksheet can motivate students to learn to understand the learning materials more easily.

[1]* Mathematics Education Department, Universitas Muhammadiyah Sorong, INDONESIA.
Email: syahrulkahar@um-sorong.ac.id, ORCID ID: 0000-0003-4899-4836
[2] Electro Engineering Department, Universitas Muhammadiyah Yogyakarta, INDONESIA
Email: ramadoni@umy.ac.id, ORCID ID: 0000-0002-0175-7385
[3] Mathematics Education Department, Universitas Muhammadiyah Sorong, INDONESIA.
Email: rahmatullahbinarsyad@gmail.com, ORCID ID: 0000-0002-5799-5892
[4] Civil Engineering Department, Universitas Muhammadiyah Yogyakarta, INDONESIA
Email: nursetiawan@umy.ac.id, ORCID ID: 0000-0001-9898-6768
[5] Mechanical Engineering Department, Universitas Muhammadiyah Tasikmalaya, INDONESIA
Email: mujiarto@umtas.ac.id, ORCID ID : https://orcid.org/0000-0002-4825-8436

Introduction

Teaching is the process of delivering information that can affect students' knowledge. An evaluation of students' knowledge can be done using a student worksheet. Besides evaluation, it is expected to increase their high order thinking skill. According to training students in higher-order thinking skills helps them reflect on the material they have learned, which can deepen their understanding and improve their skills. The process can be evaluated from their learning results. (Anderson & Krathwohl, 2010) mentioned three crucial points in reviewing higher order thinking skills: analysis, evaluation, and creation. Those three processes can become the guideline to measure students' understanding level after using a complex and structured method. In line with (Vidergor, 2018) higher-order thinking skill is defined as reviewing various innovations of teaching strategies that can improve students' thinking skills on an ongoing basis.

Therefore, each learning needs a strategy to maximize the absorption of material in students' minds to improve their higher order thinking skills. A media that can be utilized is the student worksheet. According to (Maharajh, Brijlall, & Govender, 2008) the worksheet is a media that focuses on the distribution of knowledge through figures and symbols that can design students' thinking so that they can think structurally to understand the material. Besides that, (Chao, Yu, Chang, & Chueh, 2019)that a worksheet is learning media that focuses on training students to interpret the learning material to provide a new experience.(Chang, 2014; Luo, Ba, & Zhang, 2012) argued that to ensure the effectiveness of student worksheets, they can be adjusted based on the learning pattern and design applied in each learning material.

It is also evident that worksheets oriented to Higher Order Thinking Skills (HOTS) are necessary to students' thinking and acting skills because they can examine whether all information is received optimally and accurately (Pratama & Retnawati). (Eisenman & Payne, 1997) explained that learning-oriented field study could give students high-order thinking skills to analyze problems. The study focused on improving students' high order thinking skills that can be measured from their learning results. The study also developed a worksheet integrating high order thinking skills to boost students' understanding of learning materials.

The current study aimed to: (1) measure out the validity level of the developed Student Worksheets, (2) explain the students' responses and learning motivation in using HOTS-based worksheets. (3) find the effect of the HOTS-based worksheet on learning outcomes. This study also aimed to develop students' higher-order thinking skill-based worksheets that compiled different sub materials to help students directly construct their knowledge and understanding to improve their ability to analyze each problem they found.

Literature review

It is necessary to consider all supporting aspects preparing the young generation to face challenges in the 21st century. However, the current classroom has limited learning innovation, students have low interest in reading, and materials have poor quality. Furthermore, (Pratama & Retnawati) explained that the material complexity impacted the laziness and weakness of students to read science, especially physics. Therefore, there should be innovation in media used in the classroom (Maharajh et al., 2008; Maksum, 2013; Zohar, 2013) too, suggested using modules or worksheets as printed teaching materials or as independent guides to students. It included content, implementation, and other activities required for learning.

Unfortunately, many educators do not implement innovations due to their lack of creativity, which affects their competence. Other factors include the lack of class mastery, soft skills, and laboratories; thus, many students cannot reach the competency standards. According to (Purnamawati, Ertikanto, & Suyatna, 2017; Rizqa Safitri, Budiharti, & Yusliana Ekawati, 2014; Ulaş, Sevim, & Tan, 2012) student worksheets can be used as a reference to support the learning process and as guidelines in assessing the level of student competencies after learning the material. Teachers usually provide worksheets not fully meeting the competency standards of each lesson because sometimes they do not consider the substance. Therefore, according to(Khoiri, Kusumawati, Kahar, & Mursidi) an innovative worksheet oriented to the students' ability to think highly or commonly called High Order Thinking Skills (HOTS) is necessary. (Eisenman & Payne, 1997; Febu, Nuswowati, & Sumarni; Firdaus & Wilujeng, 2018) explained that implementing learning focusing on students' high order thinking skills brings better learning nuance so that the material will be easier to understand.

(Suriasa, 2018) observes that a learning process does not only help students knowing and memorizing physics concepts, but it also trains and develops high order thinking skills, soft skills, and scientific attitudes. Therefore, students should be able to analyze, evaluate, and create each material (three aspects of High Order Thinking Skills) by compiling and designing a worksheet integrated into higher-order thinking skills. (Kurniati; Maharajh et al., 2008) mention three indicators to measure higher-order thinking skills including 1) Analysis (structuring information into small parts); 2) Evaluation (providing an assessment of a solution, idea, or opinion using specific criteria); 3) Creation (designing an idea to solve a problem)

(Widodo & Kadarwati, 2013) argue that students with low critical thinking ability also have inactive actions in learning and no willingness to seek information. Furthermore, passive educators only provide information, while students are embarrassed to ask questions and not dare express opinions. state that learning models and media could improve students' higher-order thinking skills. Eventually, according to (Barak & Dori, 2009) implementing a learning model with higher-order thinking skills can stimulate student understanding and construct problems to achieve the best results.

In general, learner worksheet applied in curriculum 2013 is similar to Student Worksheet. (Nadhiroh & Latifah, 2020; Pratama & Retnawati) state that student worksheet,

which is still more commonly called LKS, is a printed material containing materials, summary, and learning guidelines for students, which refer to the Basic Competencies. Therefore, student worksheet can become a learning resource in the forms of a worksheet, procedures of tasks, and learning evaluation that must be completed according to the essential competencies that must be achieved. Besides a guideline, Student Worksheet also has some other functions. (Ulaş et al., 2012; Vidergor, 2018) mentions that student worksheets could guide students to develop their cognitive skills and perform a trial or demonstration.

The student worksheet is developed to (1) present the learning materials so that students can more easily understand the material; (2) present tasks related to the material; (3) train the independence in learning; and (4) to ease the teachers in preparing tasks (Pratama & Retnawati). Based on the statement, it can be concluded that the primary function of student worksheet is learning media that can be used to maximize the learning process to deliver the learning goals in the class. Student worksheet assists students to understand the material more easily, and they can more actively participate in the learning activities through pages of tasks provided in the student worksheet.

High order thinking skills are higher cognitive thinking implemented in various cognitive concepts and methods and Bloom's taxonomy like problem-solving approach, bloom taxonomy, learning, teaching, and assessment taxonomy (Sawyer, 2018). (Kurniati) mentioned that higher-order thinking happens when students can relate a priory information recorded in their memory with the new information, they get by rearranging them to solve each problem given to achieve the learning goal. The concept of high order thinking skills is based on some ideas, as presented in Table 1.

Table 1.

Basics of High Order Thinking Skill Concept

Problem Solving (Krulik & Rudnick, 1999)	**Original Bloom Cognitive Taxonomy (1956)**	**Revised Bloom Taxonomy (**Anderson & Karthwohl, 2010)	**High Order Thinking Skills**
Recall	Knowledge	Remember	Critical Thinking
Basic	Comprehensive	Understand	Critical Thinking
	Application	Apply	Creative Thinking
Critical	Analysis	Analyze	Problem Solving
Creative	Synthesis	Evaluate	Decision Making
	Evaluation	Create	Creative Thinking

The revision of Bloom's taxonomy by Anderson and Krathwohl focuses on more meaningful and applicative cognitive aspects for teachers. The learning practice is expected to help students process and elaborate learning goals efficiently and effectively. (Krathwohl, 2002) argues that a few of the indicators to measure the higher-order thinking skill include analyzing, the ability to review an old concept to the new one and correlate each component of the idea to make it easier to understand holistically; evaluating, which refers to the ability to do measurement and assessment based on particular criteria or standard, and creating, which is the ability to develop and unify each component into a solid concept that is more detailed and original.

Method

Research Design

The study employed one group pretest-posttest design with Research and Development (R and D) approach. Three stages conducted in the study included: (1) preliminary study, (2) development, and (3) implementation(Walkoe & Luna, 2020; Whalen & Paez, 2021)

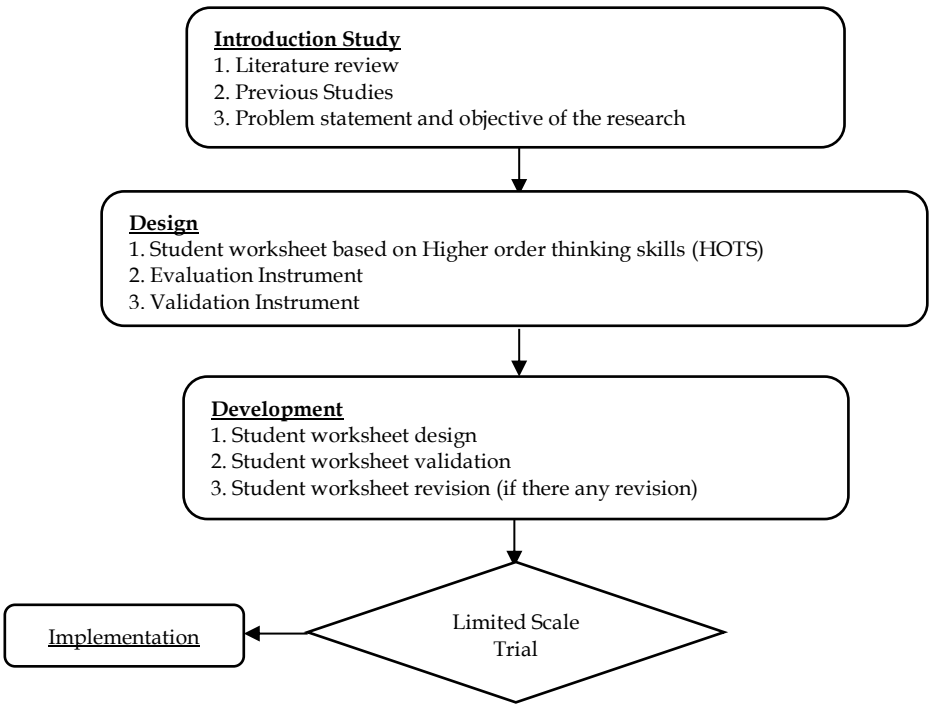

Figure 1. *Research and Development (R and D) Procedures*

Research Sample

The research population was all even semester students in the academic year 2020/2021 (90 students) in three classes (A, B, and C). 30 students of the Informatics Engineering Study Program at the Universitas Muhammadiyah Sorong were selected as the sample for a small/limited trial. The selection of the sample used the proportionate stratified random sampling technique to ensure its representativeness, considering that the population was spread in some heterogeneous classes.

Research Instruments and procedures

The instrument used to collect data were a pre-test and a post-test. Data obtained from the tests were the basis for evaluating the HOTS-based worksheet which was being developed. After that, motivation and response tests were distributed to investigate the students' interests during the learning process using the worksheet. The further stages followed the development design according to (Widodo & Kadarwati, 2013)

Data Analysis

In this research, expert validation was required before distributing the HOTS-based worksheets to the students. The instrument used in the study was a feasibility assessment rubric consisting of several indicators, namely: (1) Worksheet Format, (2) Worksheet Substance, (3) Grammar, and (4) Benefits. The use of the rubric in the validation stage was to obtain more precise information about the media that was being developed related to some indicators to be applicable to measure students' ability.

Meanwhile, validity criteria adapted from (Maksum, 2013; Martin et al., 2015; Mutlu, 2020) student worksheets and adopted in this study runs thus:

$1 \leq va < 2$ invalid
$2 \leq va < 3$ quite valid
$3 \leq va < 4$ valid
Where Va = expert rating average

The product is regarded to be valid when expert rating average Va is more than 3. An average score of less than 3 indicates that the developed worksheet is not valid and that the developed materials must be revised. Furthermore, the data were analyzed using descriptive statistics techniques to describe the characteristics of the distribution of students' learning results in Physics. Besides, data was also analyzed using the multiple regression method to see if students' responses and the learning activity influenced the students' learning results after using the HOTS-based worksheet. It is formulated as below (Pratama & Retnawati)

$$y^1 = a + b_1X_1 + b_2X_2 \quad (1)$$

Annotation:

Y_1 : Students' learning results
X_1 : Learning motivation
X_2 : Students' response

The research hypothesis was tested using a t-test with a two-tailed test as below (Pratama & Retnawati)(Pratama, 2014).

$$t = \frac{\bar{x} - \mu}{S_{\bar{x}}} \quad (2)$$

$$S_{\bar{x}} = \frac{s}{\sqrt{n}} \quad (3)$$

Note:

$\bar{x}_1$ = average sample
μ = average population or hypothesis
S = Deviation Standard
$S_{\bar{x}}$ = standard error
n = number of samples
the hypothesis is formulated as below:

$Ho: \mu = \mu_0$
$H_1: \mu \neq \mu_0$

Note:

The null hypothesis (Ho) states that there is no increase in students' learning results after using a HOTS based worksheet. The alternative hypothesis (H_1) says an increase in students' learning results after being taught using a HOTS-based worksheet.

Results

The student worksheet was developed following the design that was predetermined. The products that were developed are shown in Figure 1.

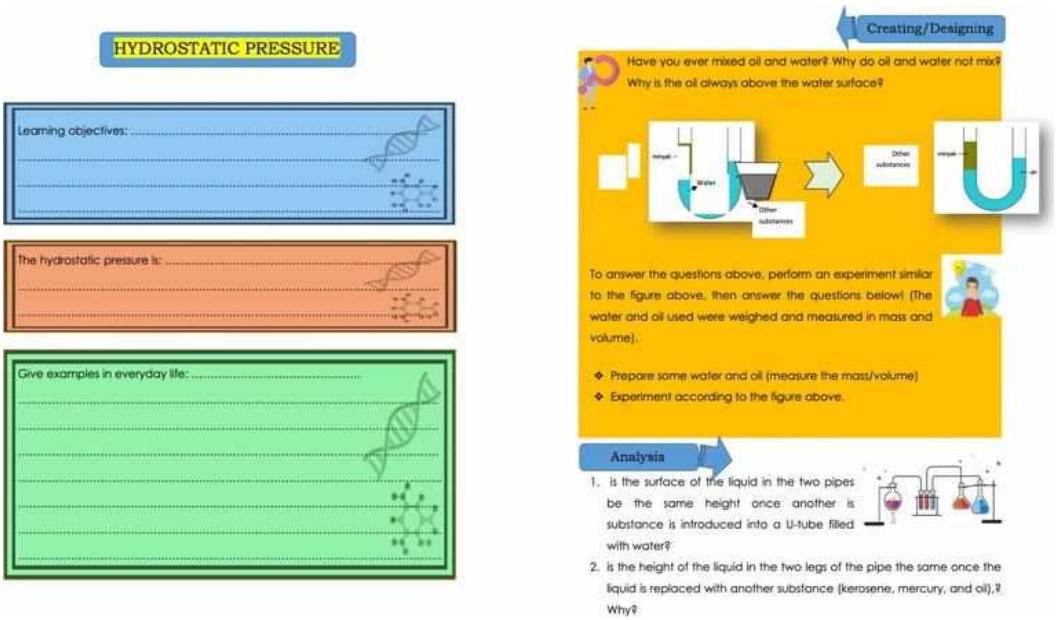

Figure 1. *Student Worksheet*

These developments were emphasized on several aspects and validated by experts. The expert validation is shown in Figure 2.

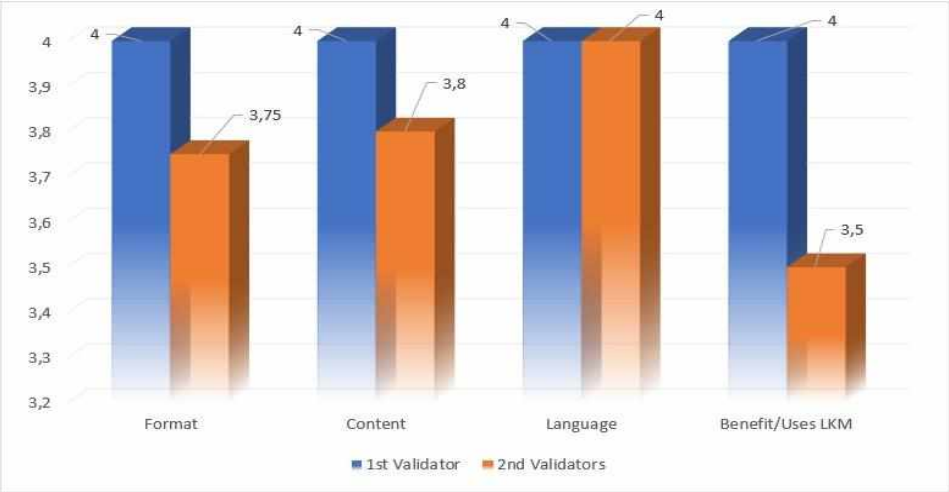

Figure 2. *Student Worksheet Expert Validation*

Figure 1 illustrates the design of the worksheet used in the classroom, which had been integrated with high order thinking skills, and it was expected to measure the students' ability after learning. Figure 2 indicates that the developed worksheet can be implemented in a limited trial. The trial showed the average score of each indicator in good category for the four aspects. However, the qualitative analysis shows that the meaningfulness and clarity in certain sections of this HOTS based worksheet should be revised. Hence, the expected content can produce valuable outcomes for students.

(Febu et al.; Firdaus & Wilujeng, 2018; Ruiz-Gallardo & Reavey, 2019; Sawyer, 2018; Suriasa, 2018) believe that such as development can help students to think critically about the learning materials. Similarly, (Chang, 2014; Chao et al., 2019; Chen, Chan, Chan, Clarke, & Resnick, 2020) argue that learning media development could increase students' understanding in the classroom. This finding is consistent with the descriptive test results obtained in implementing the limited trial, as shown in Table 2.

Table 2

Descriptive Statistics

Items	**Learning Outcome**
N	30
Minimum	4,00
Maximum	10,00
Sum	262,00
Average	8,73
Deviation Standard	1,28
Variance	1,65
Kurtosis	5,16

Table 2 exhibits the average student learning outcomes after implementing the developed HOTS-based worksheets, showing an average level (8.73). It made clear that such a development could increase the students' ability to understand the material presented. Similarly, (Khoiri et al.) Komariah et al. (2015) explained that the application of worksheets can develop students' learning outcomes maximally as indicated in the results of the regression test listed in Table 3.

Table 3

Multiple Regression Test

Coefficients [a]									
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	4.640	2.457		1.889	0.086			
	Motivation	0.194	0.090	0.546	2.152	0.054	0.561	0.544	0.535
	Response	-0.006	0.019	-0.076	-0.299	0.770	-0.186	-0.090	-0.074
a. Dependent Variable: HB									

Table 3 shows that the development and application of HOTS-based worksheets can promote various positive impacts, including students' motivation and responses. The significance test on learning outcomes was at the level of 0.086, indicating that the developed worksheets significantly influence (maximizes) the students' motivation and response and hence can affect their learning outcomes. (Muhammad Syahrul Kahar, Wekke, Ibrahim, Amri, & Pristianto; Krathwohl, 2002; Krulik & Rudnick, 1999; Kurniati) too found that increased motivation and responses can significantly boost student learning outcomes. (Luo et al., 2012; Maharajh et al., 2008) too, explained that the learning elaboration based on the provision of illustrations either through media or other designs could improve learning outcomes and foster higher thinking skills.

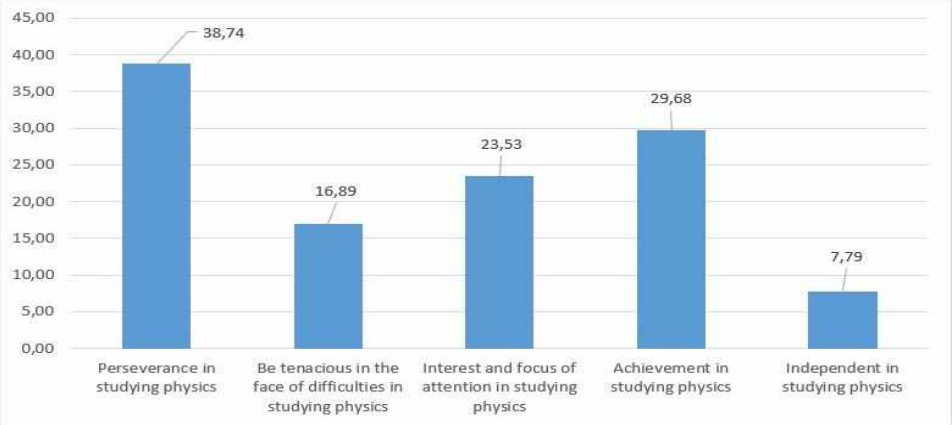

Figure 3. *Average Learning Motivation*

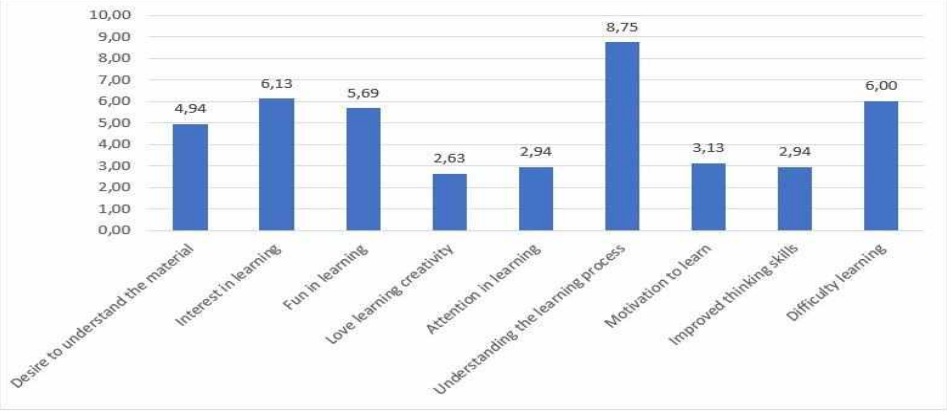

Figure 4. *Average Student Responses*

Figures 3 and 4 show that students can take part in real learning so that they can solve problems independently and tenaciously. This persistence is believed to be able to foster interest in learning. On the other hand, there is also a response factor that can encourage willingness and motivation to learn because the learning pattern applied in the classroom is very good. This can encourage several aspects, including the desire to understand the material and increase the ability to think.

However, based on the findings in this study, the aspect of creativity development still requires attention because there are still some students who find it difficult to find patterns of understanding in solving problems optimally. It is, therefore, necessary to have a special model and strategy in teaching each material by emphasizing the HOTS aspect which is oriented towards learning media, including worksheets, applications, and others. In line with the development of learning patterns can encourage an increase in students' understanding of learning material.

The hypothesis testing in this study was based on a limited trial of students' learning outcomes as set out in Table 4.

Table 4

Hypothesis Test (T-test)

One-Sample Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
HB	37.233	29	0.000	8.73333	8.2536	9.2131

Table 4 presents a significant increase in student learning outcomes as indicated by the t-test score of 37.233, and a significance level of 0.000. This shows that the development of HOTS-based student worksheets can encourage students to think more comprehensively. This is consistent with (Abdullah et al., 2016; Anderson et al., 2001; Ayva, 2012) who stated that the use of worksheets is beneficial for students as it grows the high order thinking skill to support the development of students' acquisition patterns.

Discussion

Student worksheet based on Higher-order Thinking Skills (HOTS) was the main output of this research, produced by pre-determined development design (starting from the needs analysis stage to the design and development stages). The stages ensured the integration of HOTS into the learning material. Experts' validation results showed an average score of 3.88 (Good category), which meant that the worksheet could be applied on the field to develop students' thinking skills. According to (Martin et al., 2015; Mutlu, 2020; Nadhiroh & Latifah, 2020) using HOTS in worksheet-based learning helps them understand and

integrate material effectively. Therefore, this made an impact on their achievement. (Vidergor, 2018; Virranmäki, Valta-Hulkkonen, & Pellikka, 2021) too, have argued that learning evaluation using HOTS-based instruments could improve students' ability to understand the material. (Abdullah et al., 2016; Barak & Dori, 2009; Carroll & Harris, 2020; Chang, 2014) explained that the development of integrated learning HOTS can maximize students' thinking abilities. This enabled the student to solve any problems during learning.

Meanwhile, the developed worksheet was tested on a limited basis, and the descriptive test showed an average learning outcome of 8.73 with a standard deviation of 1.28. The test performed on the hypothesis indicated that the development of worksheets based on students' high thinking skills can increase the learning outcomes since students are stimulated to think comprehensively. (Maharajh et al., 2008; Martin et al., 2015; Mutlu, 2020) stated that the use of worksheets significantly impacts students in learning; one of them is to train their scientific skills and problem-solving. It can also encourage an improvement in their higher-order thinking skills.

Furthermore, based on the tests performed on students' motivation and response to the learning results, the three components significantly influence the significance level of 0.086. it means that teaching using a worksheet integrates high order thinking skills that can grow and stimulate students' willingness to learn each material they receive. According to (M. S. Kahar, Fathurrahman, Amri, & Pristianto; Rizqa Safitri et al., 2014; Ruiz-Gallardo & Reavey, 2019) learning media combined with practice-based learning can facilitate students' curiosity about the importance of understanding problems. Therefore, every student can actively involve in the learning process

The regression test results confirmed this phenomenon, by showing that the increase in the learning outcomes can simultaneously encourage maximum achievement for various aspects, including learning motivation and responses. Therefore, the developed worksheet significantly influences motivation and student responses, including competence to understand the material being taught. It is also evident in students' ability to understand the material during the class, which is high (8.75). Furthermore, the measurement of students' motivation was based on several indicators that explained how learning patterns in the classroom could encourage them to be tenacious and grow maximum willingness to continue learning and understanding each material. This is because learning is presented in an integrated worksheet on HOTS, which encourages curiosity about a problem.

According to (Pratama & Retnawati; Ulaş et al., 2012; Vidergor, 2018; Whalen & Paez, 2021) the patterns that prioritize problem-solving methods can promote students' awareness and motivation, affecting their learning outcomes. Moreover, because of the media, students' skills in finding solutions are also stimulated. (Ulaş et al., 2012; Virranmäki et al., 2021; Walkoe & Luna, 2020) argue that worksheets collaborated with learning models can increase the students' ability to understand the material, which results in the growth of their learning motivation. In line with motivation, student responses significantly impact their desire to continue learning problem-solving. However, they are also eager to learn every material provided by the teacher. According to (Febu et al.;

Firdaus & Wilujeng, 2018; Rizqa Safitri et al., 2014; Ruiz-Gallardo & Reavey, 2019) increased students' motivation and response in a collaborative learning strategy can improve their abilities and skills.

The results of the hypothesis test show increase in students' learning achievement after implementing a high order thinking skill-based worksheet with a t-test score of 37.233 and a significance level of 0.000. (Luo et al., 2012; Walkoe & Luna, 2020; Whalen & Paez, 2021; Widodo & Kadarwati, 2013) stated that components influencing learning success are students' higher-order thinking skills. They enable them to evaluate the information they get, problems they find and construct knowledge using material they get in the classroom. Those three components can lead to a solution to each problem they face.(Chao et al., 2019) argued that worksheets integrated with higher order thinking skills can habituate students to untangle each information they get.

Conclusion, Recommendation, and Implications

The study concluded that (1) student worksheets based on HOTS developed in the study were valid and feasible to be applied to small/limited trials. The assessment showed the results in the good category. (2) There was an increase in learning motivation and responses after implementing the developed HOTS-based worksheets. It is indicated in the willingness and curiosity to understand the material provided, with an average result of 23.32 and 4.79. The maximum scores for each instrument were 30 and 6.67, improving the learning outcomes. The HOTS-based worksheets improved students' motivation and response in learning. (3) There was a significant increase in student learning outcomes according to the t_{count} of 37.233 with a significance level of 0,000.

Based on these conclusions, the study recommends that educators should provide factual learning design to stimulate students' thinking skills in each class. The study suggests an increase in students' thinking skills through the development of worksheets. In this case, the implementation of the media will improve and push students' enthusiasm to learn and to understand the learning materials. For teachers, the development of higher-order thinking skills-based worksheets can become the model in designing learning activities according to the complexity level of the material.

Acknowledgment

A heart-felt gratitude is due to Ministry of Education, Culture, Research, and Technology, Directorate General of Higher Education for the research funding assistance provided in 2021.

References

Abdullah, A. H., Mokhtar, M., Abd Halim, N. D., Ali, D. F., Tahir, L. M., & Kohar, U. H. A. (2016). Mathematics teachers' level of knowledge and practice on the implementation of higher-order thinking skills (HOTS). *Eurasia Journal of Mathematics, Science and Technology Education, 13*(1),132-134 3-17. doi:https://doi.org/10.12973/eurasia.2017.00601a

Anderson, L. W., & Krathwohl, D. R. (2010). Kerangka landasan untuk pembelajaran, pengajaran, dan asesmen [A fundamental framework for learning, teaching, and assessment]. *Yogyakarta: Pustaka Pelajar, 300*, 10-15.

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., . . . Wittrock, M. C. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives, abridged edition. *White Plains, NY: Longman, 5*(1, 25-45.

Ayva, O. (2012). Developing students' ability to read, understand and analyze scientific data through the use of worksheets that focus on studying historical documents. *Procedia-Social and Behavioral Sciences, 46*, 5128-5132. doi:https://doi.org/10.1016/j.sbspro.2012.06.395

Barak, M., & Dori, Y. J. (2009). Enhancing higher order thinking skills among inservice science teachers via embedded assessment. *Journal of Science Teacher Education, 20*(5), 459-474. doi:https://doi.org/10.1007/s10972-009-9141-z

Carroll, K. A., & Harris, C. M. (2020). Using A Repetitive Instructional Intervention to Improve Students' Higher-Order Thinking Skills. *College Teaching, 69*(2), 82-90. doi:https://doi.org/10.1080/87567555.2020.1823310

Chang, K.-C. (2014). Examining the effect of tour guide performance, tourist trust, tourist satisfaction, and flow experience on tourists' shopping behavior. *Asia Pacific Journal of Tourism Research, 19*(2), 219-247. doi:https://doi.org/10.1080/10941665.2012.739189

Chao, P.-H., Yu, C.-P., Chang, J.-P., & Chueh, H.-c. (2019). Effectiveness of family-oriented interpretive media with different design characteristics: A study of family visitors' satisfaction on the worksheets of a botanical garden. *Applied Environmental Education & Communication, 18*(4), 331-349. doi:https://doi.org/10.1080/1533015X.2018.1486246

Chen, G., Chan, C. K. K., Chan, K. K. H., Clarke, S. N., & Resnick, L. B. (2020). Efficacy of video-based teacher professional development for increasing classroom discourse and student learning. *Journal of the Learning Sciences, 29*(4-5), 642-680. doi:https://doi.org/10.1080/10508406.2020.1783269

Eisenman, G., & Payne, B. D. (1997). Effects of the higher order thinking skills program on at-risk young adolescents' self-concept, reading achievement, and thinking skills. *Research in middle level education quarterly, 20*(3), 1-25.

Febu, R., Nuswowati, M., & Sumarni, W. (2017). *Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student's entrepreneurship, 534-546*.

Firdaus, M., & Wilujeng, I. (2018). Pengembangan LKPD inkuiri terbimbing untuk meningkatkan keterampilan berpikir kritis dan hasil belajar peserta didik. *Jurnal*

Inovasi Pendidikan IPA, 4(1), 26-40. doi:https://doi.org/10.21831/jipi.v4i1.5574

Kahar, M. S., Fathurrahman, M., Amri, I., & Pristianto, H. (2018). *Development of Cavendish Balance of Aids Based on Blender Application in Learning Physics, 34-56*.

Kahar, M. S., Wekke, I. S., Ibrahim, I., Amri, I., & Pristianto, H. (2019). *Students' profile of science process in conducting physics practicum, 453-465*.

Khoiri, A., Kusumawati, I., Kahar, M. S., & Mursidi, A. (2019). *Analysis of three representations in problem solving on additional relativistic velocities,67-78*.

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into practice, 41*(4), 212-218. doi:https://doi.org/10.1207/s15430421tip4104_2

Krulik, S., & Rudnick, J. A. (1999). Innovative tasks to improve critical and creative thinking skills. *from Developing Mathematical reasoning in Grades K-12*, 138-145.

Kurniati, D. (2016). *The Higher Order Thinking Skill of the Junior High School Students in Solving PISA Standard-Based Test Item, 345-367*.

Luo, J., Ba, S., & Zhang, H. (2012). The effectiveness of online shopping characteristics and well-designed websites on satisfaction. *Mis Quarterly*, 1131-1144. doi:https://doi.org/10.2307/41703501

Maharajh, N., Brijlall, D., & Govender, N. (2008). Preservice mathematics students' notions of the concept definition of continuity in calculus through collaborative instructional design worksheets. *African Journal of Research in Mathematics, Science and Technology Education, 12*(sup1), 93-106. doi:https://doi.org/10.1080/10288457.2008.10740644

Maksum, A. (2013). Model Cooperative Script Berpendekatan Scinece, Environment, Technology, and Society (SETS) Terhadap Hasil Belajar. *Jurnal Inovasi Pendidikan Kimia, 7*(1), 12-23.

Martin, T., Petrick Smith, C., Forsgren, N., Aghababyan, A., Janisiewicz, P., & Baker, S. (2015). Learning fractions by splitting: Using learning analytics to illuminate the development of mathematical understanding. *Journal of the Learning Sciences, 24*(4), 593-637. doi:https://doi.org/10.1080/10508406.2015.1078244

Mutlu, A. (2020). Evaluation of students' scientific process skills through reflective worksheets in the inquiry-based learning environments. *Reflective Practice, 21*(2), 271-286. doi:https://doi.org/10.1080/14623943.2020.1736999

Nadhiroh, N., & Latifah, S. (2020). Higher Order Thinking Skills (HOTS)-Based Students' Worksheets in Thermodynamics Materials. *Indonesian Journal of Science and Mathematics Education, 3*(1), 87-95. doi:https://doi.org/10.24042/ijsme.v3i1.6082

Pratama, G. S., & Retnawati, H. (2018). *Urgency of higher order thinking skills (HOTS) content analysis in mathematics textbook, 35-56*.

Purnamawati, D., Ertikanto, C., & Suyatna, A. (2017). Keefektifan lembar kerja siswa berbasis inkuiri untuk menumbuhkan keterampilan berpikir tingkat tinggi. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni, 6*(2), 209-219. doi:https://doi.org/10.24042/jipfalbiruni.v6i2.2070

Rizqa Safitri, M., Budiharti, R., & Yusliana Ekawati, E. (2014). Pengembangan media pembelajaran IPA terpadu interaktif dalam bentuk MOODLE untuk siswa SMP pada tema hujan asam. *Jurnal Pendidikan Fisika Universitas Sebelas Maret, 15*(1), 1-14. doi:https://doi.org/10.1080/10508406.2018.1506988

Ruiz-Gallardo, J.-R., & Reavey, D. (2019). Learning science concepts by teaching peers in a

cooperative environment: A longitudinal study of preservice teachers. *Journal of the Learning Sciences, 28*(1), 73-107.

Sawyer, R. K. (2018). Teaching and learning how to create in schools of art and design. *Journal of the Learning Sciences, 27*(1), 137-181.

Suriasa, S. (2018). Penerapan Model Pembelajaran Problem Posing Menggunakan LKS Berbasis Scientific Aproach untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Berkala Ilmiah Pendidikan Fisika, 6*(2), 190-204. doi:https://doi.org/10.20527/bipf.v6i2.4853

Ulaş, A. H., Sevim, O., & Tan, E. (2012). The effect of worksheets based upon 5e learning cycle model on student success in teaching of adjectives as grammatical components. *Procedia-Social and Behavioral Sciences, 31*, 391-398. doi:https://doi.org/10.1016/j.sbspro.2011.12.072

Vidergor, H. E. (2018). Effectiveness of the multidimensional curriculum model in developing higher-order thinking skills in elementary and secondary students. *The curriculum journal, 29*(1), 95-115.

Virranmäki, E., Valta-Hulkkonen, K., & Pellikka, A. (2021). Geography Curricula Objectives and Students' Performance: Enhancing the Student's Higher-Order Thinking Skills? *Journal of Geography*, 1-33. doi:https://doi.org/10.1080/09585176.2017.1318771

Walkoe, J. D. K., & Luna, M. J. (2020). What we are missing in studies of teacher learning: A call for microgenetic, interactional analyses to examine teacher learning processes. *Journal of the Learning Sciences, 29*(2), 285-307. doi:https://doi.org/10.1080/10508406.2019.1681998

Whalen, K., & Paez, A. (2021). Student perceptions of reflection and the acquisition of higher-order thinking skills in a university sustainability course. *Journal of Geography in Higher Education, 45*(1), 108-127.

Widodo, T., & Kadarwati, S. (2013). Higher order thinking berbasis pemecahan masalah untuk meningkatkan hasil belajar berorientasi pembentukan karakter siswa. *Jurnal Cakrawala Pendidikan, 5*(1).,24-34 doi:https://doi.org/10.21831/cp.v5i1.1269

Zohar, A. (2013). Challenges in wide scale implementation efforts to foster higher order thinking (HOT) in science education across a whole school system. *Thinking Skills and Creativity, 10*, 233-249. doi:https://doi.org/10.1016/j.tsc.2013.06.002