DEVELOPMENT OF STUDENT WORKSHEET WITH GUIDED DISCOVERY ORIENTED TO TRAIN HOTS ON THERMOCHEMISTRY MATTER

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Abstract. *This research purpose to describe the feasibility of student worksheet with guided discovery oriented to train HOTS on thermochemistry matter. Research methodology that used was research and development which consist of 10 stages, but this research is limited to product trial stages. The result shows that student worksheet is feasible on validity aspect which viewed from content and construct validity. The content validity get percentage of 85.76% for student worksheet 1 and 85.91% for student worksheet 2. The construct validity obtained percentage of 87.16% for student worksheet 1 and 2. Practicality aspect is viewed from student responses that get percentage in range 75-100% and observation of students activities shows overall relevant activities are greater than irelevant activities. Effectiveness aspect is viewed from student's HOTS test result that get gains score in range 0.58-0.96 with medium (21.875%) to high (78.125%) criteria and knowledge domain test result with >80% of classical completeness.*

Keywords: *Student Worksheet with Guided Discovery Oriented, HOTS, Thermochemistry*

INTRODUCTION

Chemistry is the study of matter and its change that cannot be taught only through theory but need teaching that involves students to gain hands-on experience through planned experiment activities [1][2]. The chemistry matter in XI grade that is less studied and desired by students and need direct experience through experiment is thermochemistry [3]. Thermochemistry is the study of heat changes that accompany chemical reactions and phase changes that demands analytical, critical, logical, and creative thinking [3][4]. Direct experience through experiment activities can facilitate students in understanding of thermochemistry matter [5].

High Order Thinking Skills (HOTS) is the ability of students to use their thoughts, reason, and actions efficiently and effectively for logical, critical, reflective, metacognitive, and creative thinking [6]. The cognitive domain of Revised Bloom's Taxonomy included in HOTS is C4 (Analyze) which includes formulate problem; identify experiment variables; and analyze data, C5 (Evaluate) includes making conclusions and C6 (Create) which includes making hypotheses; designing experimental procedures; making observational data tables; and discovering ideas [7][8].

HOTS needs to be trained on students, so they have information and are able to understand, apply, and analyze so that they can improve their skills in solving problems and constructing their own understanding [6][8]. The use of HOTS to teach science gives students a real opportunity to act like a scientist through experiment activities during learning to prove the facts of the phenomena that occur and provide solutions of problems [8][9]. Problems that occur so far, the teacher feel difficulties and is still confused how to train students to be able to think at a higher level even though the teacher in the classroom has an important role in regulating and motivating students to think at a higher level so the appropriate learning media is needed [6][10][11].

Learning media is one of the tools that teachers can use to help and facilitate the learning process [11]. Student worksheet is one type of learning media that serves as a student's learning guide and makes it easier for students to do teaching and learning activities [12][13][14]. Based on the field study, student worksheet that already circulate in the market and used in schools generally contain of matter with multiple choice question which are still categorized as C1 (Knowing) and C2 (Understanding). That student worksheet cannot trained HOTS yet which consist of analyze, evaluate, and create so the student can't be active and creative when chemistry learning in the class.

Student worksheet to train HOTS is needed to facilitate students and teacher as teaching material that is able to encourage student's interest in learning and student's thinking potency [15]. The using of student worksheet succeeds to train student's HOTS especially in laboratory activity [16][17]. One of the learning approach that suggested by 2013 curriculum to train HOTS is discovery learning [18]. The application of discovery learning in learning activities has a significant effect on the improvement of student's HOTS [19][20]. The application of guided discovery in learning activity also has a big effect to improve the student learning outcomes [21][22]. Guided discovery learning is places students as learning subjects who no longer only receive the knowledge from teacher but provide opportunities for students to actively gain their knowledge under teacher's control [23][24].

The results of pre-research data that have been carried out at MAN 1 Gresik on Tuesday, October 8th 2019 with 35 respondents shows that students get scores in the range of 0-40 in the C4 category; score 0 for the C5 category; and the score range 0-66.667 in C6 category. Based on these results, it can be seen that the average value of student's HOTS which involve C4, C5, and C6 is include in the low category because it has not reached the minimum completeness criteria for schools which is 75. The results of student questionnaires and teacher interviews show that 62.86% of students have never been HOTS trained because of time limitation and lack of student interest in learning chemistry.

Based on the description above, it is necessary to conduct research entitled "Development of Student Worksheet with Guided Discovery Oriented to Train HOTS on Thermochemistry Matter".

METHOD

The research type that used is a development research wirh R&D design according to [25]. The aim of this research is the development of student worksheet with guided discovery oriented to train HOTS of XI grade students on thermochemistry matter. R&D design according to [25] consists of 10 stages, however, this research is limited to sixth stages which is product trial. The research design consisted of potential and problem analysis, data collection, product design, design review, design validation, design revision, and limited product trials.

The subject of this research are 32 students of X grade who had not receive thermochemistry matter yet. The instruments that used to collect data consisted of student worksheet review sheet, student worksheet validation sheet, student questionnaire responses, student activity observation sheets, student's knowledge and HOTS learning outcomes test sheet.

Data collection methods in accordance with the instruments that used are involve the review method, validation method, questionnaire method, observing student activity method, and learning outcomes tests method which consisting of knowledge test through posttest and HOTS realm test through pretest and posttest.

Data of student worksheeet validation were obtained from two chemistry lecturers and one chemistry teacher. This assessment uses calculations from the Likert scale presented in Table 1.

Table 1. Likert Scale

Criteria	Score
Very good	5
Good	4
Enough	3
Less	2
Bad	1

[26]

The result data from the scale is then calculated using a formula:

$$P(\%) = \frac{total\ score\ gained}{maximum\ score} \times 100\%$$

The percentage results are then interpreted using the criteria presented in Table 2.

Table 2. Validation Interpretation Score

Percentage	Critera
0% - 20%	Invalid
21% - 40%	Less valid
41% - 60%	Quite valid
61% - 80%	Valid
81% - 100%	Very valid

[26]

Student worksheet that developed can be categorized valid if it is get a percentage of >61% [26].

Data of student responses were calculated using the Guttman scale presented in Table 3.

Table 3. Guttman Scale

Response	Score	
	Yes	No
Statement (+)	1	0
Statement (-)	0	1

[26]

The data is then processed and calculated using the following formula:

Percentage for positive statement (%) = $\frac{\sum "yes"\ answer}{\sum respondents} \times 100\%$

Percentage for negative statement (%) = $\frac{\sum "no"\ answer}{\sum respondents} \times 100\%$

The percentage results above are then interpreted into several categories according to Table 4.

Table 4. Practicality Interpretation Score

Percentage	Critera
0% - 20%	Not practical
21% - 40%	Less practical
41% - 60%	Quite practical
61% - 80%	Practical
81% - 100%	Very practical

[26]

Student worksheet that developed can be categorized practical if it is get a percentage of >61% [26].

Analysis of observations of student's activities during the learning process is seen from the most dominant activities undertaken by students in a class. The data is analyzed using the formula:

$$P(\%) = \frac{\sum frequency\ of\ observed\ student\ activity}{\sum frequency\ of\ overall\ student\ activity} \times 100\%$$

Student worksheets are categorized as practical if data analysis obtained from all aspects of the relevant activities is greater than irrelevant activities. The results of this analysis are used to support the analysis of student responses.

Analysis of student learning outcomes data obtained from the pretest and posttest. The difference between the pretest and posttest scores is used to show the improvement of student's abilities after using the developed student worksheet.

This test result data were analyzed using the N-Gain comparison with the formula:

$$\langle g \rangle = \frac{posttest\ score - pretest\ score}{score\ maximal - pretest\ score}$$ [27]

Assessment scores use a range of numbers from 0-100 according to Permendikbud number 23 of 2016. The results of the calculation of the gain score are then interpreted into Table 5.

Table 5. Gain Level Criteria

Gain Score	Criteria
$\langle g \rangle < 0.3$	Low
$0,7 > \langle g \rangle \geq 0.3$	Medium
$\langle g \rangle \geq 0.7$	High

[27]

The developed student worksheet can be categorized as effective if students get a minimum N-Gain of 0.3 or in the medium category [27]. The effectiveness aspect of the student worksheet is also reviewed from the results of the students' knowledge tests which can be seen from the results of the posttest. Student worksheets are categorized as effective if 80% of students get a score of ≥75 (minimum completeness criteria) for the knowledge domain test.

RESULT AND DISCUSSION

The results obtained include the feasibility assessment of the student worksheet that was developed. The assessment of the feasibility of student worksheet is reviewed from several aspects including validity, practicality, and effectiveness. Validity aspect is reviewed from two criteria that is content validity and construct validity. Practicality aspect is reviewed from the results of student's responses and the observations of student's activities at the time of learning. The effectiveness aspect is reviewed from the improvement of HOTS test results and student's knowledge test results.

The student worksheet with guided discovery oriented to train student's HOTS on thermochemistry matter was developed after an analysis of existing student worksheet that being used in schools, curricullum analysis, objective learning formulation, learning model analysis, and student's condition analysis. The developed student worksheet consists of 2 student worksheet which are experiment worksheets. Student worksheet 1 discussing the type of reaction enthalpy and Hess's law while student worksheet 2 discussing the concept of bonding energy and fuel.

This research was tested on 32 students of Science X grade who have not get thermochemistry matter yet. The limited trial research was conducted at SMAN 1 Manyar in January and February 2020.

Validity of Student Worksheet

The components of content and construct validity is according to [28] and [29] criteria. The validation result of student worksheet with guided discovery oriented to train HOTS were shown in Table 6.

Table 6. Validation Result

No	Aspect	Percentage (%) and Category	
		Student Work-sheet 1	**Student Work-sheet 2**
1	Content validity		
	Suitability with the matter	89.33 Very Valid	90.67 Very Valid
	Suitability with learning objectives	88.15	87.41
		Very Valid	Very Valid
	Suitability with HOTS components	82.22 Very Valid	82.22 Very Valid
	Suitability with guided discovery learning model	83.34 Very Valid	83.34 Very Valid
2	Construct validity		
	Suitability with language criteria	80 Valid	80 Valid
	Suitability with presentation criteria	93.97 Very Valid	93.97 Very Valid
	Suitability with graphic criteria	86.67 Very Valid	86.67 Very Valid

Based on Table 6, the student worksheet is categorized as valid because each assessment component gets a percentage of ≥61% [26]. Assessment of content validity and construct validity is in the range of 80% -93.97% with a valid or very valid category.

Based on Table 6 known that overall aspect of content validity get a percentage with the range of 82.22%-89.33% and have a very valid category. This result is shown that termochemistry matter that used and learning objectives formulation is suitable with 2013 curricullum and the basic competence which are 3.5 and 4.5 that concerned about the type of reaction enthalpy, Hess's law, and bonding energi. The thermochemistry content that used in student worksheet 1 which about the type of reaction entalphy and Hess's 230su si adapted from [4] and [30], meanwhile student worksheet 2 which about the concept of bonding energy and fuel is adapted from [31] and [32]. The HOTS components and learning approach that used also suitable and organized well.

The overall aspect of construct validity that shown in Table 6 get the percentage of 80%-93.93% with valid or very vallid category. This result is indicated that the used languange in developed student worksheet is already suitable with the prevail theorem, the presentation of student worksheet is very good and sistematic, also the graphic of student

worksheet that concerned on font, figure, and printout quality is very good so it can attrack the student's interest. A good quality student worksheet is using interactive and standard languange, also attrack the student's interest in learning activity so it will easily to understand by students [33].

Practicality of Student Worksheet

The practicality of student worksheets is based on the results of student's responses that are supported by observations of student's activities when learning using the developed student worksheet. The results of overall student responses are presented in Table 7.

Table 7. Student Responses Result

No	Aspect	Percentage	Category
1.	This student worksheet made me feel curious and interested in learning	96.88 %	Very Practical
2.	This student worksheet is arranged systematically	100.00 %	Very Practical
3.	The appearance of this student worksheet is interesting	96.88 %	Very Practical
*4.	This student worksheet did not motivate me to study	90.63 %	Very Practical
5.	The experimental activities in this student worksheet provide a real illustration of the matter	90.63 %	Very Practical
*6.	This student worksheet is not accompanied by an explanation that is easily understood	84.38 %	Very Practical
7.	The message in this student worksheet matches the material being studied	87.50 %	Very Practical
*8.	The use of language in this student worksheet is not easy to understand	75.00 %	Practical
9.	Using this student worksheet can help me be more active in the learning process	78.13 %	Practical
*10.	The use of images in this student worksheet is not right	87.50 %	Very Practical
11.	This student worksheet helped me solve a problem that was systematic and coherent	90.63 %	Very Practical
*12.	This student worksheet cannot help me understand the type of reaction enthalpy, Hess's law and the concept of bond energy matter.	78.13 %	Practical
13.	This student worksheet led me to conduct an investigation to reach conclusions on each problem	93.75 %	Very Practical
*14.	The use of student worksheets did not make me work with groups	100.00 %	Very Practical
15.	The contents of the student worksheet are arranged systematically and make it easy to use	100.00 %	Very Practical

∗ negative statement

Based on Table 7, the HOTS student worksheet with guided discovery oriented to train on thermochemistry matter is categorized as practical because students' responses to each component get a percentage of ≥61% ie in the range of 75%-100% with a practical or very practical category. This is supported by observing student activity data during learning activities using the developed student worksheet.

Statements in the student response questionnaire relating to content aspect are shown on number 5,7,9,11,12,13, and 14 while construct aspects relating to language criteria are found in statements numbers 6 and 8, presentation criteria are found in numbers 1,2,4 and 15, also graphic criteria are in statements number 3 and 10.

Based on the questionnaire result, students giving responses that experiment activity in student worksheet can provide the real image of thermochemistry matter that studied. This result is suitable with contructivism theory which see the study as student's active process

to construct their knowledge through of text, dialogue, physical experience, and etc [34].

The activities observed in the learning activities are adjusted to the guided discovery learning model used in the student worksheet. The guided discovery phase according to [35] includes: (1) stimulation, (2) problem statements, (3) data collection, (4) data processing, (5) verification, and (6) generalization [35]. Activities of students observed were 16 activities.

Components on the student activity sheet that are observed include: (1) listening to the teacher's explanation, (2) forming groups based on the teacher's direction, (3) observing and reading phenomena in the student worksheet, (4) discussing/asking questions, (5) formulating problems, (6) formulating hypotheses, (7) determining the variables in the experiment, (8) designing experimental procedures, (9) conducting experiments, (10) writing experimental data, (11) analyzing experimental data, (12) reading material/ literature to help analyze experimental data, (13) making conclusions, (14) presenting experimental results, analysis, and conclusions, (15) answering questions related to grammar, and (16) irrelevant activities.

The results of observations of student's activities briefly are presented in Figure 1 below.

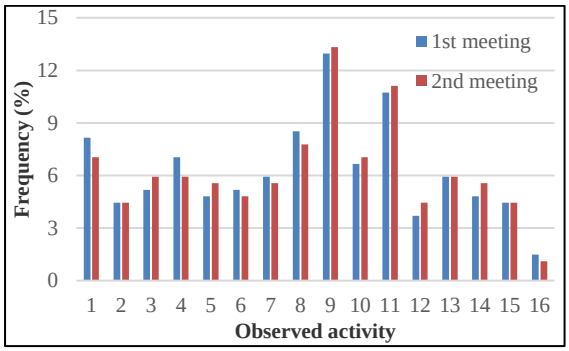

Figure 1. Graphic of Observed Student's Activities

Based on Figure 1, it is known that the overall percentage of each component of relevant activity is greater than the percentage of irrelevant activity. This shows that the developed student worksheet can be said to be practical. This result can be used as supporting data for student's responses to the questionnaire [36]. The highest percentage of activities at meeting 1 and meeting 2 is at number 9, which is conducting an experiment. The percentage of activities conducted in the first meeting was 12.96% while in the second meeting was 13.33%. This is in accordance with the developed student worksheet that students are guided to conduct investigations through experimental activities to solve the problems and tasks provided in the student worksheet.

Effectiveness of Student Worksheet

The effectiveness of student worksheets in terms of learning outcomes tests consisting of HOTS domain test results and knowledge domain test results. Each test is done individually with an allocation of 45 minutes each. Student learning outcomes test sheet consists of pretest and posttest questions. Knowledge learning outcomes test is conducted to determine student's understanding of the material after using the developed student worksheet. HOTS learning outcomes test is conducted to determine and measure HOTS of students before and after using the developed student worksheet.

Following Figure 2 shows the N-gain score diagram of students who are the subjects of limited trials.

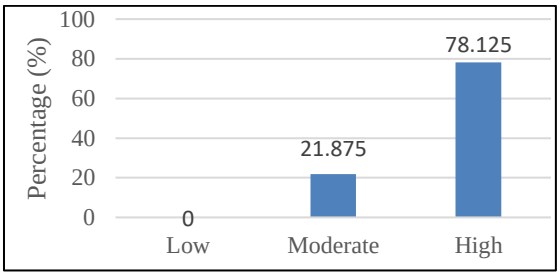

Figure 2. Percentage of Students Gain Scores

Based on Figure 2, it can be seen that students have increased HOTS test results with an N-gain range of 0.58-0.96 with moderate to high categories. The following Table 8 shows the average improvement in HOTS test results for students for each HOTS component.

Tabel 8. HOTS Test Results for Each Component

No	HOTS Component	Average Score	
		Pretest	Posttest
1	C4 (Analyze)	41.49	80.38
2	C5 (Evaluate)	0	75
3	C6 (Create)	32.69	92.55

The data in Table 8 is the overall data of student test results on each HOTS component before and after learning using the developed student worksheet. The developed student worksheet is content of 2 student worksheet with the type of reaction enthalpy and Hess's law in student worksheet 1 and the concept of bonding energy and fuel in student worksheet 2. The student worksheet is consist of phenomenon that relevance with the discussed matter and considered close with student's condition.

The phenomenon of student worksheet 1 is adapted from [4] and [37] which concerned about obecity and determination the calories of chips while the phonomenon of student worksheet 2 was adapted from [31] and [32] which concerned about alcohol as fuel and determination of its enthalpy. Based on phenomenon that student's read, they have to anwser the several question that direct them to conduct an experiment, analyze the data, and make conclusion to understand the thermochemistry matter. The question in student worksheet is adjusted to indicator, HOTS components, and guided discovery approach.

The HOTS component in student worksheet are C4 (Analyze) which includes formulate problem; identify experiment variables; and analyze data, C5 (Evaluate) includes making conclusions and C6 (Create) which includes making hypotheses; designing experimental procedures; making observational data tables; and discovering ideas [7][8].

Based on these data it is known that each HOTS component consisting of C4 (Analyze), C5 (Evaluate), and C6 (Create) has an average value of ≥75 so that it can be said that HOTS students have been trained well. This result is shown that student's completeness of HOTS test result reach 100% for individual and classical completeness in each component. Based on the Table 8 known that C6 (create) component have the highest average value. This result is supported by [38] which state that student's ability to design an experiment that start with hypothesis formulation has a small positive result. These results cannot be separated from the existence of training activities through appropiate learning and the use of student worksheet [38].

Table 8 also shown that C5 (evaluate) component have lowest average value than other components. It is because partly of students not able yet to conclude correctly. This result due to student's information processing still uncomplete. Students when conclude is less of concentration so the information their have is discontinue to short term memory. The information that enter short term memory will miss if there is no repeating and concentrating so the information is discontinue to long term memory [39].

Knowledge learning achievement test is used to find out the final knowledge and level of understanding students have towards thermochemical material. The problem of learning outcomes in the realm of knowledge is in the form of multiple choice questions with five answers (A-E). The completeness data of student's knowledge about the thermochemical material is presented in Figure 3 below.

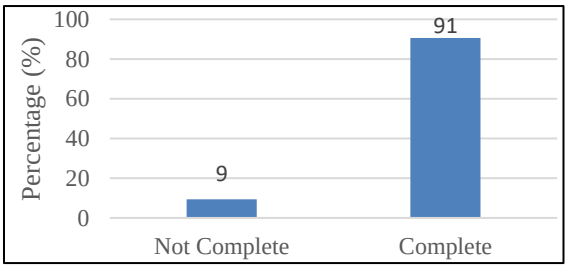

Figure 3. Percentage of Student's Completeness

Based on Figure 3, it can be seen the completeness of student's understanding of the thermochemistry matter given. The minimum completeness criteria for chemistry subjects is 75. Figure 3 shown that 9% of students cannot reach completeness yet. This result shown that they have less understanding the thermochemistry matter.

Based on the constructivism theory, learning outcomes very depend on the learning environment, student's knowledge and need student's willingness to accept their studied knowledge [40]. [41] stated that student's understanding develop in different ways on different assignment and their study experience have a large effect on student's cognitive development rate. This result is supported by the implication of Piaget's cognitive theory in education that is "acceptance of individual's difference in advencement of development". Piaget's theory assume that every child pass the

same development stage but they did it with different rate [24]. Knowledge learning outcomes sheet compiled in multiple choice question so there is possiblity that students answer the question randomly [42].

Classical completeness of knowledge learning result is obtained if ≥80% of students reach the minimum completeness criteria that applies to the knowledge domain test. Student worksheets are effective if it is comply with classical completeness criteria. Based on these data it is known that ≥80% of students are said to be classically complete. This result is evidence that student worksheets with guided discovery oriented to train HOTS on thermochemistry matter can be categorized effectively used in learning activities.

CONCLUSION

Based on the problem formulation and discussion that have been described, it can conclude that student worksheet with guided discovery oriented to train HOTS in thermochemistry matter is feasible in term of validity, practicality, and effectiveness which are described as follows:

1. Validity aspect is viewed from content validity and construct validity. The content validity of student worksheet get percentage of 85.76% with very valid category for student worksheet 1 and 85.91% with very valid category for student worksheet 2. The construct validity includes language, presentation, and graphic criteria obtained average percentage of 87.16% with very valid category for student worksheet 1 and 2.
2. Practicality aspect is viewed from the result of student responses that get percentage in range 75-100% with practical to very practical category. The results of observations of students' activities are used as supporting data which shows that overall relevant activities are greater than the activities of students that are not relevant.
3. Effectiveness aspect is viewed from the student's HOTS test result that get gain score in range 0.58-0.96 with moderate to high criteria and supported by the knowledge domain test result which shows the classical mastery learning is >80%. This shows that there is an increase in HOTS test results for each student.

SUGGESTION

Some suggestions for improvement in future research are:

1. The development of student worksheet with guided discovery oriented to train HOTS in thermochemistry matter is further enhanced in C5 (evaluate) category, which is making conclusion.
2. Student worksheet that used as trial products in this research were revised products after validation, so the student worksheet that used as trial products and validation is different. The revised student worksheet that will be used as trial product should re-validated so the student worksheet that used in the trial is truly valid.

REFERENCES

[1] George-Williams, S. R., Soo, J. T., Ziebell, A. L., Thompson, C. D., & Overton, T. L. (2018). Inquiry and Industry Inspired Laboratories: the Impact on Students' Perceptions of Skill Development and Engagements. *Chemistry Education Research and Practice, 9*, 583-596.

[2] Mamlok-Naaman, R., Eilks, I., Bodner, G., & Hofstein, A. (2018). *Advances in Chemistry Education Series No. 1, Professional Development of Chemistry Teachers: Theory and Practice.* United Kingdom: the Royal Society of Chemistry.

[3] Retno, A. T., Saputro, S., & Ulfa, M. (2018). Properness Test: Development of an Inquiry-Based Learning Module to Improve Science Literacy in Thermochemistry Subject. *The 8th Annual Basic Science International Conference* (hal. 1-8). Surakarta: AIP Publishing.

[4] Dingrando, L., Gregg, K., Hainen, N., & Wistorm, C. (2004). *Chemistry: Matter & Change, Student Edition (GLENCOE CHEMISTRY) 2nd Edition.* USA: McGraw Hill.

[5] Susparini, N. T., Ashadi, & Masykuri, M. (2016). Pengaruh Model Pembelajaran Inkuiri Terbimbing dan Inkuiri Bebas Termodifikasi pada Materi Termokimia terhadap Keterampilan Berpikir Tingkat Tinggi dan Hasil Belajar Siswa Kelas XI SMA Negeri 1 Sukoharjo Tahun Pelajaran 2015/2016. *Jurnal Pendidikan Kimia, 5*(2), 44-51.

[6] Sani, R. A. (2019). *Pembelajaran Berbasis HOTS (Higher Order Thinking Skills).* Tangerang: Tira Smart.

[7] Anderson, L., & Krathwohl, D. (2001). *A Taxonomy for Learning, Teaching, and Assessing.* England: Longman.

[8] Nugroho, R. A. (2018). *HOTS (Kemampuan Berpikir Tingkat Tinggi: Konsep, Pembelajaran, dan Soal-soal).* Jakarta: PT Gramedia Widiasarana Indonesia.

[9] Tajudin, N. M., & Chinnappan, M. (2016). The Link between Higher Order Thinking Skills, Representation, and Concepts in Enhancing TIMSS Tasks. *International Journal of Instruction, 9*(2), 119-214.

[10] Fakhomah, D. N., & Utami, M. S. (2019). Pre-Service English Teacher Perception about Higher Order Thinking Skills (HOTS) in the 21st Century Learning. *International Journal of Indonesian Education and Teaching, 3*(1), 41-49.

[11] Riyana, C. (2012). *Media Pembelajaran.* Jakarta: Direktorat Jenderal Pendidikan Islam, Kementrian Agama RI.

[12] Asri, D. Z., Novita, D., & Yonata, B. (2017). The Development of Student Worksheet with Contextual Teaching and Learning Oriented on Thermochemical Matter to Train Student Critical Thinking Skills. *Unesa Journal of Chemical Education*, 66-73.

[13] Prahasta, F. L., Agustini, R., & Hidayah, R. (2018). Development of Student Worksheet Based on Guided Inquiry Model with KIT Instrument of Reaction Rate Matter to Train the Science Process Skills in XI Grade Senior High School 1 Cerme. *Unesa Journal of Chemical Education*, 52-57.

[14] Zulaicha, A. S., Fadiawati, N., & Tania, L. (2016). Pengembangan Lembar Kerja Siswa Berbasis Pendekatan Saintifik pada Materi Termokimia. *Jurnal Pendidikan dan Pembelajaran Kimia*, 179-190.

[15] Verdina, R., Gani, A., & Sulastri. (2018). Improving Student's Higher Order Thinking Skills in Thermochemistry Concept Using Worksheets Based on 2013 Curriculum. *Journal Of Physics*, 1-6.

[16] Yonata, B., Tjahjani, S., & Novita, D. (2018). Student's Creativity and High-Order Thinking Skills in Laboratory Activity of Surface Chemistry. *Proceedings of Mathematics, Informatics, Science, and Education International Conference (MISEIC 2018). 157*, pp. 54-58. Surabaya: Atlantis Press.

[17] Ghani, I., Ibrahim, N., Yahaya, N., & Surif, J. (2017). Enhancing Students' HOTS in Laboratory Educational Activity by Using Concept Map as an Alternative Assessment Tool. *Chemistry Education Research and Practice, 18*, 849-874.

[18] Kemendikbud. (2016). *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 22 Tahun 2016 tentang Standar Proses Pendidikan Dasar dan Menengah.* Jakarta: Kementerian Pendidikan dan Kebudayaan.

[19] Riandari, F., Susanti, R., & Suratmi. (2018). The Influence of Discovery Learning Model Application to the Higher Order Thinking Skills Student of Srijaya Negara Senior High School Palembang on the Animal Kingdom Subject Matter. *Journal of Physics: Conference Series*, 1-8.

[20] Rudibyani, R. B., & Perdana, R. (2018). Enhancing Higher-order Thinking Skills using Discovery Learning Model's on Acid-Base pH Material. *International Conference on Science and Applied Science* (pp. 1-10). Surakarta: AIP Publishing.

[21] Aswardi. (2017). The Implementation of Guided Discovery Learning Method to Improve Student Learning Outcomes at Electromagnetic Control System and Operation Course. *The International Journal of Counseling and Education, 2*(2), 85-91.

[22] Batubara, I. H. (2019). Improving Student's Critical Thinking Ability Through Guided

Discovery Learning Methods Assisted by Geogebra. *International Journal for Education and Vocational Studies, 1*(2), 116-119.

[23] Martaida, T., Bukit, N., & Ginting, E. M. (2017). The Effect of Discovery Learning Model on Student's Critical Thinking and Cognitive Ability in Junior High School. *IOSR Journal of Research & Method in Education, 7*(6), 1-8.

[24] Slavin, R. E. (2006). *Educational Psychology: Theory and Practice 8th Edition.* Boston: Pearson.

[25] Sugiyono. (2016). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfa Beta.

[26] Riduwan. (2015). *Skala Pengukuran variabel-variabel Penelitian.* Bandung: Alfabeta.

[27] Hake, R. R. (1998). Interactive-engangement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*(1), 64-74.

[28] Badan Standar Nasional Pendidikan. (2014). *Penilaian Buku Teks Pelajaran Kimia untuk Siswa SMA/MA.* Jakarta: BSNP.

[29] Depdiknas. (2008). *Panduan Pengembangan Bahan Ajar*. Jakarta: Departemen Pendidikan Nasional.

[30] Tro, Nivaldo J. (2017). *Chemistry : A Molecular Approach 4th Edition*. Boston : Pearson.

[31] Kotz, J. C., Treichel, P. M., & Townsend, J. R. (2012). *Chemistry and Chemical Reactivity, Eight Edition.* USA: Brooks/Cole.

[32] OCR. (2012). *Cambridge Nationals : Science ½ Unit R073- How Scientists Test Their Ideas : Burning Fuels*. England : Oxford Cambridge and RSA Examination.

[33] Widjajanti, E. (2008). Kualitas Lembar Kerja Siswa. *Pelatihan Penyusunan LKS Mata Pelajaran Kimia Berdasarkan Kurikulum Tingkat Satuan Pendidikan Bagi Guru SMK/MAK* (hal. 1-7). Yogyakarta: Kimia FMIPA UNY.

[34] Waseso, H. P. (2018, Januari). Kurikulum 2013 dalam Perspektif Teori Pembelajaran Konstruktivis. *Ta'lim : Jurnal Studi Pendidikan Islam, 1*(1), 59-72.

[35] Ariyana, Y., Pudjiastuti, A., Bestari, R., & Zamroni. (2019). *Buku Pegangan Pembelajaran Berorientasipada Keterampilan Berpikir Tingkat Tinggi.* Jakarta: Kementrian Pendidikan dan Kebudayaan.

[36] Aisyah, D., & Yonata, B. (2019). The Development of Student Worksheet to Train Critical Thinking Skills in Acid Base Matter for Senior High School in 11th Grade. *Unesa Journal of Chemical Education, 8*(3), 340-349.

[37] Wulandari, S., Lestari, H., & Fachlevy, A. F. (2017). Faktor yang Berhubungan dengan Kejadian Obesitas pada Remaja di SMA Negeri 4 Kendari Tahun 2016. *Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat, 1*(3), 1-13.

[38] Szalay, L., Toth, Z., & Kiss, E. (2020). Introducing Students to Experimental Design Skills. *Chemistry Education Research and Practice, 21*, 331-356.

[39] Arends, R. (2012). *Learning to Teach 9th Edition.* New York: Mc Graw Hill.

[40] Brooks, J. G., & Brooks, M. G. (1999). *In search of understanding : the case for constructivist classroom.* Virginia: ASCD.

[41] Woolfolk, A. (2016). *Educational Psychology, THIRTEENTH EDITION.* USA: Pearson Education.

[42] Yuliati, S. R., & Lestari, I. (2018). Higher-Order Thinking Skills (HOTS) Analysis of Students in Solving HOTS Question in Higher Education. *PERSPEKTIF Ilmu Pendidikan, 32*(2), 181-188.