Development of Guided Inquiry-Based Learner Worksheets to Improve Higher Level Thinking Skills of Learners on Redox Reaction Material

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Abstract This research aims to: (1) knowing the level of need for guided inquiry-based Learner Worksheets (LKPD) at Imelda Medan Private High School. (2) to know the design of LKPD based on guided inquiry on redox material. (3) knowing the feasibility of LKPD according to BSNP standards. (4) knowing the improvement of students' higher-level thinking skills and. (5) knowing the students' response to the guided inquiry-based LKPD on redox reaction material that has been developed. This development was carried out using the R&D method with the 4D development model (Define, Design, Develop, Disseminate). The instruments used are interview guidelines, LKPD validation sheets by validators, questionnaire sheets for students' responses to the developed LKPD. The results of this study indicate that the LKPD prepared has met the eligibility criteria according to BSNP standards validated by material experts and media experts who are UNIMED chemistry lecturers by obtaining a percentage value of 88.46% with the criteria "very feasible needs revision". The average value of students' higher order thinking skills after being taught using the developed LKPD was 83.48 with an n-gain value of 0.79 and the results of students' responses were 85.14% with "very good" criteria. So that overall the guided inquiry-based Learner Worksheet to improve students' higher-level thinking skills is feasible to use in the learning process, especially in redox reaction material.

How to Cite: Br Tarigan, E., & Sugiharti, G. (2024). Development of Guided Inquiry-Based Learner Worksheets to Improve Higher Level Thinking Skills of Learners on Redox Reaction Material. *Jurnal Teknologi Pendidikan : Jurnal Penelitian dan Pengembangan Pembelajaran, 9*(2), 301-307. doi:https://doi.org/10.33394/jtp.v9i2.11188

Introduction

Education today is inseparable from 21st century competencies, where in this century learning will be student centered and there are competencies that students must have. To achieve these competencies, students are required to be able to actively and independently form 4C skills consisting of critical thinking, communication, collaboration, and creativity (Indarta, 2021). The importance of 4C for students is because there are thinking skills that must be the main focus so that the goal of mastering 21st century thinking skills/4C can be achieved. These skills are high-order thinking skills (HOTS) (Saido, et al. 2018).

Carroll & Harris (2020) informed that Bloom, Krathwol, and Anderson's research shows that students have six levels of thinking, such as: remembering (CI); understanding (C2); applying (C3); analyzing (C4); evaluating (C5); and creating (C6). Of the six levels of

thinking, analyzing, evaluating and creating skills are standard indicators in higher order thinking skills. (Saregar, Latifah, & Sari, 2016).

Chemistry subjects use a combination of theoretical and mathematical concepts so that higher order thinking skills need to be applied in chemistry learning. According to Astutik (2017), chemical concepts are tiered concepts from simple to higher-level concepts. Based on this statement, a correct understanding of the basic concepts is needed so that it can build an understanding of higher-level concepts. One of the concepts in chemistry that is tiered is the concept of Oxidation-Reduction Reaction (Redox).

In addition, Harefa (2020) stated that current chemistry learning is still considered difficult by students, even though students have not tried to learn it. This mindset will have an influence on the cognitive, affective, and psychomotor domains of students. The impact is seen in research (Sugiharti, 2021) in the form of the lack of students' abilities when learning chemistry as evidenced by the average student learning outcomes at SMA Negeri 10 Medan, which still do not meet the minimum completeness criteria (KKM) so that later students will have difficulty when working on HOTS practice questions. In order for the learning process to be of high quality and in line with the learning objectives, teaching materials are applied. The selection of appropriate teaching materials is an important factor in honing students' higher order thinking skills. An example is the Learner Worksheet (LKPD). LKPD is one of the teaching materials that is often used but less developed so that it is less optimal in its use (Dewi, 2020).

Learner Worksheet (LKPD) is one of the means to help and facilitate learning activities so that effective interaction between students and educators will be formed so that it can increase students' activities in improving their high-level thinking skills. The activity of solving problems in the LKPD which can later have an impact on improving the way of thinking including high-level thinking (Astuti, Danial, & Anwar, 2018). In the research of Verdina, Gani, & Sulastri (2018), entitled Improving students' higher order thinking skills in thermochemistry concept using worksheets based on 2013 curriculum shows that using student worksheets or LKPD can improve students' HOTS.

Based on the results of interviews conducted by researchers with chemistry teachers at SMA Swasta Imelda Medan, it shows that some teachers have used LKPD during the chemistry learning process, especially on redox material. However, the LKPD used by the teacher is not the result of the teacher's development but the LKPD in the book, so it is not in accordance with the needs and conditions of students in improving their high-level thinking skills. In addition, the LKPD used by the teacher also has not touched on the relationship between the material and the context of students' lives. This causes the understanding of concepts received by students to be less well digested and less trained so that the students' higher-level thinking skills are still fairly low.

An example of appropriate learning to be implemented in this problem is guided inquiry-based learning. Guided inquiry is one of the learner-centered learning models where the teacher's role is to direct learners to get new ideas through learning activities rather than explaining existing ideas (Yuzan and Jahro, 2022).

The guided inquiry model also stimulates and strengthens students' higher order thinking skills. In the learning process with this model, learners are encouraged to think critically, analyze information, and find solutions to complex problems. This develops

higher-order thinking skills such as analysis, synthesis, evaluation, and a deeper understanding of the subject matter studied (Kanj, 2023).

The development of guided inquiry-based LKPD is appropriate to try with the aim of improving students' higher order thinking skills. LKPD based on guided inquiry has distinctive characteristics, namely consisting of guided inquiry stages, presenting investigation activities and questions designed to train students' higher order thinking skills (Firdaus & Wilujeng, 2018).

The investigation activities are carried out by raising cases around students. The case provides an opportunity for learners to analyze phenomena that occur in the surrounding environment themselves, as well as apply the knowledge that learners have and provide solutions (Rachman, Ahsanunnisa, & Nawawi, 2017).

Research Methods

The research conducted is included in development research that refers to the development of Research and Development (R&D) with the 4D research model which consists of 4 research stages namely Define, Design, Develop, Disseminate. This research produces products in the form of guided inquiry-based Learner Worksheets to improve students' higher order thinking skills on redox reaction material. This research was conducted at Imelda Medan Private High School which is located at Jalan Bilal No. 24, Pulo Brayan Darat I, East Medan District, Medan City, North Sumatra.

The population in this study were all students of class X MIA at SMA Swasta Imelda Medan even semester of the 2023/2024 school year consisting of 3 MIA classes with a total population of 185 students. Sampling in this study was taken by purposive sampling technique, so students from class X MIA 1 were sampled with a total of 31 students.

The instruments used in this research are test and non-test instruments. The test instrument used is 10 essay questions to measure students' higher order thinking skills. While the non-test instrument used is a questionnaire for the feasibility of guided inquiry-based student worksheets according to BSNP (National Education Standards Agency) standards and a student response questionnaire. For non-test data analysis, the feasibility of BSNP-based module validation is shown in table 1 below.

Table 1. Percentage Range and Feasibility Criteria

Percentage Range	Criteria
81,25% - 100%	very feasible
62.5% - 81.24%	feasible
43.75% - 62.49%	decent enough
25% - 43.74%	not feasible

To determine the average level of answer scores from expert validators, this study used the following formula:
Percentage value = (validator answer score/total value should be) x 100% (Kamelta, 2013).

The aspects available in the LKPD validation questionnaire include: content feasibility, language feasibility, presentation feasibility and graphic feasibility. Analysis of learner response data is calculated with the same percentage using the formula above and then converted to the percentage result criteria in table 2.

Table 2. Percentage range of learner response questionnaire

Percentage Range	Criteria
81,25% - 100%	very good
62.5% - 81.24%	good
43.75% - 62.49%	good enough
25% - 43.74%	not good

To determine the increase in students' high-level thinking skills after using the guided inquiry-based LKPD developed is higher than the thinking skills of students using LKPD in the textbook at school, the n-Gain test is used. The criteria for the test results if $g < 0, 3$: then the low category, $0, 3 \leq g \leq 0, 7$: then the medium category, $g > 0, 7$: then the high category (Meltzer, 2002).

Research Results and Discussion

The main result of this research is a guided inquiry-based chemistry LKPD product to improve students' higher order thinking skills. This guided inquiry-based LKPD was developed using the 4D model which consists of 4 stages, namely defining, designing, developing, disseminating.

At the defining stage, a needs analysis has been carried out through interviews with chemistry teachers which will then be designed at the design stage by going through the material selection and format selection stages. Furthermore, at the development stage, validation is carried out to media experts and material experts, as for the average percentage of validation results of media and material experts in the diagram below:
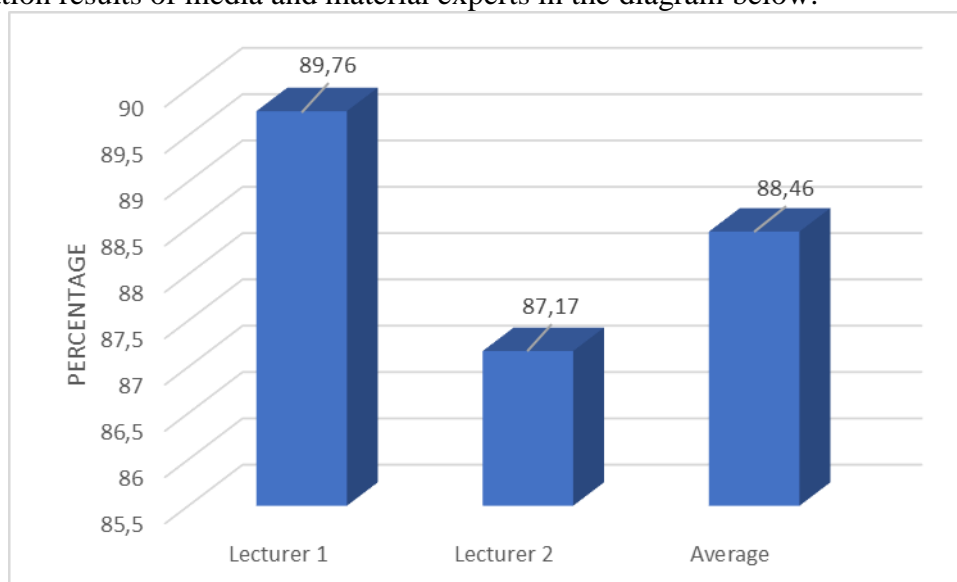

Figure 1. Average percentage of validation results of media and material experts

For the average of the guided inquiry-based LKPD assessment is in accordance with BSNP standards with an average percentage value of 88.46%, indicating that this LKPD is included in the "very feasible and needs revision" category. In line with previous research,

namely Noviani's research (2021) entitled "Design and trial of guided inquiry-based student worksheets (LKPD) on chemical bonding material". The resulting student worksheet has been tested by obtaining a validity level of 93.59% (very feasible) From these results, it identifies that the student worksheets tested are suitable to be used as additional teaching materials for teachers at school. Here are some guided inquiry-based LKPD designs that have passed the revision stage:
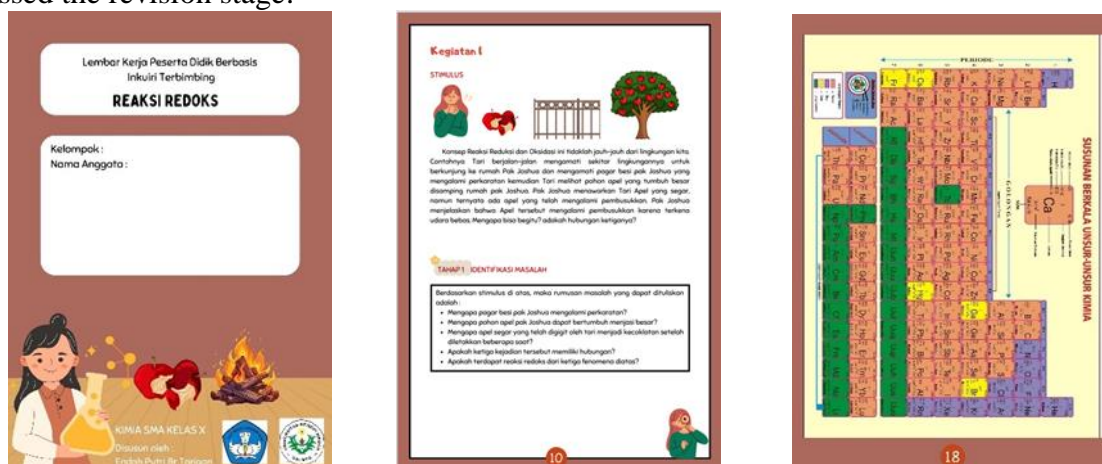

Figure 2. Inquiry-based LKPD designs

In the final stage, namely the dissemination stage, the revised LKPD was disseminated to determine the magnitude of the increase in students' higher-level thinking skills and student responses after using LKPD in chemistry learning, especially redox material. The results of the dissemination stage obtained an increase in students' higher-level thinking skills with an n-gain value of 0.79 in the "medium" category. Based on previous research by Junita & Sugiharti (2023) entitled Development of STEM-based LKS on redox reaction material to improve students' HOTS, the resulting n-gain test value is 0.69 in the "medium" category where it can be concluded that the use of STEM-based LKS has a role in improving students' higher-level thinking skills.

In addition to increasing students' higher order thinking skills, there was also a positive response from students to the LKPD developed with an average percentage value of 85.14% in the questionnaire in the "very good" category. . In line with previous research by Sari & Jahro (2023) entitled Development of Guided Inquiry-Based Learner Worksheets (LKPD) to Improve Students' Critical Thinking Skills on the Material Composing Particles of Objects, it can be seen that students' responses to guided inquiry-based LKPD on the material composing particles of objects to improve students' critical thinking skills contain positive responses. This is shown through the average percentage figure of 74%. Based on the percentage results, it is included in the very interesting category. This guided inquiry-based LKPD is able to encourage student curiosity which is seen during the learning process with students often asking questions and finding out about something that is being faced.

Conclusion

Based on the results and discussion that has been presented, it can be concluded that the guided inquiry-based LKPD developed on redox reaction material has fulfilled the BSNP eligibility aspects with a score of 88.46% which is categorized as "very valid and needs

revision", as well as with its implementation which provides an increase in students in answering HOTS questions as evidenced by the results of the N-gain test which is worth 0.79 and is categorized as "moderate" along with the positive response from students to the developed product which is marked with a value of 85,14% including in the "very good" category.

Suggestion

Researchers suggest to chemistry teachers to use this developed LKPD on redox reaction material as a learning teaching material, because this LKPD has been declared very good and feasible to use in learning chemistry, especially on redox reaction material and is able to improve students' higher order thinking skills.

Acknowledgments

References

Astuti, S., Danial, M., & Anwar, M. (2018). Pengembangan LKPD Berbasis PBL untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik pada Materi Kesetimbangan Kimia. *Chemistry Education Review (CER)*. 1 (2) : 90-114.

Astutik, T. P. (2017). Identifikasi Konsep Sukar dan Kesalahan Konsep Reaksi Redoks. *Jurnal Zarah.* 50 (1) : 22-28. https://doi.org/10.31629/zarah.v5i1.155.

BSNP (2014). *Permendikbud Nomor 59 Tahun 2014 tentang Standar Proses Pendidikan Dasar Dan Menengah.* Kemendikbud. Jakarta.

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.

Dewi, N., & Hamdu, G. (2020). LKS Pembelajaran STEM Berdasarkan Kemampuan 4C dengan Media Lightning Tamiya Car. *Jurnal Imiah Pendidikan dan Pembelajaran*, 4(2) : 369- 378.

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.

Harefa, N., Tafonao, G. S., & Hidar, S. (2020). ANALISIS MINAT BELAJAR KIMIA SISWA MELALUI PEMBELAJARAN BERBASIS MULTIMEDIA. PAEDAGORIA. *Jurnal Kajian, Penelitian dan Pengembangan Kependidikan*, 11(2), 81-86.

Junita, V., & Sugiharti, G. (2023). Pengembangan LKS Berbasis STEM Pada Materi Reaksi Redoks Untuk Meningkatkan HOTS Siswa. *Proceedings Series of Educational Studies*, 127-132.

Kamelta, E. (2013). Pemanfaatan internet oleh mahasiswa jurusan teknik sipil fakultas teknik Universitas Negeri Padang. *Jurnal Cived,* 1(1) : 142-146.

Kanj, R. (2023). The Influence of the Inquiry-Based Model on Improving High Level Thinking Skills of Students at Al-Kawthar School, Lebanon. *Journal of Global and Multidisciplinary,* 1(1) : 1-6.

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

Meltzer, D. E. (2002). The relationship between mathematics preparation and conceptual learning gains in physics: A possible "hidden variable" in diagnostic pretest scores. *American journal of physics*. 70 (12) : 1259-1268.

Noviani, S. (2021). *DESAIN DAN UJI COBA LEMBAR KERJA PESERTA DIDIK (LKPD) BERBASIS INKUIRI TERBIMBING PADA MATERI IKATAN KIMIA* (Doctoral dissertation, UNIVERSITAS ISLAM NEGERI SULTAN SYARIF KASIM RIAU).

Rachman, FA, Ahsanunnisa, R., & Nawawi, E. (2017). Pengembangan LKPD berbasis berpikir kritis materi kelarutan dan hasil kali kelarutan pada mata pelajaran kimia di SMA. *ALKIMIA: Jurnal Ilmu Kimia dan Terapan* , *1* (1) : 16-25.

Saido, G. M., Siraj, S., Nordin, A. B. Bin, & Al_Amedy, O. S. (2018). Higher Order Thinking Skills Among Secondary School Students in Science Learning. *MOJES: Malaysian Online Journal of Educational Sciences*, 3(3) :13–20.

Saregar, A., Latifah, S., & Sari, M. (2016). Efektivitas Model Pembelajaran CUPS: Dampak Terhadap Kemampuan Berpikir Tingkat Tinggi Peserta Didik Madrasah Aliyah Mathla'ul Anwar Gisting Lampung. *Jurnal Ilmiah Pendidikan Fisika Al-BiRuNi*, 5 (2)

Sari, N., & Jahro, I. S. (2023). PENGEMBANGAN LEMBAR KERJA PESERTA DIDIK (LKPD) BERBASIS INKUIRI TERBIMBING UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR KRITIS SISWA PADA MATERI PENYUSUN PARTIKEL BENDA. *Jurnal Pendidikan Sosial dan Humaniora*, 2(3).

Sugiharti, G., & Ananda, W. R. (2021). The Effect of Instruction Model Using Media and Motivation on Chemical Learning Results (Study of The Effect of Instruction Models Using Media and Motivation in Learning). *In Journal of Physics: Conference Series*, 1940(1).

Verdina, R., & Gani, A. (2018). Improving students' higher order thinking skills in thermochemistry concept using worksheets based on 2013 curriculum. In *Journal of Physics: Conference Series*. 1088 (1). IOP Publishing.

Yuzan, I. F., & Jahro, I. S. (2022). Pengembangan e-LKPD Berbasis Inkuiri Terbimbing pada Pokok Bahasan Ikatan Kimia untuk Mengukur Kemampuan Berpikir Kritis Siswa. *Ensiklopedia: Jurnal Pendidikan Dan Inovasi Pembelajaran Saburai*, *2*(01) : 54-65.