

## The Development of E-Worksheet based on Discovery Learning with Google Docs to Improve Students' Higher Order Thinking Skills

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### Keywords

Discovery learning, HOTS, Student worksheet, Google Docs

### Abstract

This study aimed to 1) find out the feasibility of the E-worksheet based on discovery learning with Google Docs product, 2) explain the practicality of the E-worksheet based on discovery learning with Google Docs product, and 3) understand the effectiveness of the E-worksheet based on discovery learning with Google Docs product to grow higher order thinking skills (HOTS) of VIII grade junior high school students on the simple machine topic. The study was a research and development (R&D) with the 4D model. The subjects were 32 students of VIIIA class in SMPN 4 Pakem. The instruments were product validation sheet, students' response questionnaire, pre-test and post-test questions, and learning observation sheet. The feasibility and practicality of the product were analyzed using score conversion. The results of the pre-test and post-test were analyzed using qualitative and quantitative descriptive analysis to find out the effectiveness of the product. The research concluded that 1) the E-worksheet based on discovery learning with Google Docs product was very feasible, both in the material and media aspects, 2) the E-worksheet based on discovery learning with Google Docs was practical based on the teacher and students' responses, and 3) the E-worksheet based on discovery learning with Google Docs was effective to build the HOTS of the students.

### INTRODUCTION

Education plays an important role in the development of the nation (Makhin, Maryuningsih, & Saifuddin, 2014). Education in the 21st century must reflect four skills, namely (1) critical thinking and problem solving; (2) creativity and innovation; (3) communication; and (4) collaboration. These skills are considered higher order thinking skills (HOTS) (Pratiwi, Dewi, & Paramartha, 2019).

However, the HOTS ability of Indonesian students still needs to be improved, as shown by the results of the 2018 PISA assessment (Schleicher, 2019) and also the 2018 TIMSS, which shows that Indonesia is in the lower ranking. The low achievement is strongly related to Indonesian students that are not used to facing TIMSS and PISA questions that measure students' cognitive abilities at the level of knowing, applying, reasoning, formulating, and interpreting in various contexts (Jailani & Retnawati, 2016).

The HOTS of students at SMP N 4 Pakem still need to be improved. The result of the previous assessment performed with HOT

questions for students in grade VIII A shows that the average score is 68.75 on the topic of Work and Power, and the average of 68.12 on the topic of Simple Machines and Inclined Planes, which are below the minimum threshold of 75. The N-gain from the pre-test and post-test performed during the learning process is 0.15 for the topic of Work and Power, and 0.03 for the topic of Simple Machines and Inclined Planes, which are in the low category. This shows that there is no significant improvement in students' HOTS in the previous learning process.

In the science learning conducted at SMP N 4 Pakem, HOTS questions have been given in the exams and assessments. However, a student worksheet specialized in HOTS activities to increase the HOTS ability of students has not been developed before. In the Simple Machine topic, students need to understand the concepts and apply them to various problems. For this reason, the most appropriate learning model is discovery learning with a syntax consisting of stimulation, problem identification, data collection, data processing, proofing, and making conclusions

(Budi, 2022). Although the learning is designed with discovery learning, the worksheets used in SMP N 4 Pakem are not designed according to the discovery learning syntax.

The learning process at SMP N 4 Pakem is conducted online with Google Meet, so students are not facilitated to work on their worksheets. If they are given assignment or homework, the teacher cannot supervise and guide the students in doing assignments. As a result, they are difficult to submit their assignments on time. So, a worksheet needs to be developed that can be used simultaneously by students and can be supervised directly by the teacher.

Science learning should involve students in various domains, such as cognitive, psychomotor, and affective learning (Hisbullah & Selvi, 2018). Science learning emphasizes direct experience, understanding of nature, and practice (Wilujeng, 2020). This study develops a student worksheet covering a learning material that is capable to encourage students to participate in activities that make them active in learning.

A student worksheet is a learning material consisting of questions and information designed to guide students in carrying out activities (Choo, Rotgans, Yew, & Schmidt, 2011), which is also available in electronic form and done digitally, i.e.: electronic worksheet (E-worksheet) (Ramlawati, Liliarsari, Martoprawiro, & Wulan, 2014), that can be accessed by the students via the internet (Ramadhana & Hadi, 2022). In this study, the E-worksheet is developed with Google Docs, which is a word processing application that can be accessed online and allows users to collaborate remotely (Indriasari, 2020). Through Google Docs, students can work on the worksheets and discuss directly and improve communication and collaboration (Gozali, 2020).

The product in this particular research is developed using the discovery-learning model. By using the discovery learning-based student worksheet, teachers can direct the mindset of students, grow students' independence, find knowledge independently, and make students to be more active in the learning activities (Agustha, Susilawati, & Haryati, 2021). The syntax of the discovery learning model consists of 1) stimulation, 2) identifying problems, 3) collecting data, 4) processing data, 5) proving, and 6) making conclusions (Telaumbanua, 2022). A student worksheet for science learning developed with the discovery model emphasizes students to think critically and use their HOTS (Pratiwi & Yulkifli, 2019). The use of the discovery-learning model is a way to improve the HOTS of students.

HOTS include problem-solving skills, creative and critical thinking, analysis skills, the ability to argue, and the ability to make decisions (Fani, Fauziana, & Rahmiaty, 2021). The indicators to measure the HOTS are analyze (C4), evaluate (C5), and create (C6) (Anderson & Krathwohl, 2001). The developed product in this study aims to improve students' HOTS according to these indicators.

This study develops the E-worksheet based on discovery learning with Google Docs to build HOTS of students. The aims of this study are 1) to find out the feasibility of the E-worksheet based on discovery learning with Google Docs, 2) to explain the practicality of the E-worksheet based on discovery learning with Google Docs, and 3) to know the effectiveness of the E-worksheet based on discovery learning with Google Docs to grow HOTS of junior high school students.

## **RESEARCH METHOD**

The study was a research and development (R&D) with 4-D models, that is Define, Design, Develop, and Disseminate (Thiagarajan, Semmel, & Semmel, 1974). This study was performed until the develop stage. The first stage is the define stage consisting of initial analysis, student analysis, concept analysis, task analysis, and the making of learning objectives. The second stage is the design stage consisting of the making of instruments, the selection of teaching materials and formats, and the making of the initial design. The development stage consisting of expert validation and limited trial.

The developed product in this research was E-worksheet based on discovery learning with Google Docs to build HOTS of junior high school students. The study was conducted in October 2021. The subjects of the study consisted of 32 students of grade VIII A. The data collection technique used non-test techniques that consisted of product validation assessments, student and teacher response questionnaires, learning observation sheet, and test techniques in the form of pre-test and post-test to determine the students' HOTS. Limited trial was conducted using the one group pre-test post-test design.

The feasibility of the worksheet was assessed by the validators using a Likert scale of 1 – 4. The average of these assessments was then classified based on the score conversion by Widoyoko (2011) in Table 1. The product assessment through students' and teacher's response questionnaires were also assessed using a Likert scale 1 – 4 and classified using the score conversion also according to Table 1.

**Table 1.** Score Conversion According to Widoyoko (2011)

Score Interval	Mark	Category
$X > (\bar{X}_i + 1.8Sb_i)$	A	Very high
$(\bar{X}_i + 0.6Sb_i) < X < (\bar{X}_i + 1.8Sb_i)$	B	High
$(\bar{X}_i - 0.6Sb_i) < X < (\bar{X}_i + 0.6Sb_i)$	C	Average
$(\bar{X}_i - 1.8Sb_i) < X < (\bar{X}_i + 1.8Sb_i)$	D	Low
$X > (\bar{X}_i + 1.8Sb_i)$	E	Very low

The increase in HOTS of students was analyzed based on the results of the pre-test and post-test through a series of tests. The first test consisted of homogeneity and normality tests. The second test was a mean comparison test using paired sample t-test. Then, increase in students' HOTS is calculated using N-gain and effect size. After that, the results of the assessment are classified according to the N-gain and effect size classification in Tables 2 and 3.

**Table 2.** N-Gain Classification (Arikunto, 2008)

N-gain	Category
$g < 0.3$	Low
$0.3 < g < 0.7$	Average
$0.7 < g$	High

**Table 3.** Effect Size Classification (Grove & CIPHER, 2019)

Cohen's D	Category
0.2	Low
0.5	Average
0.8	High

The performance of the discovery-learning model implemented in the classroom was assessed using the learning observation sheet. After that, the learning performance is classified based on Table 4.

**Table 4.** Learning Performance Classification (Widoyoko, 2011)

Percentage	Category
$80 < X 100$	Excellent
$60 < X 80$	Good
$40 < X 60$	Fair
$20 < X 40$	Poor
$0 < X 20$	Very poor

**RESULTS AND DISCUSSION**

The E-worksheet based on discovery learning with Google Docs product is developed through the 4D development model according to Thiagarajan, Semmel, and Semmel (1974), which consists of Define, Design, Develop, and Disseminate stages. The product development in this research is performed until the develop stage.

The first stage is the define stage, which consists of the initial analysis, student analysis, concept analysis, task analysis, and formulate

learning objectives. The results of the initial analysis show that learning science at SMP N 4 Pakem requires an E-worksheet that uses the discovery-learning model and students worked together in real-time. The analysis carried out on the students shows that the students' HOTS abilities needed to be improved with a discovery learning worksheet that might be worked together in real-time. The concept analysis produces a concept map of the Wheel and Axles, Pulleys, and Levers of Simple Machines. Task analysis produces an overview of the Simple Machine subject, which is followed up by formulating the learning objectives.

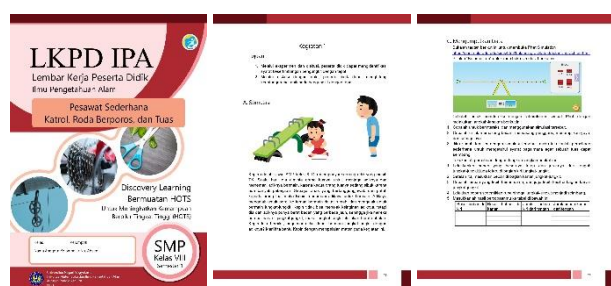
The second stage is the design stage, which consists of the preparation of instruments, the selection of teaching materials, the selection of formats, and the initial product design. The instruments prepared are lesson plans, validation sheets, student response questionnaires, observation sheets, and pre-test and post-test questions. The selection of teaching material resulted in a decision that the teaching material to be developed is the E-worksheet based on discovery learning with Google Docs. The selection of format resulted in a decision that the worksheet is developed based on the worksheet format according to Sari, Lubis, and Sugiarti (2021), which consists of title, instructions, competencies, supporting information, tasks, procedures, and assessment. The initial design of the product is called the first draft of the worksheet, which is validated by the validators.

The third stage is the develop stage consisting of product validation and limited trial. The results of validation by experts indicate that the E-worksheet based on discovery learning with Google Docs is very feasible to be used in the class. The assessment results are presented in Table 5. After revision, a limited trial is carried out on the product. The limited trial is carried out by doing a learning session using the product in an experimental class and also giving pre-test and post-test.

The developed product consists of four learning activities for two meetings with two activities for each meeting. The activities presented for the first meeting are designing a pulley, wheel and axle. Meanwhile, the activities for the second meeting are virtual experiment with Phet and classifying tools into their lever classes. Every activity in the product development is designed according to the syntax of discovery learning.

**Table 5.** Expert Validation Results

Validation Aspects		Score	Maximum Score	Category
Content	Contents and materials	20	20	Very Feasible
	Language	15.5	16	
	Discovery learning	7.5	8	
Media	Design	11.5	12	
	Graphics	11.5	12	
	Usage	8	8	
	Visual communication	11.5	12	
All Aspects		85.5	88	



**Figure 1.** Product Content Sample

Each activity consists of six parts, i.e.: stimulation (*stimulasi*), problem statement (*menyatakan masalah*), data collecting (*mengumpulkan data*), data analysis (*mengolah data*), proving (*membuktikan*), and concluding (*menyimpulkan*). These parts are designed to meet the syntax of the discovery-learning model. The students are presented with a problem in the stimulation, then a stated problem. After that, they collect data and analyze them to discover a finding. From the data analysis results, they use their understanding to prove their understanding and solve the problem. Finally, in the end, they are asked to conclude. The product content sample can be observed in Figure 1.

All of these activities are designed to be done by team working with a team consisting of four students. Using the Google Docs platform let students work together on the worksheet easily, as it can be accessed from home using a personal computer or a mobile phone.

The trial using the one group pre-test post-test design shows an increase in the HOTS of the students. The results of the pre-test and post-test is presented in Table 6. The test results show that the N-gain is 0.53 in the medium category. The effect size is 1.77 in the high category.

**Table 6.** Pre-test and Post-test Results

Average Pre-test	Post-test Average	N-gain	Effect Size
4.3	7.1	0.53	1.77

The teachers’ response shows that all aspects of the content and media in the worksheet are very feasible with a maximum score. Students’ responses show that the worksheet is in the feasible category, which is presented in Table 7.

**Table 7.** Student Responses Regarding to the E-worksheet

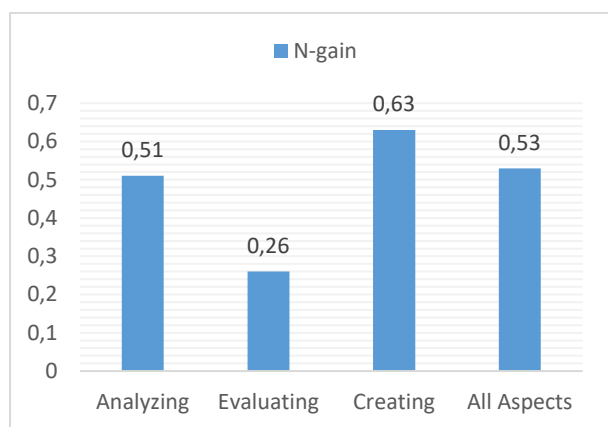
Aspect	Mark	Category
Content	17.09	Very Feasible
Language	12.84	Feasible
Appearance	13.16	Feasible
All Aspects	43.09	Feasible

The product that is developed in the research is the E-worksheet based on discovery learning with Google Docs. This E-worksheet product is used in learning with the discovery-learning model enriched with HOTS and using the Google Docs platform. The worksheet is designed according to the discovery learning model syntax and the activities are designed according to the discovery-learning model to support its implementation in the class.

The feasibility of the worksheet regarding the content shows that the worksheet contains correct contents and supports the growth of students' HOTS. The language is in accordance with the standard Indonesian guide and the characteristics of students. Also, the contents of the worksheet follow the syntax of discovery learning and support its implementation.

The feasibility of the worksheet regarding the media shows that the worksheet has an attractive design and comfortable in the display and visual. The worksheet has illustrations that support its use and content. The worksheet has an easy-to-use design and supports effective visual communication.

Based on the results of the limited trials, an N-gain of 0.53 is obtained, which is in the medium category and an effect size of 1.77 in the high category. This indicates that the E-worksheet based on discovery learning with Google Docs is effective in increasing HOTS of students. The score of N-gain for each indicator of HOTS is presented in Figure 2.



**Figure 2.** The N-gain for each HOTS Indicator

The graph in Figure 2 shows that the highest increase in students' HOTS is in the creating skills indicator (C6). In Bloom's taxonomy, the creating skills are the highest level indicating that the students can create, and requires the ability to analyze and evaluate. The activities in the worksheet support the improvement of HOTS. In Worksheet 1, the activity of designing wheels, axles, and pulleys supports the increase of students' HOTS. In line with the opinion of Untari, Rohmah, and Lestari (2018), when students are asked to conduct problem solving, then they built the ability to analyze, evaluate, and create. Worksheet 2 consists of a virtual simulation activity with Phet simulation to know the principle of the mechanical advantage of a lever. Virtual simulations can improve students' HOTS. This is in line with the results of the study by Anisa, Niki, and Nova (2020) that the use of virtual simulation media can improve HOTS.

The use of the discovery-learning model on the worksheets can train students' HOTS (Pristiyono, Herpratiwi, Jalmo, & Hartono, 2021). Also, a worksheet with a discovery-learning model can increase the students' creative thinking ability (Subakti, Marzal, & Hsb, 2021). Critical and creative thinking are part of HOTS, thus the worksheet with discovery learning may increase students' HOTS ability. The E-worksheet with Google Docs that is developed in this study uses the discovery-learning model so that the discovery learning may be applied when using the worksheet.

The E-worksheet based on discovery learning is developed with Google Docs to make the students work together and complete their work in a team. According to the study by Hutami and Wiyatmo (2018), a worksheet developed with the discovery learning model is appropriate to be used in a team and encourages students to work together and discuss, share information, listen, and use the ideas of others. A worksheet developed using Google Docs provides facilities for students to work together and be able to work on the worksheet more effectively than doing the worksheet as homework or assignment. This is in line with a study conducted

by Gozali (2020) that the use of a worksheet assisted by Google Docs application could increase collaboration in online learning.

The increase in students' HOTS as the consequence of the E-worksheet based on discovery learning with Google Docs product is in accordance with other relevant research. A study conducted by Fitria, Wijaya, and Danial (2020) shows that a HOTS-based worksheet developed using discovery learning model syntax can increase the HOTS ability of the students. Another research conducted by Suarni (2021) also shows a similar finding. The learning conducted with a worksheet based on discovery learning equipped with HOTS tasks can increase students' cognitive competence. Likewise, in this study, the use of E-worksheet based on discovery learning with Google Docs can improve HOTS of students. Hence, based on the above findings, the E-worksheet based on discovery learning with Google Docs is feasible and effective in increasing HOTS of students.

## CONCLUSION

Based on the results of the data collection, analysis, and discussion, it can concluded that, first, the E-worksheet based on discovery learning with Google Docs is very feasible to be used for students' learning. Second, The E-worksheet based on discovery learning with Google Docs is practical to be used in learning. Finally, the E-worksheet based on discovery learning with Google Docs is effective in increasing HOTS of students.

## REFERENCES

- Agustha, A., Susilawati, & Haryati, S. (2021). Pengembangan E-LKPD Berbasis Discovery Learning Menggunakan Aplikasi Adobe Acrobat 11 Pro Extended pada Materi Kesetimbangan Ion dan pH Larutan Garam Untuk Kelas XI SMA/MA Sederajat. *Journal of Research and Education Chemistry*, 3(1), 28-42.
- Anderson, W. L., & Krathwohl, R. D. (2001). *A Taxonomy for Learning Teaching and Assesing A Revision of Bloom's Taxonomy of Educational Objectives*. Boston: Addison Wesley Longman.
- Arikunto, S. (2008). *Prosedur Penelitian: Suatu Pendekatan Praktek*. Jakarta: Rinneka Cipta.
- Budi, G. S. (2022). *Penerapan Berbagai Model dan Metode Pembelajaran dalam Praktik Pengalaman Lapangan Mahasiswa Program Studi Pendidikan Fisika*. Bogor: Guepedia.
- Choo, S. S., Rotgans, J. I., Yew, E. H., & Schmidt, H. G. (2011). Effect of Worksheet Scaffolds on Student Learning in Problem-based Learning. *Health Sci Edu*, 16(4), 517-528.

- Fani, K., Fauziana, & Rahmiaty. (2021). Analisis Kemampuan Siswa Dalam Menyelesaikan Soal HOTS pada Pelajaran IPA Kelas V MIN 25 Aceh Utara. *Genderang Asa: Journal Of Primary Education*, 66-75.
- Fitria, A., Wijaya, M., & Danial, M. (2020). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis High Order Thinking Skill (HOTS). *Chemistry Education Review*, 3(2), 163-171.
- Gozali, M. (2020). Pemanfaatan LKPD Berbantu Aplikasi Google Dokumen Untuk Meningkatkan Kerjasama Pada Pembelajaran Daring Peserta Didik Kelas 5 SD N 3 Wadas Tahun Pelajaran 2020/2021. *Jurnal Pendidikan dan Profesi Pendidik*, 6(1), 34-41.
- Grove, S. K., & Cipher, D. J. (2019). *Statistics for Nursing Research - E-Book: A Workbook for Evidence-Based Practice*. Amsterdam: Elsevier Health Sciences.
- Hisbullah, & Selvi, N. (2018). *Pembelajaran Ilmu Pengetahuan Alam di Sekolah Dasar*. Makassar: Penerbit Aksara Timur.
- Hutami, D. P., & Wiyatmo, Y. (2018). Pengembangan Perangkat Pembelajaran Berbasis Guided Discovery Learning Untuk Meningkatkan Pemahaman Konsep dan Kemampuan Kerja Sama Peserta Didik. *Jurnal Pendidikan Fisika*, 7(1), 18-28.
- Indriasari, S. (2020). *Aplikasi Office Menggunakan Google Suite*. Sleman: Deepublish.
- Jailani, & Retnawati, H. (2016). Keefektifan Pemanfaatan Perangkat Pembelajaran Berbasis Masalah untuk Meningkatkan HOTS dan Karakter Siswa. *Jurnal Pendidikan dan Pembelajaran*, 23(2) 111-123.
- Makhin, A., Maryuningsih, Y., & Saifuddin. (2014). Penggunaan Bahan Ajar Berbasis Imtaq Dalam Meningkatkan Hasil Belajar Siswa Pada Pokok Bahasan Sistem Reproduksi Manusia Di Kelas XI IPA SMA Negeri 1 Astanajapura Kabupaten Cirebon. *Scientiae Educatia*, 3(1), 89-105.
- Pratiwi, N. P., Dewi, N. L., & Paramartha, A. A. (2019). The Reflection of HOTS in EFL Teachers' Summative Assessment. *Journal of Educational Research and Evaluation*, 3(3), 127-133.
- Pratiwi, N., & Yulkifli. (2019). Peningkatan Kompetensi Keterampilan Peserta Didik Berbantuan LKPD Berbasis Model Discovery Learning pada Materi Fluida. *Indonesian Journal of Science and Mathematics Education*, 2(1), 130-139.
- Pristiyono, E., Herpratiwi, Jalmo, T., & Hartono, R. (2021). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Discovery Learning untuk Melatih Kemampuan Berpikir Tingkat Tinggi Peserta Didik SMA. *Edukatif: Jurnal Ilmu Pendidikan*, 3(6), 5265-5275.
- Ramadhana, R., & Hadi, A. (2022). Efektivitas Penerapan Model Pembelajaran Berbasis E-Learning Berbantuan LKPD Elektronik Terhadap Hasil Belajar Peserta Didik. *Edukatif: Jurnal Ilmu Pendidikan*, 4(1), 380-389.
- Ramlawati, Liliarsari, Martoprawiro, M. A., & Wulan, A. R. (2014). The Effect of Electronic Portfolio Assessment Model to Increase of Student's Generic Science Skills in Practical Inorganic Chemistry. *J. Educ. L.*, 8(3), 179-186.
- Sari, S. P., Lubis, P. H., & Sugiarti. (2021). Pengembangan LKPD Berbasis Discovery Learning Berbantuan Software Tracker Pada Materi Gerak Melingkar Untuk Meningkatkan Pemahaman Konsep Peserta Didik. *Jurnal Kumparan Fisika*, 4(2), 137-146.
- Schleicher, A. (2019). *PISA 2018 results*. Dipetik Agustus 3, 2021, dari Programme for International Student Assessment: <https://www.oecd.org/pisa/publications/pisa-2018-results.htm>.
- Suarni. (2021). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Discovery Based Learning (DBL) Dilengkapi Soal Higher Order Thinking Skills (HOTS) Peserta Didik Kelas XI MAN Kota Sorong. *SOCIAL: Jurnal Inovasi Pendidikan IPS*, 1(3), 144-155.
- Subakti, D. P., Marzal, J., & Hsb, M. H. (2021). Pengembangan E-LKPD Berkarakteristik Budaya Jambi Menggunakan Model Discovery Learning Berbasis STEM Untuk Meningkatkan Kemampuan Berpikir Kreatif Matematis. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(2), 1249-1264.
- Telaumbanua, E. H. (2022). *Pengembangan Model WICDIE dalam Pembelajaran Paduan Suara*. Depok: Publica Indonesia Utama.
- Thiagarajan, Semmel, D., & Semmel. (1974). *Instructional Development for Training Teacher of Exceptional Children a Sourcebook*. Bloomington: Center for Innovation on Teaching the Handicaped.
- Untari, E., Rohmah, N., & Lestari, D. W. (2018). Model Pembelajaran Problem Based Learning (PBL) Sebagai Pembiasaan Higher Order Thinking Skills (HOTS) Pada Pembelajaran IPA di Sekolah Dasar. *Prosiding Seminar Nasional Pendidikan Sains (SNPS)*: 135-142). Surakarta: FKIP UNS.
- Widoyoko, S. (2011). *Evaluasi Program Pembelajaran*. Yogyakarta: Pustaka Pelajar.
- Wilujeng, I. (2020). *IPA Terintegrasi dan Pembelajarannya*. Yogyakarta: UNY.

