

Profile of higher order thinking ability in differentiation-based problem-based learning models

Satia Zulfiani Rosyid *, Setiono, Billyardi Ramdhan

Study Program of Biology Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sukabumi, Sukabumi, West Java, Indonesia

*Corresponding Author Email: Satiazulfiani@ummi.ac.id

Article Information

Keyword:

Higher order thinking skills; Differentiation; Problem-based learning

Kata Kunci:

Berpikir tingkat tinggi; Diferensiasi; Pembelajaran berbasis masalah

History:

Received : 20/06/2023

Accepted : 30/09/2023

Abstract

The high-level thinking abilities of students in Indonesia still need to improve. This is shown by the results of international studies such as PISA and TIMSS; Indonesia's ranking in these programs still needs to be at a higher level. Therefore, this research aims to determine the profile of high-level thinking abilities in problem-based learning differentiation. The method used is quantitative descriptive. The research subjects were MAN 2 Sukabumi City students, with a total of 26 students. The sampling technique, namely purposive sampling, is based on the student's ability to see a problem and play an active role in the learning process. This is based on recommendations from the subject teacher. This research shows that the N-gain value for high-level thinking abilities in the upper, middle, and lower groups is in the medium category, namely in the upper group with a value of 0.64, the middle group with 0.37, and the lower group with a value of 0.36. Therefore, differentiation-based problem-based learning (PBL) is effective for all groups in improving high-level thinking abilities.

Abstrak

Kemampuan berpikir tingkat tinggi peserta didik di Indonesia masih cukup rendah hal ini ditunjukkan dari hasil studi internasional seperti PISA dan TIMSS, peringkat Indonesia pada program tersebut masih berada ditingkat rendah oleh karena itu, penelitian ini bertujuan mengetahui profil kemampuan berpikir tingkat tinggi pada pembelajaran *problem based learning* berbasis diferensiasi, Metode yang digunakan yaitu deskriptif kuantitatif. Subjek penelitian adalah peserta didik MAN 2 Kota Sukabumi dengan jumlah 26 peserta didik. Teknik sampling yaitu purposive sampling berdasarkan dari kemampuan peserta didik dalam melihat suatu permasalahan dan berperan aktif dalam proses pembelajaran hal ini didasarkan atas rekomendasi dari guru mata pelajaran. Hasil penelitian ini menunjukkan nilai N-gain pada kemampuan berpikir tingkat tinggi pada kelompok atas, tengah dan bawah ini berada pada kategori sedang yaitu pada kelompok atas dengan nilai 0,64, kelompok tengah 0,37 dan kelompok bawah mendapat nilai 0,36. Oleh karena itu pembelajaran problem based learning (PBL) berbasis diferensiasi ini efektif untuk semua kelompok dalam meningkatkan kemampuan berpikir tingkat tinggi.

A. Introduction

In the 21st century, there has been a shift in the educational paradigm towards mastering essential skills. In Indonesia, education is aimed at honing high-level thinking skills (High Order Thinking Skills), which is in line with the demands of the 2013 curriculum (Gradini, 2019). High-level thinking skills can transform students' initial knowledge to produce new insights. Students are expected to clearly select ideas and break down complex concepts into simpler ones (Hentian et al., 2022). Therefore, the application of High Order Thinking Skills (HOTS) is expected to solve educational problems and improve the education system in Indonesia (Sofyan, 2019). High-order thinking skills (High Order Thinking Skills) are abilities that involve critical and creative thinking to solve a problem. With high-level thinking skills, students must analyse, connect, and interpret problems to obtain solutions or new ideas (Saraswati & Agustika, 2020). Strengthening high-order thinking skills for students is a learning process that is expected to improve the quality of learning to be more effective, efficient and meaningful to increase learning outcomes (Acesta, 2020).

High-order thinking Skills must be applied in the education sector, considering Indonesia's low ranking in the 2018 Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) compared to other countries. The results of the Program for International Student Assessment (PISA) in 2018 saw Indonesia ranked 74th out of 79 participating countries, with a score of 396 (Yuliati, 2017), while Trends in International Mathematics and Science Study (TIMSS) was also ranked bottom, namely ranked 45th out of 50 countries (Martyanti & Suhartini, 2018). Apart from that, based on the results of field observations at one of the schools in Sukabumi, the data obtained showed that high-order thinking skills (High Order Thinking Skills) were still relatively low, proven when the teacher gave HOTS questions, approximately only 20% could answer the questions, and when learning is faced with analysing problems, most students are still confused, this is because students still don't understand the questions given, students tend to give up quickly, and students don't get used to it. In this research, one of the models included in the 2013 curriculum is the Problem-Based Learning (PBL) learning model to develop high-level thinking skills (Renika & Dian, 2020). One learning model that contributes to developing high-level thinking skills is problem-based learning because

this learning focuses students on solving complex real-world problems while working in small groups to gather information and find solutions. Therefore, problem-based learning is appropriate to apply to learning (Suwastini et al., 2021). According to Fajrilia et al. (2019), using the problem-based learning (PBL) model has improved high-level thinking abilities. Learning using the Problem-Based Learning (PBL) model is one learning model that can facilitate a learning environment that supports high-order thinking because the Problem-Based Learning (PBL) model is based on situations that present confusing problems so that train curiosity and students are interested in investigating the problem. When students carry out investigations, they use their abilities to analyse problems based on evidence and make decisions based on the investigation results (Nafiah & Suyanto, 2014).

Apart from using the problem-based learning (PBL) model to improve students' high-order thinking skills, learning can be carried out more optimally in a differentiated manner. Differentiated Instruction is an approach that allows teachers to plan strategies to meet the needs of each student based on diversity of readiness, student learning profiles and interests (Siburian et al., 2019). Hadi et al. (2022) suggest that students of the same age have differences in their readiness to learn, their interests, the way they learn, their experiences and their lives. Because, in principle, differentiated learning is an effort to adapt the learning process in the classroom to meet the individual learning needs of each student (Fitra, 2022). According to learning, using the problem-based learning (PBL) model with a differentiation learning strategy can improve the abilities that will be measured compared to traditional learning models. This is supported by research by Sarie (2022) that differentiated learning can improve the measured abilities of students.

Therefore, this differentiation-based problem-based learning (PBL) model can be a solution to improve high-level thinking abilities because not only can it improve problem-solving abilities, but it can also improve students' scientific thinking skills, thinking based on scientific principles by meeting their needs every student learns (Saraswati & Agustika, 2020). This is in line with the research. This is in line with the use of a differentiation-based problem-based learning model has a positive impact on biology learning and produces a pleasant learning atmosphere. This is supported by research that differentiation-based problem-based learning has a positive impact on

biology learning. What is more, Ramadhanti et al (2022) explain that the problem-based learning (PBL) model itself can have a positive influence on students' high-level thinking abilities.

B. Material and Method

This research uses quantitative descriptive analysis methods; the research population is students of MAN 2 Sukabumi City, with samples taken from 26 class X students. In this research, the sample data collection technique is purposive sampling based on the student's ability to see a problem and play an active role in the learning process; this is based on recommendations from the subject teacher. This research was conducted in May 2023.

The form of instrument used in this research was a multiple choice test consisting of 10 questions with a cognitive level using Bloom's taxonomy, namely at levels C4-C6. This research was conducted on environmental pollution material.

The research procedure includes implementing offline learning using a differentiation-based problem-based learning (PBL) learning model, where students are divided into three groups, namely upper, middle and lower groups, based on the level of students' understanding, which is supported by the report cards obtained and test results. Biology material questions are carried out long before learning begins, and learning is designed to suit each group. Each group is assigned to analyse environmental pollution. In the lower group, students are given videos, and during the learning process, there are many explanations given, which make it easier for them to understand the learning material, and in the middle group, they were given a pollution text with explanatory explanations adapted for the middle group, while in the upper group, they carried out an analysis of environmental pollution at school; students were given a pretest then after carrying out the learning students were given a posttest to measure the students' high-level thinking abilities.

$$N\ Gain = \frac{Sp_{post} - Sp_{pre}}{Sm_{max} - Sp_{pre}} \dots\dots\dots Formula\ 1$$

Information:

Sp_{post} = Final test or posttest score

Sp_{pre} = Initial test or pretest score

Sm_{max} = Maximum score

The high-level thinking category is interpreted based on Bloom's revised taxonomy according to Anderson et al. (2001). Meanwhile, to determine the increase in high-level thinking

abilities based on class groups is carried out using the N-gain test on the pretest and posttest. N-gain is calculated using Formula 1. The categories used to see the total n-gain value are following Table 1.

Table 1 N-gain Category

N-gain calculation	Category
N-Gain ≥ 0,71	High
0,31 ≥ N-Gain ≥ 0,70	Medium
N-Gain ≥ 0,30	Low

(Source: Sugiyono, 2017)

C. Results and Discussion

Based on research that has been conducted, students are grouped into three levels of understanding. These results are presented in a graph, which can be seen in Figure 1.

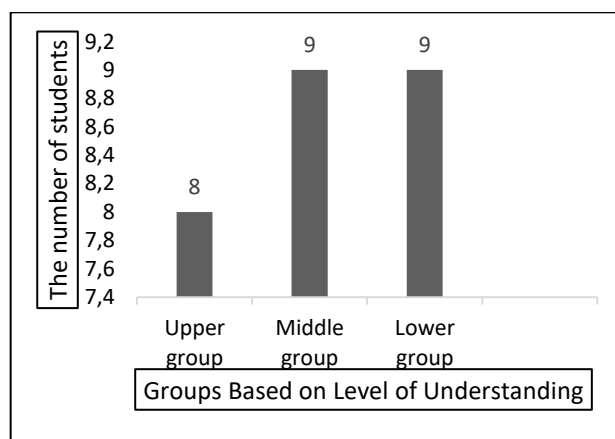


Figure 1
 Graph of Student Grouping Based on Level of Understanding

Based on Figure 1, of the 26 students sampled in the research, after grouping them based on the student's level of understanding obtained from the sum of their report card scores and test results before learning, three groups were obtained, namely the upper, middle and lower groups.

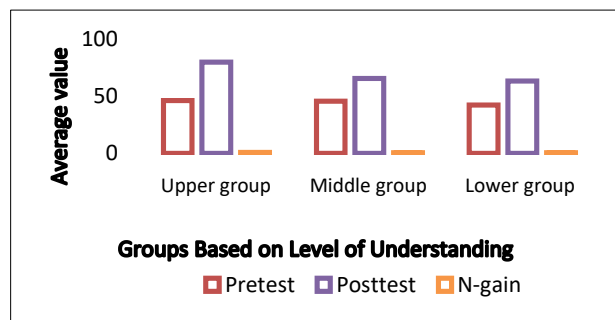


Figure 2
 Comparison of High-Order Thinking Abilities Based on Students' Level of Understanding

Figure 2 shows the average pretest, posttest and n-gain scores in the upper group, middle group and lower group. The top group had a pretest score of 46.3 and a posttest score of 80, with an n-gain value of 0.64. In the middle group, the pretest score was 45.6, and the posttest score was 65.6, with an n-gain value of 0.37. Meanwhile, in the lower group, the pretest score was 42.2, and the posttest score was 63.3, with an n-gain value of 0.36. If we look at the n-gain value according to Sugiyono (2017), each group has a medium category. However, the top group has a higher value than the middle group and the bottom group because if we look at it in terms of characteristics, the top group has the ability and readiness to learn high so that the upper group tends to keep going in looking for problems (Meriyati, 2015). Apart from that, the top group does learning outside the classroom, while the other two groups do it in the classroom. Therefore, internal and external factors can influence student learning outcomes. However, the most significant influencing factor is the student's internal factors. According to Wardani et al. (2013), in their research, internal factors have a significant influence on student learning outcomes. And this is in line with Primahendra et al (2020) that internal factors can influence students' learning processes, such as self-motivation because self-motivation can develop a positive learning process. To see what students' high-level thinking abilities look like, see Figure 3.

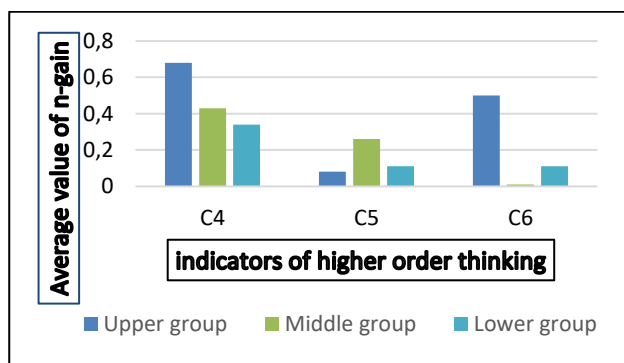


Figure 3
 Average Value of N-Gain on Higher Order Thinking Indicators

Based on the following picture, the C4 indicator (analysing), the top group has the most considerable N-gain value, namely 0.68. In contrast, the middle group has an n-gain value of 0.43, and the bottom group has an n-gain value of 0.34. Therefore, the highest increase in the C4 indicator (analysing) is in the top group. In indicator C5 (evaluating), the top group has an n-gain value of 0.08, and the middle group has an n-gain value of 0.26, while the bottom group has an n-gain value of

0.11. In indicator C5 (evaluating), there was a significant increase in the middle group. In the C6 (creating) indicator, the top group has an n-gain value of 0.50, the middle group has an n-gain value of 0.01, and the bottom group has an n-gain value of 0.11. In the C6 (creating) indicator, the upper class has a higher increase value. In this case, the dominant upper group experienced a higher increase than the middle and lower groups; this increase was in two indicators, namely C4 and C6. This occurs because of differences in the learning process that occurs in the upper group, middle group and lower group.

To see how high-level thinking abilities are overall, you can see Table 2.

Table 2 Average Test Score for Each High-Order Thinking Indicator

No	Comparison	Indicator		
		C4	C5	C6
1	Pretest	33,5	71,2	69,2
2	Posttest	65,4	78,9	76,9
3	N-Gain	0,47	0,15	0,19

The table shows the average score for students' high-level thinking abilities. We can see that indicator C4 (analysing) has an n-gain value with medium criteria. In the cognitive domain of C4, students analyse and identify the information that has been given, while C5 and C6 have criteria with a low increase. This shows that when filling in the test questions, students do not show their readiness to work on the test questions, indicated by the fact that students often chat and play around when working on the questions, thus showing that the average student is not yet optimally able to answer the questions. This is in line with Tania (2021) factors that influence students' low mastery of C5 and C6, including students' need for more accuracy in the process of working on questions. Meanwhile, according to Prasetyani et al. (2016), the emergence of evaluating and creating indicators is lower than analysing indicators; this is because not all students can decide, assess, support, deny or write conclusions correctly.

Students must be trained more in order to develop high-level thinking skills, namely by implementing activities that can encourage high-level thinking skills, such as discussions, contextual problem-based learning and making comparisons, as well as practising working on HOTS-type questions (Fani et al., 2021). Learning activities carried out by discussion can encourage students to solve a problem with ideas and solutions; this is in line with research (Prasetyani et al., 2016).

In essence, this is an indicator of high-level thinking abilities, according to Anderson et al. (2001), which includes C4 (analysing), C5 (evaluating), and C6 creating. Learning activities that can develop analytical skills are activities by selecting relevant facts from irrelevant ones, determining how the elements in the material can function well and marking the meaning of learning (Mahariyanti et al., 2021). Meanwhile, learning activities that can develop students' ability to evaluate by training students to make decisions, solutions and ideas from problems obtained from the school environment and to create consist of three cognitive stages, namely formulating, planning and producing (Mahariyanti et al., 2021).

Students' high-level thinking abilities have increased because, seen from the results obtained, the N-gain value in this study shows that there is an increase in students' high-level thinking abilities in the upper, middle and lower groups, which means that students' abilities after being treated using the problem model This differentiation-based learning (PBL) can be used to improve the high-level thinking abilities of students in the upper, middle and lower groups. This is in line with research (Noma et al., 2016) that the problem-based learning (PBL) model on environmental pollution material is able to improve students' high-level thinking abilities. Supported by research by Ramadhanti et al. (2022), the problem-based learning (PBL) model can improve students' high-level thinking abilities. Siregar (2022) then confirmed this problem-based learning model can increase positive changes in students' higher-level thinking abilities.

D. Conclusion

From the results of the research and data analysis that has been carried out, students' high-level thinking abilities can be improved through a differentiation-based problem-based learning (PBL) learning model. This can be seen from the N-gain results obtained that there is an increase in ability in each group. Therefore, the differentiation-based problem-based learning (PBL) learning model allows students to have high-level thinking skills to adapt to 21st-century learning.

E. Acknowledgement

Thank you to my supervisor for direction and guidance during the research process, Biology Education, Faculty of Teacher Training and Education, Muhammadiyah University Sukabumi and MAN 2 Sukabumi City, who helped facilitate my research needs.

F. References

- Acesta, A. (2020). Analisis kemampuan higher order thinking skills (HOTS) siswa materi IPA di sekolah dasar. *Quagga: Jurnal Pendidikan dan Biologi*, 12(2), 170-175. DOI: <https://doi.org/10.25134/quagga.v12i2.2831>
- Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., ... & Wittrock, M. C. (2001). *Taxonomy for assessing a revision of Bloom's taxonomy of educational objectives*. New York: Langman.
- Fajrilia, A., Handoyo, B., & Utomo, D. H. (2019). Pengaruh model problem based learning terhadap kemampuan berpikir tingkat tinggi siswa SMA. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 4(10), 1276-1280. DOI: <http://dx.doi.org/10.17977/jptpp.v4i10.12798>
- Fani, K., Fauziana, F., & Rahmiaty, R. (2021). Analisis kemampuan siswa dalam menyelesaikan soal HOTS pada pelajaran IPA. *Genderang Asa: Journal of Primary Education*, 2(2), 66-75. Retrieved from <https://garuda.kemdikbud.go.id/documents/detail/3353270>
- Fitra, D. K. (2022). Pembelajaran berdiferensiasi dalam perspektif progresivisme pada mata pelajaran IPA. *Jurnal Filsafat Indonesia*, 5(3), 250-258. Retrieved from <https://ejournal.undiksha.ac.id/index.php/JFI/article/download/41249/25699>
- Gradini, E. (2019). Menilik konsep kemampuan berpikir tingkat tinggi (higher order thinking skills) dalam pembelajaran matematika. *Numeracy*, 6(2), 189-203. DOI: <https://doi.org/10.46244/numeracy.v6i2.475>
- Hadi, W., Wuriyani, E. P., Yuhdi, A., & Agustina, R. (2022). Desain pembelajaran diferensiasi bermuatan Problem Based Learning (Pbl) mendukung critical thinking skill siswa pada era kenormalan baru pascapandemi covid-19. *Basastra*, 11(1), 56-68. DOI: <https://doi.org/10.24114/bss.v11i1.33852>
- Hentian, N. Y., Ramdhan, B., & Setiono, S. (2022). Profil higher order thinking skills dan literasi sains siswa dalam pembelajaran inkuiri terbimbing berbantuan virtual lab. *Jurnal Ilmiah Pendidikan Biologi*, 8(3), 79-90. DOI: <https://doi.org/10.22437/bio.v8i3.19003>
- Mahariyanti, E., Irwansah, I., Murniatun, M., & Mediawati, M. (2021). Analisis kesulitan guru dalam mengembangkan keterampilan berpikir tingkat tinggi peserta didik pada pembelajaran biologi SMA. *Jurnal Ilmiah Global Education*, 2(1), 96-103. DOI: <https://doi.org/10.55681/jige.v2i1.82>

- Martyanti, A., & Suhartini, S. (2018). Etnomatematika: Menumbuhkan kemampuan berpikir kritis melalui budaya dan matematika. *IndoMath: Indonesia Mathematics Education*, 1(1), 35-41. DOI: <https://doi.org/10.30738/indomath.v1i1.2212>
- Meriyati, M. (2015). *Memahami karakteristik anak didik* (1st ed.). Bandar Lampung: Fakta Press IAIN Raden Intan Lampung.
- Nafiah, Y. N., & Suyanto, W. (2014). Penerapan model problem-based learning untuk meningkatkan keterampilan berpikir kritis dan hasil belajar siswa. *Jurnal Pendidikan Vokasi*, 4(1), 125-143. DOI: <http://dx.doi.org/10.21831/jpv.v4i1.2540>
- Noma, L. D., Prayitno, B. A., & Suwarno, S. (2016). Problem based learning to improve HOTS of high school students. *Bioedukasi: Jurnal Pendidikan Biologi*, 9(2), 62-66. DOI: <https://dx.doi.org/10.20961/bioedukasi-uns.v9i2.4222>
- Prasetyani, E., Hartono, Y., & Susanti, E. (2016). Kemampuan berpikir tingkat tinggi siswa kelas XI dalam pembelajaran trigonometri berbasis masalah di SMA Negeri 18 Palembang. *Jurnal Gantang*, 1(1), 31-40. DOI: <https://doi.org/10.31629/jg.v1i1.4>
- Primahendra, R., Freddy, F., & Sopa, A. (2020). Pengaruh hots, peer group, classroom management, motivasi diri pada proses belajar siswa sekolah menengah atas jurusan sosial. *Jurnal Pendidikan Ilmu Sosial*, 29(1), 51-58. DOI: <https://doi.org/10.17509/jpis.v29i1.21368>
- Ramadhanti, F. T., Juandi, D., & Jupri, A. (2022). Pengaruh problem-based learning terhadap kemampuan berpikir tingkat tinggi matematis siswa. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, 11(1), 667-682. DOI: <https://doi.org/10.24127/ajpm.v11i1.4715>
- Renika, V., & Dian, R. N. (2020). Peningkatan Keterampilan Berpikir Tingkat Tinggi (HOTS) Menggunakan Model Problem Based Learning. *Jurnal Pendidikan Hayati*, 6(1), 1-7.
- Saraswati, P. M. S., & Agustika, G. N. S. (2020). Kemampuan berpikir tingkat tinggi dalam menyelesaikan soal HOTS mata pelajaran matematika. *Jurnal Ilmiah Sekolah Dasar*, 4(2), 257-269. DOI: <https://doi.org/10.23887/jisd.v4i2.25336>
- Sarie, F. N. (2022). Implementasi pembelajaran berdiferensiasi dengan model problem based learning pada siswa sekolah dasar kelas VI. *Tunas Nusantara*, 4(2), 492-498. DOI: <https://doi.org/10.34001/jtn.v4i2.3782>
- Siburian, R., Simanjuntak, S. D., Frida, F., & Simorangkir, F. M. (2019). Penerapan pembelajaran diferensiasi dalam meningkatkan kemampuan pemecahan masalah matematika siswa pada pembelajaran daring. *Jurnal Riset Pendidikan Matematika*, 6(2), 1-3. <https://doi.org/10.21831/jrpm.v7i1.000000>
- Siregar, N. F. (2022). Pengaruh model problem based learning terhadap higher order thinking skills siswa SMP. *EKSAKTA: Jurnal Penelitian dan Pembelajaran MIPA*, 7(1), 14-23. DOI: <https://doi.org/10.31604/eksakta.v7i1.14-23>
- Sofyan, F. A. (2019). Implementasi HOTS pada kurikulum 2013. *INVENTA: Jurnal Pendidikan Guru Sekolah Dasar*, 3(1), 1-9. DOI: <https://doi.org/10.36456/inventa.3.1.a1803>
- Sugiyono. (2017). *Metode penelitian kuantitatif, kualitatif, dan R&D* (25th ed.). Bandung: CV Alfabeta.
- Suwastini, N. K. A., Puspawati, N. W. N., Adnyani, N. L. P. S., Dantes, G. R., & Rusnalasari, Z. D. (2021). Problem-based learning and 21st-century skills: Are they compatible? *EduLite: Journal of English Education, Literature and Culture*, 6(2), 326-340. DOI: <https://doi.org/10.30659/e.6.2.326-340>
- Tania, D. (2021). *Analisis kemampuan HOTS (higher order thinking skills) siswa pada pembelajaran online di SMAN 1 Teluk Kuantan tahun pelajaran 2020/2021*. (Undergraduate thesis, Universitas Islam Riau, Pekanbaru). Retrieved from <https://repository.uir.ac.id/10502/>
- Wardani, F. T., Kantun, S., & Djaja, S. (2013). *Pengaruh faktor internal dan faktor eksternal yang mendorong siswa untuk belajar terhadap hasil belajarkuntansi pada siswa kelas XI IPS MAN Lumajang tahun pelajaran 2012/2013*. (Undergraduate article, Universitas Jember). Retrieved from <https://repository.unej.ac.id/handle/123456789/62776>