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Development of a Problem Based Learning Teaching Module on the Topic of Comparison to Facilitate Mathematical Reasoning Skills of Phase D Students

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ABSTRACT

This research is motivated by the importance and low level of mathematical reasoning skills. The purpose of the research is to produce a Problem Based Learning-based teaching module on the topic of comparison to facilitate the mathematical reasoning skills of phase D students that meet the requirements of validity and practicality. The method used is Research & Development (R&D) with a 4-D development model (define, design, develop, disseminate). The test subjects were 6 eighth grade junior high school students in the small group test and 34 students in the field test. Based on the assessment by three validators, the teaching module met the valid criteria with an average percentage of 99% for part I of the teaching module, 94% for part II of the teaching module, and 97% for part III of the teaching module. The assessment of the student response questionnaire obtained an average of 91% with very practical criteria in the small group test and 96% with very practical criteria in the field test. It can be concluded that the Problem Based Learning-based teaching module on the topic of comparison to facilitate the mathematical reasoning skills of phase D students meets the valid and practical requirements.

1. Introduction

Mathematics is a fundamental science that is essential to be learned at every level of education. One of the objectives of mathematics learning in the Merdeka curriculum, as stated in Ministry of Education, Culture, Research, and Technology Regulation No. 033/H/KR/2022, is mathematical reasoning and proof. Therefore, mathematical reasoning is one of the competencies expected to be achieved after students study mathematics. Mathematics and reasoning are inseparable. Mathematics is understood through reasoning, and reasoning is honed through learning mathematics. This means that mathematical reasoning serves as the foundation for acquiring or building mathematical knowledge (Gulo & Mendrofa, 2023). Therefore, mathematical reasoning is a skill that must be mastered by

students (Ariati, 2022). Mathematical reasoning skills are crucial for students to achieve the goal of mathematics learning, which is to draw conclusions in solving problems (Purwanti et al., 2020). It can be concluded that mathematical reasoning skills need to be trained and developed in students during mathematics lessons at school.

The importance of mathematical reasoning skills is not in line with the facts that show the low mathematical reasoning skills of students based on the results of the 2022 PISA which experienced a decline from 2018, then the results of the Education Report which also experienced a decline and several studies that have been conducted, the results show that students' mathematical reasoning skills are still relatively low (Aprilianti & Zanthi, 2019; Khoeriyah & Ahmad, 2020; Najilah, 2022; Windiyarti et al., 2022). Based on the explanation above, it can be concluded that mathematical reasoning is a skill that needs to be facilitated considering the low and important mathematical reasoning skills of students.

The topic of comparison was chosen for this study based on several supporting studies, including the fact that many students still experience difficulty in identifying equivalent and inverse ratios, thus requiring mathematical reasoning skills when learning it (Saputri et al., 2017). Furthermore, research by Windiyarti et al. (2022) found that students' mathematical reasoning skills at SMP Negeri 3 Prabumulih were still low on the topic of comparison, with an average score of 55.03. Therefore, comparison is a topic in mathematics that requires reasoning skills to learn and understand.

Classroom learning activities must be well-prepared to develop students' mathematical reasoning skills. This preparation can be achieved by using learning models that support the improvement of students' mathematical reasoning skills to achieve learning objectives (Arif et al., 2021). The learning model used requires students to learn more actively. One learning model that can be applied is the Problem-Based Learning model (Marfu'ah et al., 2022). PBL is applied to the learning process by developing a series of structured activities to support effective learning implementation. Therefore, a good learning structure is needed to achieve an effective learning process and achieve objectives. The procedures and structure for delivering lessons are called learning plans (Nursobah, 2019). A set of learning plans in the independent curriculum is called a teaching module. According to Ministry of Education, Culture, Research, and Technology Regulation No. 262/M/2022, a teaching module is a plan compiled according to objectives, steps, and assessments that serve as guidelines for teachers in carrying out the learning process based on the learning objectives.

Based on observations and interviews with mathematics teachers at Pasir Penyu 1 Junior High School, Pekanbaru 21 Junior High School, and Pekanbaru 8 Junior High School, it was found that students were not actively involved in the learning process. The learning process also tended to be dominated by the teacher. The implementation of learning, as outlined in the learning guide for the independent curriculum, was not yet clearly visible, as were assessments and student worksheets (LKPD). The LKPD's typically provided contained questions and did not include

problems that could develop students reasoning skills. The LKPD used should also be considered to train and guide students in facilitating mathematical reasoning skills (Arif et al., 2021). Schools have used teaching modules, but there are no teaching modules that can facilitate mathematical reasoning skills. Therefore, a teaching module is needed that can facilitate the mathematical reasoning skills of phase D students.

Based on the problems and facts described above, the researcher conducted development research with the aim of producing a Problem-Based Learning-based teaching module on the topic of comparison to facilitate the mathematical reasoning skills of phase D students. This module meets the requirements of validity and practicality, making it feasible and easy to use to facilitate students' mathematical reasoning skills.

2. Methodology

The development model used is the development model according to Thiagarajan (Sugiyono, 2019), namely the 4-D model which is an abbreviation of define, design, development, and disseminate. The defining stage includes five stages, namely front-end analysis, learner analysis, concept analysis, task analysis, and formulation of learning objectives (specifying instructional objectives). Observations and interviews with teachers of SMPN 21 Pekanbaru, SMPN 8 Pekanbaru, and SMPN 1 Pasir Penyau were conducted in the initial-final analysis. Reviewing literature reviews relevant to student development at secondary school age and the results of interviews with students are needed in compiling teaching modules that are appropriate to student characteristics are carried out in the student analysis. The concept analysis, assignment, and learning objective formulation stages are conducted to obtain a series of subtopic assignments that students must complete, related to the desired learning objectives.

The design stage includes the development of validity and practicality sheets, media selection, format selection, and initial design. This stage begins with the development of validation sheets and response questionnaires, which serve as evaluation tools and objectives for the resulting product. Next, the media and format for the teaching module are selected, and then developed into an initial design for the teaching module. The development stage includes expert review, one-on-one evaluation, small group testing, and field testing. During the expert assessment, the teaching module, approved by the supervising lecturer, is then validated by three validators. After validation, revisions are made based on the validators' suggestions to ensure the teaching module meets the validity criteria. The assessments on the validation sheets are compiled using the Guttman scale and the Likert scale. The validation data analysis was adapted from Akbar (2017) with the following formula.

$$V_a = \frac{TS_a}{TS_h} \times 100\%$$

Information:

V_a : Expert validation of the product is reviewed from every aspect

TS_a : Total score obtained from the validator

TS_h : The maximum possible total score that can be obtained

After the teaching module is valid, a one-on-one evaluation is carried out involving 3 students to test the readability of the LKPD, a small group test involving 6 students and a field test involving one class of students to see the practicality of the LKPD which can be known based on the questionnaire that the students have filled out. The assessment of the student response questionnaire is arranged based on a Likert scale. The analysis of practicality data results is adapted from Akbar (2017) with the following formula.

$$V_p = \frac{TS_p}{TS_h} \times 100\%$$

Information:

V_p : Percentage score from student response questionnaire

TS_p : Total score obtained by students

TS_h : Total skor maksimal yang mungkin diperoleh

Teaching modules and LKPD are considered valid and practical if they meet the criteria of meeting more than 70%.

In the dissemination stage, the developed products are disseminated through seminars and publications. Teaching modules that meet the criteria for validity and practicality are then packaged or published in a book for publication.

3. Results and Discussion

This research is a developmental research with the aim of producing a product, namely a teaching module. The results of this product development research include a teaching module based on problem-based learning on the topic of comparison to facilitate mathematical reasoning skills for phase D students.

Define

The definition stage was conducted to identify the underlying issues that underpinned the need to develop a teaching module to facilitate students' mathematical reasoning skills. Interviews were conducted with mathematics teachers at SMPN 8 Pekanbaru, SMPN 21 Pekanbaru, and SMPN 1 Pasir Penyau, as well as direct observations of the teaching module used. Interviews and observations were also conducted with students at SMPN 8 Pekanbaru. Based on this, it was found that students were not actively involved in the learning process. Students had difficulty understanding questions in the form of problems or non-routine questions, especially on the topic of comparison, which contains indicators of mathematical reasoning skills. In line with the results of the diagnostic assessment answers in the study by Fitri & Abadi (2021), it was found that most students still made errors in solving non-routine problems. The LKPD usually provided contained questions and did not include problems that could develop students' reasoning skills. Teaching modules that could facilitate mathematical reasoning skills, specifically on the topic of comparison, also did not exist. According to Nesri & Kristanto (2020), teaching modules play a crucial role in

developing students' 21st-century skills in mathematics, with reasoning skills being one of them. Therefore, a comparative topic teaching module is needed that can facilitate the mathematical reasoning skills of phase D students.

Design

The preparation of validity and practicality sheets in this study involves compiling validation sheets and student response questionnaires. The validation sheets are compiled based on the completeness and suitability aspects of the teaching module. The student response questionnaire is compiled based on the presentation of the material, ease of use, and the appearance of the LKPD. Next, the researcher makes an initial design after selecting the media and format for the resulting teaching module. The media chosen is printed media with A4 paper measuring 21 x 29.7 cm while the presentation format of the teaching module is adjusted to the PBL stages. The designed teaching module consists of four subtopics, namely the concept of comparison, equivalent comparison, inverse comparison of values, and scale on maps. The teaching module was designed by the researcher based on the learning and assessment guidelines according to BSKAP (2024) but the researcher added learning media in the form of PPT and QR codes to the developed teaching module. This is supported by BSKAP (2024) that educators have the flexibility to choose and modify examples of available teaching modules or develop their own teaching modules, according to the context, needs, and characteristics of students.

Develop

During the development phase, the initial design of the teaching module, approved by the supervising lecturer, was then validated by three validators. The validators in this research development phase consisted of two mathematics education lecturers and one teacher. The following validation results from the teaching module by the three validators indicate that the teaching module meets the highly valid criteria, as presented in Table 1.

Table 1. Teaching Module Validation Results

Evaluation	The average assessment of the three validators on the module				Average	Criteria
	1	2	3	4		
Average Part I Teaching Module	100%	99%	100%	100%	99%	Very Valid
Average Part II Teaching Module	93%	95%	94%	94%	94%	Very Valid
Average Part III Teaching Module	96%	96%	98%	97%	97%	Very Valid

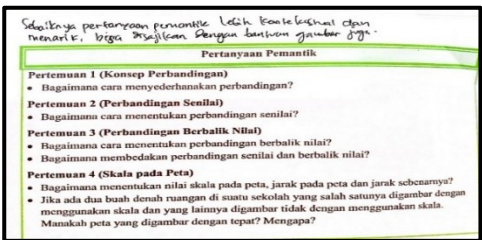
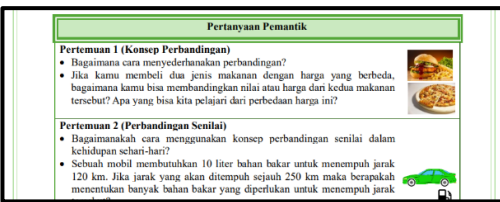
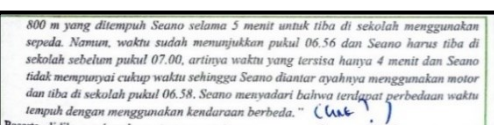
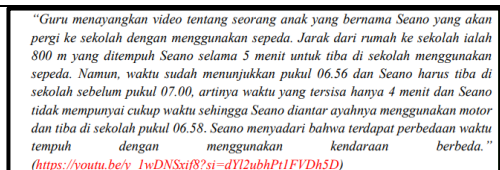
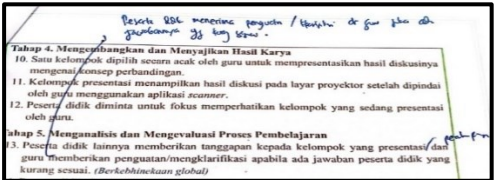
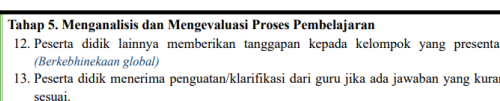
Based on Table 3, the average score for parts I, II, and III of the teaching module met the criteria for very valid. According to Akbar (2017), a teaching module is considered valid if it achieves an average score of >70%. Therefore, it can be concluded that the resulting teaching module meets the criteria for validity. After validation, revisions were made based on input and suggestions for improvement from the validator. This is similar to the research of Jannah and Prasetyo (2019)

who also obtained LKPD that was very valid and could be tested after revisions were made according to the suggestions of the validator. The validator provided several inputs and suggestions for improvement, which are outlined below.

1. In the lead-in questions section, the researcher's questions lacked contextual and engaging context. Therefore, the validator suggested that the lead-in questions be made more contextual and engaging, including images.
2. Add a video link. The introductory activities section did not include a link to the motivational video in meeting 1. The validator suggested adding a video link in that first meeting because the motivational video was provided.
3. It's best to have only one activity per learning activity to avoid ambiguity. The validator suggested that number 13 in the core activity of stage 5 be divided into two learning activity numbers to avoid ambiguity, as the word "and" separates the two activities.
4. In the content section of the LKPD, the work steps are combined, so the validator suggested separating the work steps.
5. Standardize the font and size. There are many variations in the writing in the LKPD section, so the validator recommended consistent font and size.
6. The validator also suggested adding design variations to the front cover of the LKPD.

The results before and after the revision are presented in Table 2 below.

Table 2. Results Before and After Revision

Before Revision	After Revision
 Selanjutnya pertanyaan pemantik. Lebih kontekstual dan menarik, bisa disajikan dengan bantuan gambar dg. Pertanyaan Pemantik Pertemuan 1 (Konsep Perbandingan) • Bagaimana cara menyederhanakan perbandingan? Pertemuan 2 (Perbandingan Senilai) • Bagaimana cara menentukan perbandingan senilai? Pertemuan 3 (Perbandingan Berbalik Nilai) • Bagaimana cara menentukan perbandingan berbalik nilai? • Bagaimana membedakan perbandingan senilai dan berbalik nilai? Pertemuan 4 (Skala pada Peta) • Bagaimana menentukan nilai skala pada peta, jarak pada peta dan jarak sebenarnya? • Jika ada dua buah daerah ruangan di suatu sekolah yang salah satunya digambar dengan menggunakan skala dan yang lainnya digambar tidak dengan menggunakan skala. Manakah peta yang digambar dengan tepat? Mengapa?	 Pertanyaan Pemantik Pertemuan 1 (Konsep Perbandingan) • Bagaimana cara menyederhanakan perbandingan? • Jika kamu membeli dua jenis makanan dengan harga yang berbeda, bagaimana kamu bisa membandingkan nilai atau harga dari kedua makanan tersebut? Apa yang bisa kita pelajari dari perbedaan harga ini? Pertemuan 2 (Perbandingan Senilai) • Bagaimanakah cara menggunakan konsep perbandingan senilai dalam kehidupan sehari-hari? • Sebuah mobil membutuhkan 10 liter bahan bakar untuk menempuh jarak 120 km. Jika jarak yang akan ditempuh sejauh 250 km maka berapakah menentukan banyak bahan bakar yang diperlukan untuk menempuh jarak
 800 m yang ditempuh Seano selama 5 menit untuk tiba di sekolah menggunakan sepeda. Namun, waktu sudah menunjukkan pukul 06.56 dan Seano harus tiba di sekolah sebelum pukul 07.00, artinya waktu yang tersisa hanya 4 menit dan Seano tidak mempunyai cukup waktu sehingga Seano diantar ayahnya menggunakan motor dan tiba di sekolah pukul 06.58. Seano menyadari bahwa terdapat perbedaan waktu tempuh dengan menggunakan kendaraan berbeda." (Lukman, 2019)	 "Guru menayangkan video tentang seorang anak yang bernama Seano yang akan pergi ke sekolah dengan menggunakan sepeda. Jarak dari rumah ke sekolah ialah 800 m yang ditempuh Seano selama 5 menit untuk tiba di sekolah menggunakan sepeda. Namun, waktu sudah menunjukkan pukul 06.56 dan Seano harus tiba di sekolah sebelum pukul 07.00, artinya waktu yang tersisa hanya 4 menit dan Seano tidak mempunyai cukup waktu sehingga Seano diantar ayahnya menggunakan motor dan tiba di sekolah pukul 06.58. Seano menyadari bahwa terdapat perbedaan waktu tempuh dengan menggunakan kendaraan berbeda." (https://youtu.be/y_fwDNSxj8?si=dY2ubhPt1FYDh5D)
 Berikut 884 menerima pengumuman / tugas dari guru dan akan dikerjakan dg banyu. Tahap 4. Mengembangkan dan Menyajikan Hasil Karya 10. Satu kelompok dipilih secara acak oleh guru untuk mempresentasikan hasil diskusinya mengenai konsep perbandingan. 11. Kelompok presentasi menyampaikan hasil diskusi pada layar proyektor setelah dipandu oleh guru menggunakan aplikasi zoom. 12. Peserta didik diminta untuk fokus memperhatikan kelompok yang sedang presentasi oleh guru. Tahap 5. Menganalisis dan Mengevaluasi Proses Pembelajaran 13. Peserta didik lainnya memberikan tanggapan kepada kelompok yang presentasi/ guru memberikan penguatan/mengklarifikasi apabila ada jawaban peserta didik yang kurang sesuai. (Berkebhinekaan global)	 Tahap 5. Menganalisis dan Mengevaluasi Proses Pembelajaran 12. Peserta didik lainnya memberikan tanggapan kepada kelompok yang presentasi. (Berkebhinekaan global) 13. Peserta didik menerima penguatan/klarifikasi dari guru jika ada jawaban yang kurang sesuai.



After validation, revisions and one-to-one tests were conducted to test the readability of the LKPD conducted with three students in grade VIIIJ. Students provided suggestions to enlarge the answer column, so the researcher made improvements by making the answer column larger than before. After revision, a small group test and a field test were conducted. The small group test was conducted with six students in grade VIII with heterogeneous abilities. Students with high abilities tend to dominate, so other students only follow and are less actively involved. However, according to Zaeni et al. (2017), heterogeneity in group formation is expected to provide a balance in the trend of dominance of students with high abilities, maximize the role of students with medium abilities, and provide motivation for improving attitudes and understanding for the minority, namely students with low abilities. Students with low abilities have difficulty in working, so the researcher still provides guidance regarding the steps that must be taken. In line with the opinion of Taufik (2020) who said that students with low abilities tend to have difficulty in reasoning. Students with low abilities also tend to always feel unable to work on problems. This is supported by Herawati (2023) opinion, which states that students with low self-efficacy (academic self-confidence) demonstrate weaker reasoning performance compared to those with high self-efficacy.

Field tests were conducted on a single class consisting of 34 students in grade VIIIE with heterogeneous abilities. The PBL phase encourages students to be more actively involved in discussions, asking questions, and working together in groups, resulting in increased student collaboration in solving problems at each meeting.

This aligns with research by Kurniawati et al. (2019) that PBL encourages students to actively engage in solving challenging, complex, and one-step real-life mathematical problems. Based on the results of the small group test and the field test, it was found that the LKPD had met the practical criteria presented in Table 3 below.

Table 3. Practical Results of Teaching Modules

Evaluation	The average value of the LKPD to-				Average	Criteria
	1	2	3	4		
Small Group Test Average	91%	91%	91%	91%	91%	Very Practical
Field Test Test Average	96%	96%	96%	95%	96%	Very Practical

Based on Table 3, an average of 91% was obtained with the criteria of being very practical for the small group test and the field test also showed that the LKPD had met the criteria of being very practical with an average of 96%. According to Akbar (2017), it is said to be practical if the average is $>70\%$.

Disseminate

The teaching module met the requirements for validity and practicality, and was subsequently packaged in a book form. The researcher then submitted it to the school and published it online. However, this study did not measure the effectiveness of the PBL-based teaching module due to time constraints and the research's focus on the product's validity and practicality. Therefore, the effectiveness measurement stage is planned for further research. The final product of the teaching module is shown in Figure 1.



Figure 1. Teaching Module Display

4. Conclusion

Based on the results of research and development that have been carried out through the four 4-D stages, namely the define, design, develop, and disseminate stages by involving validators and students, a product in the form of a Teaching Module that

refers to the Independent Curriculum based on Problem Based Learning on the Comparative Topic is produced which can facilitate the Mathematical Reasoning Skills of phase D students that meet valid and practical criteria. However, this study has not yet reached the point of measuring the effectiveness of the PBL-based teaching module developed due to time constraints and the focus of the research which is more focused on the validity and practicality of the product, so the effectiveness measurement stage is recommended for further research.

References

- Akbar, S. (2017). *Instrumen Perangkat Pembelajaran*. Bandung: PT. Remaja Rosdakarya.
- Aprilianti, Y., & Zanthi, L. S. (2019). Analisis Kemampuan Penalaran Matematik Siswa SMP pada Materi Segiempat dan Segitiga. *Journal on Education*, 1(2), 524–532.
- Ariati, C., & Juandi, D. (2022). Kemampuan Penalaran Matematis: Systematic Literature Review. *LEMMA: Letters Of Mathematics Education*, 8(2), 61–75.
- Arif, L., Yuanita, P., & Hutapea, N. M. (2021). Pengembangan Perangkat Pembelajaran Matematika Berbasis Problem Based Learning untuk Memfasilitasi Kemampuan Penalaran Matematis. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(1), 423–436.
- Badan, Standar, Kurikulum dan Asesmen Pendidikan (BSKAP) Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi. (2024). *Panduan Pembelajaran dan Asesmen*. Jakarta: Kementerian Pendidikan dan Kebudayaan.
- Fitri, A., & Abadi, A. M. (2021). Kesulitan Siswa SMA dalam Menyelesaikan Soal Matematika pada Materi Peluang. *Jurnal Riset Pendidikan Matematika*, 8(1), 96–105.
- Gulo, A. A. G., & Mendrofa, N. K. (2023). Pengembangan Video Pembelajaran Matematika Berbasis Discovery Learning untuk Meningkatkan Kemampuan Penalaran Matematis Siswa UPTD SMP Negeri 5 Gunungsitoli. *Pedagogy: Jurnal Pendidikan Matematika*, 8(2), 304–322.
- Herawati, A. N. A. (2023). *Analisis Kemampuan Penalaran Matematis Ditinjau dari Gaya Belajar dan Gender: Studi Kasus pada Siswa SMP dengan Gaya Belajar Auditorial* (Doctoral dissertation, Universitas Pendidikan Indonesia).
- Jannah, R., & Prasetyo, A. (2019). *Pengembangan lembar kerja peserta didik (LKPD) berbasis praktikum untuk meningkatkan kemampuan penalaran matematis*. *Jurnal Inovasi Pendidikan*, 6(2), 45–56.
- Khoeriyah, D. A. N., & Ahmad, A. (2020). Penerapan Model Pembelajaran Problem Solving dengan Pendekatan Saintifik pada Kemampuan Penalaran Matematis Siswa Kelas VIII B SMP Negeri 1 Padamara. *AlphaMath: Journal of Mathematics Education*, 6(1), 62–67.
- Kurniawati, I., Raharjo, T. J., & Khumaedi, K. (2019). Peningkatan Kemampuan Pemecahan Masalah untuk Mempersiapkan Generasi Unggul Menghadapi
-

- Tantangan abad 21. In *Prosiding Seminar Nasional Pascasarjana* (Vol. 2, No. 1, pp. 701-707).
- Marfu'ah, S., Zaenuri, Z., Masrukan, M., & Walid, W. (2022). Model Pembelajaran Matematika untuk Meningkatkan Kemampuan Penalaran Matematis Siswa. In *PRISMA, Prosiding Seminar Nasional Matematika* (Vol. 5, pp. 50-54).
- Najilah, N. F. (2022). *Analisis Kemampuan Penalaran Matematis Siswa Materi Segitiga ditinjau dari Self Regulated Learning Siswa SMP Negeri 10 Tapung* (Doctoral dissertation, Universitas Islam Negeri Sultan Syarif Kasim Riau).
- Nursobah, A. (2019). *Perencanaan Pembelajaran MI/SD*. Pamekasan: Duta Media Publishing.
- Purwanti, S., Syofiana, M., & Risnanosanti, R. (2020). Soal tentang Bilangan Bulat untuk Mengukur Kemampuan Penalaran Matematis. *Jurnal Pendidikan Matematika Raflesia*, 5(2), 145-152.
- Saputri, I., Susanti, E., & Aisyah, N. (2017). Kemampuan Penalaran Matematis Siswa Menggunakan Pendekatan Metaphorical Thinking pada Materi Perbandingan Kelas VIII di SMPN 1 Indralaya Utara. *Jurnal Elemen*, 3(1), 15 – 24.
- Sugiyono. (2019). *Metodologi Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabeta
- Taufik, A. (2020). Kesulitan Siswa dalam Pembelajaran Matematika dengan Menggunakan Pendekatan Saintifik Ditinjau dari Kemampuan Matematika di SMP. *Naskah Publikasi, Universitas Pancasakti Makassar*, 2
- Windiyarti, A., Kesumawati, N., & Misdalina, M. (2022). Analisis Kemampuan Penalaran Matematis dan Self Confidence Siswa SMP Pada Materi Perbandingan. *JEMS: Jurnal Edukasi Matematika dan Sains*, 10(2), 295-304.
- Zaeni, Z., Aulia, J., Hidayah, H., & Fatichatul, F. (2017). Analisis Keaktifan Siswa Melalui Penerapan Model Teams Gamestournaments (TGT) pada Materi Termokimia Kelas XI IPA 5 di 1 SMA N 15 Semarang. In *Prosiding Seminar Nasional & Internasional*.

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