



Enhancing Students' Critical Thinking by Integrating Contextual Problems Worksheets on Problem Based Learning

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ABSTRAK

Berpikir kritis merupakan salah satu keterampilan utama yang dibutuhkan dalam berkarir di era digital. Meskipun berpikir kritis telah dipelajari, pemikiran kritis siswa belum begitu ditekankan dalam matematika sekolah. Namun, penting untuk memberikan kehidupan siswa di masyarakat di masa depan, terutama ketika mereka menghadapi situasi yang tidak dikenal. Penelitian ini bertujuan untuk mendukung penalaran matematis siswa pada materi barisan dan deret dengan menggunakan pembelajaran berbasis masalah. Langkah-langkah pembelajaran mengintegrasikan masalah kontekstual pada lembar kerja di setiap episode. Penelitian ini merupakan penelitian tindakan kelas. Pengumpulan data menggunakan dokumentasi dan tes tertulis untuk menggali kemampuan berpikir kritis siswa. Analisis data paket pembelajaran dilakukan secara kualitatif, sedangkan kemampuan berpikir kritis siswa diolah dengan analisis deskriptif kuantitatif. Penelitian ini menyajikan deskripsi episode pembelajaran yang difokuskan untuk mengatasi pemikiran kritis siswa tentang masalah barisan dan deret. Analisis data menekankan pada lembar kerja masalah kontekstual pada pembelajaran berbasis masalah. Selain itu, kemampuan berpikir kritis siswa dijelaskan dengan metode kualitatif. Berpikir kritis siswa ditingkatkan dengan mendapatkan pembelajaran berbasis masalah dengan LKS kontekstual, meskipun keterampilan pada indikator penilaian dan inferensi belum optimal.

ABSTRACT

Critical thinking is one of the primary skills needed in a career in the digital era. Although critical thinking has been studied, students' critical thinking has not been so emphasized much in school mathematics. However, it is essential to provide student life in the community in the future, especially when they face an unfamiliar situation. This research purposed to support students' mathematical reasoning on sequences and series material using problem-based learning. Learning steps integrated contextual problems on the worksheet in every episode. This research is classroom action research. Data collection utilizes documentation and written tests to explore students' critical thinking skills. Data analysis of the learning package is carried out qualitatively, while students' critical thinking skills are processed by quantitative descriptive analysis. This study presents a description of learning episodes focused on tackling students' critical thinking about sequences and series problems. The data analysis emphasized contextual problem worksheets on problem-based learning. Besides, students' critical thinking skills are described by a qualitative method. Students' critical thinking is enhanced by getting problem-based learning with contextual problem worksheets, although the skills on assessment and inference indicators have not been optimal.

1. PENDAHULUAN

To face with Information and Communications Technology (ICT) Age, students need to master 21st-century skills (Pilgrim & Martinez, 2013; Pratama & Retnawati, 2018). The four primary learning skills echoed in the century are critical thinking, creativity, collaboration and communication. To deal with these challenges, schools should provide opportunities for students to develop critical thinking skills,

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flexible problem solving, and collaboration and communication (Erdogan, 2019; Pardede, 2020). Critical thinking is one of the primary skills needed in a career in the digital era (Vincent-Lancrini et al., 2019). Moreover, critical thinking skill is sorely students required to succeed in later life (Binkley et al., 2011). Especially for vocational secondary students before pursuing their career. Students need critical thinking skills to solve problems they encounter while working in the future (Effendi et al., 2021). Students deal with various problems (Yasin et al., 2019). Assessment of critical thinking skills must be considered regarding students' career readiness because this ability is used for data-based decision making (Lombardi et al., 2015). Thus, critical thinking must be encouraged and assessed. Schools have a responsibility in this regard (Firdaus et al., 2015).

Several experts have offered definitions and components of critical thinking skills. Ennis (1989) describes critical thinking as reasonable reflective thinking to justify what to do and believe. This concept is compatible with problem-solving, higher order thinking skills, and metacognition (Ennis, 1989). Furthermore, six basic elements of critical thinking: focus, reason, inference, situation, clarity, and overview (Chusni et al., 2020). On the other hand, there are four critical thinking indicators, namely clarification, assessment, inference, and strategies (Perkins & Murphy, 2006). In another article, instead of explaining the definition of critical thinking skills, the core of critical thinking skills as part of cognitive abilities consisting of interpretation, analysis, inference, evaluation, explanation, and self-regulation, and questions used to explore each indicator (Facione, 2015). Apart from the various indicators presented by the experts, students' critical thinking skills must be developed because this leads to problem-solving skills.

Teachers must work on how students' critical thinking skills can be built and improved. Integration in learning is necessary so that students are accustomed to gathering information, interpreting existing information, and solving problems. However, this is not easy. Teachers still tend to organize teacher-centred learning, provide direct material explanations, demonstrate problem-solving, and provide exercises. This situation also happens in learning mathematics. This learning requires students to reason and think critically. In addition, this subject truly must be mastered by students at the vocational high school. Mathematics is beneficial in various fields. It is the fundamental knowledge used in many careers, such as finance, accounting, engineering, medical. In addition, this is also an essential aspect in the field of technology and software development that strongly supports the progress of technology and information today (Mullis et al., 2015). Therefore, vocational students majoring in Computer and Network Engineering have to master mathematical content.

One of the mathematical contents that students of the Computer and Network Engineering Vocational School must be mastered is sequences and series. These material studies number patterns, arithmetic sequences and series, and geometric sequences and series. This study can strengthen students' provision in studying programming languages. In fact, the teacher observed that most students could solve routine problems related to sequences and series, but all of them had to struggle in solving non-routine problems. Students have not been able to understand the context of the problem, sort out the existing information, analyze what will be solved and determine the steps for solving it. Students tend to leave the problems of sequences and series that look complex. Students' critical thinking skills seem not optimal. Student's study using Electronic School Books (books provided by the government) and commercial worksheets during this time. Although the book was written to support the implementation of the 2013 Curriculum, which applies a scientific approach, the implementation in the classroom has not been optimal. Actually, the textbooks are prepared based on student activities (Kemendikbud, 2014). Students are also not actively involved in the learning process. The content of mathematics lessons that teachers must transfer is so dense that it is impossible to take a scientific approach all the time. In addition, students tend to be passive when learning occurs (Putra et al., 2020). They tend to be silent, listen and take notes on the teacher's explanation, then follow the teacher's instructions to try exercises that are often in the form of multiple-choice, students' critical thinking skills become challenging to develop. Based on the initial data of the study, only 4.17%, 12.5%, 25.5%, and 8.33% of students met the indicators of clarification, assessment, inference and strategies, respectively.

In the 2013 curriculum, learning must be packaged as fun, challenging and motivating students to be active in the learning process. In addition, learning must meet contextual and collaborative characteristics. Some learning models are offered to build a vibrant atmosphere in the classroom, such as problem-based learning. Problem-based learning can develop students' critical thinking skills in mathematics subjects (Firdaus et al., 2015; Serevina, 2018). Problem-based learning consists of five syntaxes: orient students to the problems, organize students to study, facilitate individual and group investigations, develop and present work, and finally analyze and evaluate the problem-solving process (Arends, 2012; Qomariyah, 2019). The problems that initiate learning must be designed to attract students' interest, problems that are by real life, and problems must be close to students to generate

interest in conducting investigations. Presentation of this problem can be done through student worksheets. Teachers can develop worksheets to support problem-based learning scenarios. Students need worksheets to facilitate understanding of the problem (Krisdiana et al., 2019). This paper presents two episodes of learning with contextual problem worksheets on problem-based learning designed to improve the critical thinking skills of vocational high school students in sequence and series learning. Besides, the result of the implementation is discussed as well.

2. METODE

This research is classroom action research. Classroom action research involves qualitative and interpretive research methods. Data collection is carried out by teachers who often involve academics so that teachers can assess how the learning practices are improving. The step of this research consists of planning, acting and observing, then reflecting (Subudi, 2021; Tias, 2017). This paper describes two problem-based learning cycles to improve students' critical thinking skills. This research is conducted in SMK (vocational senior high school) 1 Banyudono in grade 10 in Computer and Network Engineering Class with 24 students. It is a public school that prepares students to be workers or continue studying to a higher degree. This paper focuses on describing two mathematics class cycles that integrates contextual problem worksheets on problem-based learning. However, the improvement of students' critical thinking skills is also reviewed. Thus, the data of this study are a description of the use of problem-based learning tools (especially student worksheets) and the results of students' critical thinking tests. Data collection utilizes documentation and written tests to explore students' critical thinking skills. Data analysis of the learning package is carried out qualitatively, while students' critical thinking skills are processed by quantitative descriptive analysis. The problem-based learning syntax used in this study refers to the model by Arends (Arends, 2012). While the indicators of critical thinking skills using the indicators described by Perkins & Murphy (Perkins & Murphy, 2006). This indicator is chosen because the trend of research data related to critical thinking skills was obtained through a written test (without an interview). A case study related to developing a model to see students' involvement in critical thinking in online asynchronous discussions where research data was obtained through student comments on asynchronous discussion forums (Perkins & Murphy, 2006).

3. HASIL DAN PEMBAHASAN

Hasil

Problem-based learning can only occur if the teacher plans a learning situation that allows an open and honest exchange of ideas between students (Arends, 2012). Teachers must prepare learning designs and supporting tools, including lesson plans, contextual problems worksheets, learning media, and critical thinking tests. In the first stage of problem-based learning, orient students to problems, the teacher must begin by explaining the learning objectives, and the learning process students will experience. Furthermore, the teacher presents contextual problems and confusing problems to arouse students' curiosity. It is an essential part of this learning (Arends, 2012). The problem for the first learning cycle related to arithmetic sequences and series can be seen in Figure 1.

Kasus 1

Andri adalah seorang mahasiswa tahun pertama Program Studi Teknik Informatika di universitas ternama di Kota Solo. Selama menempuh program sarjana di Kota Solo, Andri tinggal di kost "Bintang". Meskipun setiap bulan uang kiriman dari orang tuanya bisa mencukupi kebutuhannya, Andri merasa harus belajar hidup mandiri. Teman Andri, Fauzan, menawari Andri untuk bekerja paruh waktu di kedai kopi "Kopiku Kopimu" milik saudara Fauzan. Fauzan memberitahu bahwa waktu bekerja di kedai hanya 5 jam per hari dengan sistem *shift* seminggu 3kali. Fauzan juga mengatakan bahwa gaji pertama nanti Rp500.000 per bulan dan gaji akan diterima Andri setiap tanggal 28 per bulan. Gaji tersebut akan naik Rp 25.000 setiap bulannya.

Andri pun mulai memikirkan tawaran Fauzan. Andri mulai berangan-angan menabung seluruh gajinya selama bekerja jika nanti dia diterima kerja tanpa dipakai sepeser pun. Jika Andri mulai bekerja awal November 2019 ini dan memperkirakan akan meminta cuti lama karena berniat mengikuti program Kampung Inggris pada libur semester Januari 2021, mungkinkah total seluruh tabungan Andri dari gaji di kedai mencapai Rp 15juta pada saat cuti nanti?

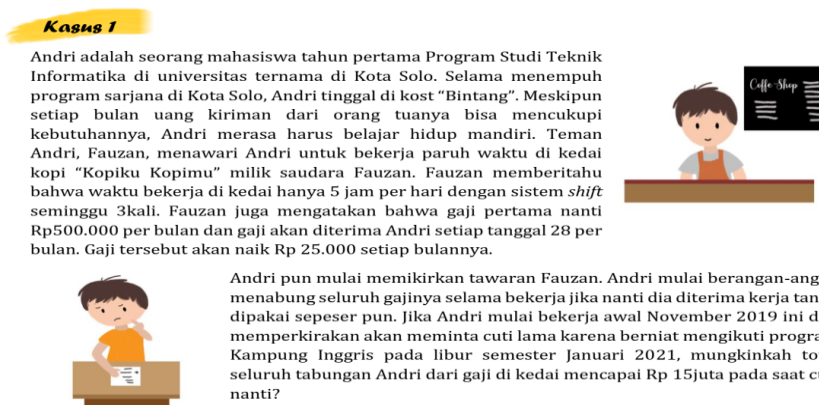


Figure 1. Contextual Problems in the First Learning Cycle Worksheet

While the second cycle is related to geometric sequences and series, contextual problems related to paper webbing are presented to start learning as shown in Figure 2.

Kasus 1

Mega, siswi SD Kabupaten Boyolali, mendapat tugas Seni Budaya dan Prakarya untuk membuat prakarya mengayam dari kertas warna. Dia harus menyusun potongan-potongan kertas berukuran sama menjadi anyaman yang rapi dan menarik. Untuk menyeragamkan ukuran anyaman satu kelas, gurunya memberitahu bahwa satu ukuran kertas warna dapat **dilipat menjadi dua bagian yang sama besar sebanyak lima kali**, lalu memotongnya menjadi potongan-potongan kecil.

Saat ini Mega masih memiliki 3 lembar kertas warna yang masih utuh. Jika Mega memerlukan 100 potongan-potongan kertas warna, cukupkah 3 lembar kertas warna yang dimiliki Mega tersebut?



Figure 2. Contextual Problems in the Second Learning Cycle Worksheet

Learning begins with presenting contextual problems that students can imagine. Problems are designed to be challenging so that students are interested in solving them and are actively involved in the learning process. Problem-based learning makes students motivated and willing to work hard in the learning process (De Graaff & Kolmos, 2003). The problems presented must be authentic, confusing, meaningful, and appropriate to the learning time, and benefit from group efforts (Arends, 2012). The next phase is organizing students to learn. The teacher facilitates students to develop collaboration skills and helps students to plan investigations. In this phase, the class is divided into 3-4 students each. In problem-based learning, teachers can divide groups according to the goals to be achieved (Arends, 2012). The third phase is investigation. In this section, students must investigate the problem both independently and in group discussions. In the first learning cycle, students investigate various information and collect data so that they find patterns of arithmetic sequences to get to the solution of the problem. The teacher ensures an in-depth investigation and helps students to ensure that students' solutions match the problems in the first cycle. Similarly, in the second cycle, students investigate the data to find solutions to the problems of geometric sequences and series. Giving students opportunities to share opinions and think about other students' arguments can make them critical thinkers (NCTM, 2000). In developing and presenting the work, students compile the investigation results coherently by writing them on students' worksheets completely. Next, they present the results and comment on the solutions obtained. This stage occurs feedback on the results of student work. In this phase, students also share the results of their activities with their friends (Rustam E et al., 2017).

The last phase is to analyze and evaluate the problem-solving process. At this stage, the teacher facilitates students in reconstructing thinking. Evaluation is carried out thoroughly on the stages of problem-solving that students have carried out during the learning process. Through this activity, the teacher allows students to express reflections on student experiences related to understanding the situation on contextual problems, the reasons students agree or reject statements, and when students find solutions to problems. Both learning cycles are implemented with a problem-based learning syntax as described above. From the two implementation cycles, the results of students' critical thinking skills are evaluated at the end of each cycle. Table 1 presents the results of students' critical thinking skills. This critical thinking skill is measured by using an instrument in contextual problems.

Table 1. Results of students' critical thinking skills

Indicators	Pre-cycle (%)	Cycle 1 (%)	Cycle 2 (%)
Clarification	4.17	41.67	83.33
Assessment	12.5	12.5	25
Inference	12.5	12.5	58.33
Strategies	8.33	75	87.56

Discussion

From Table 1, the initial results of critical thinking skills in solving contextual problems of students are not optimal. In the four critical thinking indicators, the percentages of students who meet the indicators are below 13%. Under the teacher's initial assumption, students are not familiar with complex problems. Learning resources used so far tend to be routine problems that do not develop students' critical thinking skills. After the first learning cycle is completed, students' critical thinking skills are still not optimal. In the assessment and inference indicators, there has been no improvement. However, two other indicators appear to have increased significantly, especially the strategic aspect that reached 75%. In the results of the first cycle evaluation, students began to identify important information in contextual problems. However, most students have not comprehensively analyzed the aspects contained in the problem. Therefore, in the second cycle of learning, investigations are more optimized, especially at the data collection stage, so that students identify and analyze every detail of issues and information that arise in the problem. In addition, the teacher facilitates students to discuss and ask questions related to the contextual problem situation. At the end of the second cycle, the clarification indicator was achieved by 83.33% of students. The assessment indicators are still not optimal until the second cycle is completed. In the first cycle, there is no increase in the percentage of students who could give arguments to the answers given. Most students also have not made sure the problem solving is correct. When students are asked to argue the truth of a statement, students also have not been able to state logical reasons. However, the percentage of students meeting this indicator has doubled, from 12.5% in the pre-cycle to 25% at the end of the second cycle.

At the end of the first cycle, there is no increase in the students who met the inference indicator. From the pre-learning cycle data and the first learning cycle, only 12.5% of students could relate various facts in the problem to solve it, ending with concluding solving the problem. From the results of the reflection of the first cycle, most students are still not able to use all the related information. Some students are seen making tables composed of the data in the problem and trying to generalize the pattern. The second cycle of learning presents worksheets with more directed instructions to help students find patterns of relationships between facts. The teacher helps with trigger questions so that students have an active discussion in problem-solving. However, this assistance is sought not to interfere with the problem-solving process carried out by students (Arends, 2012; Qomariyah, 2019). At the end of the second cycle, students who met this indicator rose to 58.33%. As a facilitator, the teacher has an essential role in successfully implementing problem-based learning (Amini et al., 2019; Wakit & Kusumodestoni, 2020).

From the two learning cycles, it is seen that there is an increase in the percentage of each indicator of critical thinking ability. Problem-based learning can improve students' critical thinking skills (Arviana et al., 2018; Samura et al., 2019). Students' mathematical communication skills can be improved through problem-based learning on the material of sequences and series (Atika et al., 2020). In addition, problem-based learning can improve students' higher-order thinking skills (Jailani et al., 2017), in which critical thinking is part of higher-order thinking (Arviana et al., 2018). Although there were still two critical thinking indicators at the end of the second cycle whose achievements were below 75%, the clarification aspect increased from 4.17% to 83.33%, likewise, for the strategic aspect, which rose significantly. Teachers are committed to developing the critical thinking skills of SMK students because this is very much needed when they are in the world of work and live in society. Teachers need more time to organize learning scenarios that aim to improve critical thinking skills. Treatment in a short time has not provided optimal results (Espinosa et al., 2013). Not only the final result but the success of learning is also seen in the learning process that has taken place. Problem-based learning focuses on this (Wakit & Kusumodestoni, 2020). Teachers must plan each stage of learning well because it impacts students' thinking abilities. One of the critical things teachers can prepare is a worksheet based on contextual problems, which are authentic according to the environment around students (Suryawati et al., 2020). With a worksheet according to a well-prepared lesson plan, students' critical thinking skills can increase (Afdareza et al., 2020). It is indeed not easy for teachers to do at every learning hour. It is not only a matter of preparing learning tools that take a lot of time; teachers also have to think up problem ideas that challenge and foster interest in an investigation for students.

4. SIMPULAN

Problem-based learning to improve students' critical thinking skills is carried out through six steps, namely orient students to contextual problems presented in student worksheets; organize students to learn with the help of contextual problem worksheets; individual and group investigations to complete the worksheets; develop and present the results of the work through contextual problem-solving

presentations; and analyze and evaluate the solving processes that students have carried out. Problem-based learning by integrating contextual problem worksheets improves students' critical thinking skills on all indicators, although the assessment and inference indicators have not provided optimal improvement. Mathematics learning must have a learning atmosphere to develop students' critical thinking skills. Indeed, the results can't be seen instantly, but activities designed to foster an investigative desire and curiosity in students will positively impact students' thinking skills. Again, teachers have a significant role to play in facilitating these things.

5. DAFTAR RUJUKAN

- Afdareza, M. Y., Yuanita, P., & Maimunah, M. (2020). Development of Learning Device Based on 21st Century Skill with Implementation of Problem Based Learning to Increase Critical Thinking Skill of Students on Polyhedron for Grade 8th Junior High School. *Journal of Educational Sciences*, 4(2), 273. <https://doi.org/10.31258/jes.4.2.p.273-284>.
- Amini, R., Setiawan, B., Fitriya, Y., & Ningsih, Y. (2019). The Difference of Students Learning Outcomes Using the Project-Based Learning and Problem-Based Learning Model in Terms of Self-Efficacy. *Journal of Physics: Conference Series*, 1387(1). <https://doi.org/10.1088/1742-6596/1387/1/012082>.
- Arends, R. I. (2012). *Learning to Teach* (9th ed.). Mc Graw Hill.
- Arviana, R., Irwan, & Parma, D. M. (2018). Problem Based Learning in Mathematics Education and Its Effect on Student's Critical Thinking. *Advanced Science Letters*, 24(1). <https://www.ingentaconnect.com/contentone/asp/asl/2018/00000024/00000001/art00063>.
- Atika, N., Roza, Y., & Murni, A. (2020). Development of Learning Tools by Application of Problem Based Learning Models to Improve Mathematical Communication Capabilities of Sequence and Series Materials. *Journal of Educational Sciences*, 4(1), 62. <https://doi.org/10.31258/jes.4.1.p.62-72>.
- Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2011). Defining Twenty-First Century Skills. In *Assessment and Teaching of 21st Century Skills* (pp. 17–66). Springer Science+Business Media B.V. <https://doi.org/10.1007/978-94-007-2324-5>.
- Chusni, M. M., Saputro, S., Suranto, & Rahardjo, S. B. (2020). Review of Critical Thinking Skill in Indonesia: Preparation of the 21-st Century Learner. *Journal of Critical Reviews*, 7(9).
- De Graaff, E., & Kolmos, A. (2003). Characteristics of Problem-Based Learning. *International Journal of Engineering Education*, 19(5), 657–662. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.455.3467&rep=rep1&type=pdf>.
- Effendi, R., Herpratiwi, H., & Sutiarto, S. (2021). Pengembangan LKPD Matematika Berbasis Problem Based Learning di Sekolah Dasar. *Jurnal Basicedu*, 5(2), 920–929. <https://doi.org/10.31004/basicedu.v5i2.846>.
- Ennis, R. H. (1989). Critical Thinking and Subject Specificity: Clarification and Needed Research. *Educational Researcher*, 18(3), 4–10. <https://doi.org/10.3102%2F0013189X018003004>.
- Erdogan, V. (2019). Integrating 4C Skills of 21st Century into 4 Language Skills in EFL Classes Vacide Erdoğan. *International Journal of Education and Research*, 7(11), 113–124. <https://www.ijern.com/journal/2019/November-2019/09.pdf>.
- Espinosa, A. A., Monterola, S. L. C., & Punzalan, A. E. (2013). Career-Oriented Performance Tasks in Chemistry: Effects on Students' Critical Thinking Skills. *Educational Research International*, 2013. <https://doi.org/10.1155/2013/834584>.
- Facione, P. A. (2015). *Critical Thinking : What it Is and Why It Counts?*. Insight Assessment.
- Firdaus, F., Kailani, I., Bakar, M. N. B., & Bakry, B. (2015). Developing Critical Thinking Skills of Students in Mathematics Learnin. *Journal of Education and Learning*, 9(3), 226–236. <https://core.ac.uk/download/pdf/324199933.pdf>.
- Jailani, Sugiman, S., & Apino, E. (2017). Implementing the Problem-Based Learning in Order to Improve the Students' HOTS and Characters. *Jurnal Riset Pendidikan Matematika*, 4(2), 247. <https://doi.org/10.21831/jrpm.v4i2.17674>.
- Krisdiana, I., Masfingat, T., Murtafiah, W., & Widodo, S. A. (2019). Worksheet-Based Learning Research to Improve Creative Thinking Skills. *Journal of Physics: Conference Series (1st UPY International Conference on Applied Science and Education 2018)*. <https://doi.org/10.1088/1742-6596/1254/1/012054>.
- Lombardi, A. R., Kowitz, J. S., & Staples, F. E. (2015). Correlates of Critical Thinking and College and Career Readiness for Students With and Without Disabilities. *Career Development and Transition for Exceptional Individuals*, 38(3), 142–151. <https://doi.org/10.1177/2165143414534888>.
- Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2015). TIMSS 2015 International Results in Mathematics. In *TIMSS & PIRLS International Study Center*. TIMSS&PIRLS International Study

- Center.
- NCTM. (2000). *Principles and Standards for School Mathematics*. NCTM.
- Pardede, P. (2020). Integrating the 4Cs into EFL Integrated Skills Learning. *Journal of English Teaching*, 6(March), 71–85. <https://doi.org/10.33541/jet.v6i1.190>.
- Perkins, C., & Murphy, E. (2006). Identifying and Measuring Individual Engagement in Critical Thinking in Online Discussions: An Exploratory Case Study. *Educational Technology and Society*, 9(1), 298–307. <https://www.jstor.org/stable/pdf/jeductechsoci.9.1.298.pdf>.
- Pilgrim, J., & Martinez, E. E. (2013). Defining Literacy in the 21st Century: A Guide to Terminology and Skills. *Texas Journal of Literacy Education*, 1(1), 60–69. <https://eric.ed.gov/?id=EJ1110822>.
- Pratama, G. S., & Retnawati, H. (2018). Urgency of Higher Order Thinking Skills (HOTS) Content Analysis in Mathematics Textbook. *Journal of Physics: Conference Series*, 1097(1). <https://doi.org/10.1088/1742-6596/1097/1/012147>.
- Putra, H. D., Setiawan, W., & Afrilianto, M. (2020). Indonesian High Scholar Difficulties in Learning Mathematics. *International Journal of Scientific & Technology Research*, 9(1). <https://dosen.ikipsiliwangi.ac.id/wp-content/uploads/sites/6/2020/06/Indonesian-High-Scholar-Difficulties-In-Learning-Mathematics.pdf>.
- Qomariyah, S. N. (2019). Effect of Problem Based Learning Learning Model to Improve Student Learning Outcomes. *International Journal of Educational Research Review*, 4(2), 217–222. <https://doi.org/10.24331/ijere.518056>.
- Rustam E, S., Sidabutar, D. R., & Edy, S. (2017). Improving Learning Activity and Students' Problem Solving Skill through Problem Based Learning (PBL) in Junior High School. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, 33(2), 321–331. <http://digilib.unimed.ac.id/id/eprint/24792>.
- Samura, A. O., Juandi, D., & Darhim. (2019). Improving Mathematical Critical Thinking Skills Through Problem-Based Learning. *Journal of Physics: Conference Series (International Conference on Mathematics and Science Education 2019)*. <https://doi.org/10.1088/1742-6596/1521/3/032102>.
- Serevina, V. (2018). Development of E-Module Based on Problem Based Learning (PBL) on Heat and Temperature to Improve Student's Science Process Skill. *TOJET: The Turkish Online Journal of Educational Technology*, 17(3), 26–36. <https://eric.ed.gov/?id=EJ1184205>.
- Subudi, I. K. (2021). Peningkatan Aktivitas dan Hasil Belajar Biologi sebagai Dampak Penerapan Model Pembelajaran Kooperatif Tipe Group Investigation. *Journal of Education Action Research*, 5(1), 17–25. <https://doi.org/10.23887/jear.v5i1.32131>.
- Suryawati, E., Suzanti, F., Zulfarina, Putriana, A. R., & Febrianti, L. (2020). The Implementation of Local Environmental Problem-Based Learning Student Worksheets to Strengthen Environmental Literacy. *Jurnal Pendidikan IPA Indonesia*, 9(2), 169–178. <https://doi.org/10.15294/jpii.v9i2.22892>.
- Tias, I. W. U. (2017). Penerapan Model Penemuan Terbimbing untuk Meningkatkan Hasil Belajar IPA Siswa Sekolah Dasar. *DWIJA CENDEKIA: Jurnal Riset Pedagogik*, 1(1), 50–60. <https://doi.org/10.20961/jdc.v1i1.13060>.
- Vincent-Lancrini, S., González-Sanchoi, C., Bouckaerti, M., Lucai, F. de, Fernández-Barrerrai, M., Jacotini, G., Urgeli, J., & Vidal, Q. (2019). *Fostering Students' Creativity and Critical Thinking: What it Means in School* (Centre for Educational Research and Innovation (ed.)). OECD Publishing.
- Wakit, A., & Kusumodestoni, R. H. (2020). Problem Based Learning with a Scientific Approach with Character in Mathematics Learning. *Al-Jabar: Jurnal Pendidikan Matematika*, 11(1), 121–132. <https://doi.org/10.24042/ajpm.v11i1.6411>.
- Yasin, M., Jauhariyah, D., Madiyo, M., Rahmawati, R., Farid, F., Irwandani, I., & Mardana, F. F. (2019). The Guided Inquiry to Improve Students Mathematical Critical Thinking Skills Using Student's Worksheet. *Journal for the Education of Gifted Young Scientists*, 7(4), 1345–1360. <https://doi.org/10.17478/jegys.598422>.