Problem-Based Learning: Learning Approach Solutions in Crisis Period

I Wayan Eka Mahendra[1*], Gusti Ayu Dessy Sugiharni [2] ID

[1]Hotel Management Study Program, Institut Pariwisata dan Bisnis Internasional, Indonesia
[2] Department of Information System, Institut Teknologi dan Bisnis STIKOM Bali, Indonesia

A R T I C L E   I N F O

A B S T R A K

Saat ini, banyak sekolah yang menerapkan kegiatan pembelajaran kurang baik dengan menggunakan pendekatan konvensional di masa pandemi Covid-19. Apalagi diduga telah terjadi learning loss. Oleh karena itu, diperlukan suatu pendekatan pembelajaran yang dapat meningkatkan aktivitas belajar siswa yang berujung pada peningkatan kemampuan berpikir tingkat tinggi (HOTS) siswa. Oleh karena itu, tujuan dari penelitian ini adalah untuk menganalisis penerapan PBL online dalam pengaruhnya terhadap kemampuan berpikir siswa. Penelitian ini dilakukan di SMP Negeri dengan sampel sebanyak 78 siswa yang diambil dengan teknik simple random sampling. Keterampilan berpikir tingkat tinggi (HOTS) siswa dikumpulkan dengan menggunakan tes yang telah diuji koefisien validitas dan reliabilitasnya. Data yang terkumpul dianalisis menggunakan uji-t yang pada awalnya menguji normalitas sebaran data dan homogenitas varian. Hasil penelitian ini menunjukkan bahwa ada pengaruh penerapan pendekatan pembelajaran berbasis masalah (PBL) terhadap kemampuan berpikir tingkat tinggi (HOTS) siswa.

A B S T R A C T

Currently, there are many schools that apply poor learning activities using conventional approaches during the Covid-19 pandemic. Moreover, it is suspected that there has been a learning loss. Therefore, a learning approach is needed that can improve student learning activities which lead to an increase in students' higher order thinking skills (HOTS). Therefore, the aim of this study is to analyze the application of online PBL in its effect on student`s thinking abilities. This research was conducted at State Junior High Schools which involving a sample of 78 students who were taken using a simple random sampling technique. The students' higher-order thinking skills (HOTS) were collected by using the test which has examined its validity and reliability coefficients. The collected data were analyzed using the t-test which has initially examined the normality of the data distribution and the homogeneity of the variants. The results of this study indicated that there was an effect of implementing a problem-based learning (PBL) approach on the students' higher-order thinking skills (HOTS).

1. INTRODUCTION

Covid-19 began to develop in Wuhan Province in China, with the first case was identified on December 12, 2019 (Ferri et al., 2020; Lee, S., Hwang & Moon, 2020). The World Health Organization (WHO) stated that the corona virus (Covid-19) has spread to 213 countries and more than 3 million people have been confirmed positive and more than 200 thousand deaths all over the world (Patricia Aguilera-Hermida, 2020; Suryaman et al., 2020; Yang et al., 2020). This pandemic has impacted on all aspects of human life, social, economic, and also education. Various policies and strategies have been carried out by the Indonesian government, such as social distancing, physical distancing, large-scale social restrictions, wearing masks, and washing hands frequently. In the field of Education, the United Nations Educational, Scientific and Cultural Organization (UNESCO) stated that the education system was limited, the teaching learning process was also limited, and more than 92% of educational institutions and universities were closed all over the world (Adnan, 2020; Fabriz et al., 2021; Sujarwo et al., 2020). Meanwhile, from the diagnostic assessment was conducted by the Ministry of Education and Culture for primary and secondary education, it was obtained that the students already had signs of learning loss (Dhawan, 2020; Suprayitno & Wahyudi, 2020). Learning loss is defined as the loss of learning ability and experience in students. Furthermore, previous research repost that 47 percent of schools/teachers stated that only 50 percent of students fulfilled competency standards. 20 percent of schools/teachers assessed that a small proportion of students fulfilled the competency standards. This meant that students who fulfilled competency standards were only under 50 percent. 31.9 percent of schools/teachers assessed

---

*Corresponding author.
E-mail addresses: ekaundiksha@yahoo.com (I Wayan Eka Mahendra)

that most of their students had fulfilled the competency standards. If most teachers/schools stated that their students did not fulfill the competency standards, it meant that there was a tendency that learning loss occurred (Gillis & Krull, 2020; Jaya Saragih et al., 2020).

The phenomenon above indicated that the learning process was a challenge for teachers, how to design and identify the best approaches and solutions in learning during a pandemic (Muppudathi et al., 2014; Saide & Sheng, 2020; Yuzulia, 2021). New approaches and strategies are needed to carry out learning during the pandemic as well as after the pandemic. Distance learning was the best solution during a pandemic since many schools and colleges were closed (Gurbanov, 2016; Mutohhari et al., 2021; Saputri et al., 2018). However, how distance learning could maintain students' learning activities even though studying at home was a challenge for teachers. Teachers were forced to reform the system or learning process that has been carried out, namely face-to-face learning towards online learning. Various obstacles faced by teachers and students in online learning, such as limited internet access (Khasanah et al., 2020; Mutohhari et al., 2021) the lack of the parent's ability to facilitate learning, boring due to they merely stared at a laptop or cellphone, and identical with assignments. A learning approach is needed that can increase student learning activities, not merely giving textbook assignments. The learning should be based on students' daily life problems, it is problem-based learning (PBL) (Beneroso & Robinson, 2022; Permatasari et al., 2019; Putri et al., 2020).

PBL was first developed at the McMaster School of Medicine in Canada in 1965. Furthermore, it was refined by Howard in 1988 as a curriculum development strategy and a learning process approach (Jalinus et al., 2019; Mahasneh & Alwan, 2018; Samantha Wells & Jackson., 2009). PBL was well structured in learning, would require students to express or demonstrate a sharing of skills, such as independent learning, critical thinking, team participation, and critical knowledge acquisition (Dwyer et al., 2014; Suryani et al., 2020; Yunianto et al., 2020). The process in PBL involved a systematic approach to solving problems or facing challenges following real-world situations (Charlton-Perez, 2013; Wahyuni et al., 2021). Independent learning encouraged students to consider what they knew, what they didn't know, and what they might need to know to solve existing problems and similar contextual situations in the future (Albay, 2019; Lawut et al., 2019; Yunianto et al., 2020). In essence, PBL was a learning method approach that encouraged students to learn actively. In short, students work together to solve problems. In its implementation, they learn the skills needed to explore and solve complex problems (Ana et al., 2020; Made Sudana et al., 2019; Rahmah et al., 2019). Various studies indicated the advantages of PBL over conventional learning approaches. PBL could improve students' high-order thinking skills, learning outcomes, changed attitudes and self-confidence, and critical thinking skills (Achilles & Hoover, 1996; Gordon, R et al., 2001). The problem proposed in PBL was unstructured. It's a problem where there is no single proper solution, and when new information is collected, then the problem definition will change. The research by previous researcher conduct research related about application of PBL online using asynchronous discussion boards and additional lecture videos (Luck & Norton, 2004). This study is compared student`s perspectives and experiences in online and face-to-face learning. It was found that students preferred online learning by PBL compared with face-to-face, even though there was no difference in learning results (Duncan et al., 2013). This study used a single module blended approach to knowing student`s experiences in online PBL learning. Each group of four people is given a problem scenario which is the core part of the module. The result is that online PBL seen useful for developing ideas and criticizing information. Although online PBL has advantages over other online learning, such as the results of previous research it is not investigated how the effect of online PBL on students' higher order thinking skills. Even though high-order thinking skills for students are skills needed in the 21st century (Antara & Dewantara, 2022; Astuti et al., 2019; Mrah, 2017). If student`s abilities are not explored, the impact of online PBL for students will not be maximized including student`s higher order thinking skills. This study adopts some advantages of PBL in online learning on higher-order thinking skills. Of course, there are some PBL principles that cannot be applied optimally. Physical meetings between teachers and students are limited when online classes so it doesn`t reduce student learning activities with the application of PBL. Therefore, the aim of this study is to analyses the application of online PBL in its effect on student`s thinking abilities.

2. METHODS

This research was classified as quasi-experimental research which had a control group. However, it couldn't fully function to control the external variables that affected the implementation of the experiment. This study aimed to determine the differences in students' higher-order thinking skills with online PBL and conventional learning approaches conducted. In this experimental study, researchers used two sample groups with the design used was the Non-Equivalent Controll Group Design (Mahendra et al.,

2019; Rajendra & Sudana, 2017). This research was conducted on VIII grade students of State Junior High Schools in Marga Sub-district, which consisted of 4 schools involving SMPN 1 Marga, SMPN 2 Marga, SMPN3 Marga, and SMPN 4 Marga. This study involved a sample of 78 students who were taken by simple random sampling technique. The instrument used to collect the data was a higher-order thinking skill test that was compiled by the researcher, with indicators 1) Analyzing (C4) includes: comparing, making diagrams, and describing, 2) evaluating (C5) including: checking back, giving arguments, and concluding, 3) Creating (C6) includes: designing, creating, designing, and who had previously tested the validity and calculated the reliability coefficient. There were 7 items tested that were in the valid category and had a reliability coefficient of 0.78 of high category. Five items were used as the final test which was selected from seven items that had the highest validity coefficient for items measuring the same indicator. The collected data were then analyzed using the t-test, which had previously been tested for normality of data distribution and homogeneity of variance. Instrument analysis and data analysis using SPSS 20.0 for windows.

3. RESULT AND DISCUSSION

Results

The object of this research was the difference in students' higher-order thinking skills as a result of the learning approach. The form of the learning approach in this study was divided into two, namely the problem-based learning (PBL) and the conventional learning approach. This study used a non-equivalent control group design using the t-test as a means of analyzing data. Therefore, the data in this study were classified into high-order thinking skills of students who participated in the PBL and higher-order thinking skills of students who participated in conventional learning approaches. The results of the analysis of the central tendency (mean, mode, median) and the measures dispersion of the data distribution (variance and standard deviation) on the students' higher-order thinking skills scores could be figured in Table 1.

Table 1. The results of descriptive analysis

Statistic	Experimental Group	Group
Sample	40	38
Mean	73.3750	60.7368
Median	74.5000	60.0000
Mode	72.00[a]	54.00[a]
Std. Deviation	9.80499	9.64697
Variance	96.138	93.064
Range	47.00	47.00
Minimum	48.00	38.00
Maximum	95.00	85.00
Sum	2935.00	2308.00

The normality test was carried out to ensure that the statistical test used in testing the hypothesis could be performed. It's necessary when the data were not normally distributed, the t-test which was a parametric statistic couldn't be performed. The normality test in this study used the Kolmogorov-Smirnov in both groups of data on students' higher-order thinking skills. The normality test result is show in Table 2.

Table 2. Tests of Normality

Group	Statistic	df	Sig.
Experimental	0.134	38	0.082
Control	0.118	38	0.200

Based on Table 2, the Kolmogorov-Smirnov and Shapiro-Wilk test analysis indicated that the sig. > 0.05 for both data on higher-order thinking skills in the experimental group (Y_1) and the control group (Y_2) as in the table above. This meant that H_0 was accepted (failed to be rejected), both sample groups were normally distributed. The variance homogeneity test was intended to ensure that the differences obtained from the t-test came from differences between groups, not due to differences within groups.

Based on the results of the analysis of the variance homogeneity test using SPSS 16.0 for windows could be obtained results as show in Table 3.

Table 3. Test of Homogeneity of Variances

Variances	Levene Statistic	df1	df2	Sig.
Based on Mean	0.001	1	76	0.971
Based on Median	0.001	1	76	0.983
Based on Median and with adjusted df	0.001	1	75.901	0.983
Based on trimmed mean	0.001	1	76	0.972

Based on Table 3, the analysis results, the sig value Based on Mean was obtained > 0.05 or 0.971 > 0.05; that meant H_0 was accepted. It could be stated both groups came from populations that had the same or homogeneous variances. Thus, the data on students' higher-order thinking skills came from a homogeneous population. Based on the results of the prerequisite test, namely the normality test of data distribution and the homogeneity of variance test, it could be concluded that the data on students' high-order thinking skills came from a population that was normally distributed and had the same or homogeneous variance. Therefore, hypothesis testing with a t-test could be conducted. The recapitulation of data analysis results using the t-test parametric statistics could be stated in the Table 4.

Table 4. Independent Samples t-test

Variances	Statistic		
	t	df	Sig.
Equal variances assumed	5.735	76	0.0001
Equal variances not assumed	5.737	75.9	0.0001

Based on Table 4 show the output above indicated that the significance value t calculated for the equal variances assumed for the two-tailed test was 0.001. It meant the sig. < 0.05 or 0.001 < 0.005. It could be concluded that H_0 was rejected and H_1 was accepted, in other words, there were differences in higher-order thinking skills between students who participated in the PBL and students who participated the conventional learning. The results of the data analysis also indicated that the group that followed the PBL approach had an average high-order thinking ability score of 73.3750, while the group of students who participated in the conventional learning had an average higher-order thinking skills score of 60.7368. Thus, the average higher-order thinking skills of the group of students who participated in the PBL were higher than the average of the higher-order thinking skills of the group of students who participated in conventional learning. The results of data analysis using the t-test indicated that there were differences in higher-order thinking skills between students who participated in the PBL approach and students who participated in the conventional learning approach. This also indicated that the students' higher-order thinking skills could be reliable, it's necessary to improve the quality of learning, in this case, the learning approach used. The advantages of the PBL approach compared to conventional learning approaches can be seen from the average higher-order thinking skills of students, where the average higher-order thinking skills of the experimental group was 73.3750 higher than the average of higher-order thinking skills control of 60.7368.

Discussion

The results of the data analysis indicated the advantages of the PBL approach compared to the conventional approach. This advantage is not only limited to theoretical descriptions but has been examined empirically in the field. In online PBL learning, every week students are asked to actively participate in learning, starting from finishing the assignments or problems given as well as oral presentations online through the zoom or google meet platform. In this learning process, students often had the opportunity to share the experience and knowledge, to motivate each other, and to train their communication skills (Achilles & Hoover, 1996; Wells et al., 2009). The skills acquired by students were very important to support higher-order thinking skills, including future career development. This was in line with the statement of that state PBL was a learning approach that challenged students to learn to face solutions to real-world problems (Duch et al., 2001). Based on this statement, students were required to use their thinking skills to face solutions to real problems that were given. Thus, indirectly, PBL plays a role in improving students' higher-level thinking skills. Bloom's Taxonomy at the cognitive level which was classified as higher-order thinking skills was to analyze (C4), evaluate (C5), and create (C6).

Furthermore, it was stated by previous research that analyzing (C4) was the ability to solve problems by separating information into certain parts by identifying the causes, detecting interrelations and its whole to make conclusions and supporting evidence for generalizations consisting of differentiating (Anderson & Krathwohl, 2001). Evaluating (C5) was the ability to provide an assessment or defend an opinion to make decisions about information, the validity of ideas, or quality of work based on certain criteria and standards consisting of checking and critiquing. Create (C6) was the ability to organize information together in different ways by combining elements in a new pattern, product, or structure that was coherent and functional or creating alternative solutions that were different from the previous ones which included generating, planning, producing. Through the PBL approach, students actively develop their thinking skills from C1 to C6. Through the analysis of real problems given, students were required to find out the logical relationships between the problems given and the concepts of the mathematical material given, to identify the elements that were known, were asked about a plan of their solution (Amiluddin & Sugiman, 2016; Hastuti et al., 2017; Karmana et al., 2020).

Through the real problems given, students try to find out the answer by carrying out investigations and logical analysis (Kodariyati & Astuti, 2016; Mahendra et al., 2019; Supiandi & Julung, 2016). It takes the ability to think that is not merely memorization and memory, but the ability to analyze, evaluate, and create new solutions. After finding out solutions based on the real problems given, then students presented online the results obtained. Based on this activity, students learned to defend opinions, to counter argumentation, and to answer peers' questions. All of this required the ability to evaluate (C5). Meanwhile, the ability to create will be performed when students looked for various alternative solutions to solve existing problems. Based on the learning approaches above it was not surprising that the higher-level thinking skills of students who participated in the PBL approach were better than the higher-order thinking skills of students who participated in the conventional approach. The results of this study are the same as other studies that indicate the PBL approach could improve the comprehension conceptual and problem solving, learning outcomes, learning motivation, as well as the ability to think critically (Karmana et al., 2020). Moreover other research state that online PBL can develop skills related to employability, searching/evaluating information, developing ideas, criticizing information (Duncan et al., 2013). The results of this study indicate the superiority of PBL over conventional learning in its effect on students' higher order thinking skills. PBL is significantly more effective than conventional learning in improving students' higher order thinking skills during the learning process. PBL instruction was effective when it came to long-term retention and performance improvement. PBL students were overall slightly underperforming when it came to short-term retention. The implication of this research is to provide information from problem-based learning that was tested using quasi-experimental ones that have been carried out at State Junior High Schools. This information will be very useful especially for educators who will apply PBL in the learning process. The limitation of this research is only limited to the scope of the study which only takes one subject. Therefore, it is hoped that future research will be able to deepen and broaden the scope of research related to project based learning.

4. CONCLUSION

The results of this study indicated that there were differences in students' higher-order thinking skills between the students who participated in the PBL approach and the students who participated in the conventional approach. In other words, it could be concluded that there was an effect of the implementation of the PBL approach on students' higher-order thinking skills. Therefore, it is recommended for teachers to implement the PBL approach in mathematics lessons and also in other subjects during the Covid-19 pandemic. The variable of students' high-order thinking skills in this study is expected to other researchers for examine other variables and involve a larger sample.

5. REFERENCES

Achilles, C. M., & Hoover, S. P. (1996). Exploring problem-based learning (PBL) in grades. *Paper Presented at the Annual Meeting of the Mid-South Educational Research Association, Tuscaloosa, AL*, 6–12. https://files.eric.ed.gov/fulltext/ED406406.pdf.

Adnan, M. (2020). Online learning amid the COVID-19 pandemic: Students perspectives. *Journal of Pedagogical Sociology and Psychology*, *1*(2), 45–51. https://doi.org/10.33902/jpsp.2020261309.

Albay, E. M. (2019). Analyzing the effects of the problem solving approach to the performance and attitude of first year university students. *Social Sciences & Humanities Open*, *1*(1), 100006. https://doi.org/10.1016/j.ssaho.2019.100006.

Amiluddin, R., & Sugiman, S. (2016). Pengaruh problem posing dan PBL terhadap prestasi belajar, dan motivasi belajar mahasiswa pendidikan matematika. *Jurnal Riset Pendidikan Matematika*, *3*(1), 100–108. https://doi.org/10.21831/jrpm.v3i1.7303.

Ana, A., Kustiawan, I., Ahman, E., Zakaria, S., Muktiarni, M., Dwiyanti, V., Saripudin, S., & Kahoerunnisa, I. (2020). Defining vocational teacher competencies in industry 4.0 from the perspective of policymakers. *Journal of Engineering Education Transformations*, *34*(Special Issue), 159–167. https://doi.org/10.16920/JEET/2020/V34I0/157884.

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing*. Longman.

Antara, I. G. W. S., & Dewantara, K. A. K. (2022). E-Scrapbook: The Needs of HOTS Oriented Digital Learning Media in Elementary Schools. *Journal for Lesson and Learning Studies*, *5*(1), 71–76. https://doi.org/10.23887/jlls.v5i1.48533.

Astuti, A. P., Aziz, A., Sumarti, S. S., & Bharati, D. A. L. (2019). Preparing 21st Century Teachers: Implementation of 4C Character's Pre-Service Teacher through Teaching Practice. *Journal of Physics: Conference Series*, *1233*(1). https://doi.org/10.1088/1742-6596/1233/1/012109.

Beneroso, D., & Robinson, J. (2022). Online project-based learning in engineering design: Supporting the acquisition of design skills. *Education for Chemical Engineers*, *38*(October 2021), 38–47. https://doi.org/10.1016/j.ece.2021.09.002.

Charlton-Perez, A. J. (2013). Problem-Based Learning Approaches in Meteorology. *Journal of Geoscience Education*, *61*(1), 12–19. https://doi.org/10.5408/11-281.1.

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018.

Duch, B. J., Groh, S. E., & Allen, D. E. (2001). *The power of problem-based learning*. VA: Stylus.

Duncan, M. J., Smith, M., & Cook, K. (2013). Implementing online problem-based learning (PBL) in postgraduates new to both online learning and PBL: An example from strength and conditioning. *Journal of Hospitality, Leisure, Sport & Tourism Education*, *12*(2), 79–84. https://doi.org/10.1016/j.jhlste.2012.11.004.

Dwyer, C. P., Hogan, M. J., & Stewart, I. (2014). An integrated critical thinking framework for the 21st century. *Thinking Skills and Creativity*, *12*(1), 43–52. https://doi.org/10.1016/j.tsc.2013.12.004.

Fabriz, S., Mendzheritskaya, J., & Stehle, S. (2021). Impact of Synchronous and Asynchronous Settings of Online Teaching and Learning in Higher Education on Students' Learning Experience During COVID-19. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.733554.

Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online learning and emergency remote teaching: Opportunities and challenges in emergency situations. *Societies*, *10*(4), 1–18. https://doi.org/10.3390/soc10040086.

Gillis, A., & Krull, L. M. (2020). COVID-19 Remote Learning Transition in Spring 2020: Class Structures, Student Perceptions, and Inequality in College Courses. *Teaching Sociology*, *48*(4), 283–299. https://doi.org/10.1177/0092055X20954263.

Gordon, R, P., Rogers, A. M., Comfort, M., Gavula, N., & Mcgee, B, P. (2001). A taste of problem-based learning increases achievement of urban minority middle-school students. *Educational Horizons, 79*, 171–175. http://www.jstor.org/stable/42927061.

Gurbanov, E. (2016). The Challenge of Grading in Self and Peer-Assessment (Undergraduate Students' and University Teachers' Perspectives). *Journal of Education in Black Sea Region*, *1*(2), 82–91. https://doi.org/10.31578/jebs.v1i2.21.

Hastuti, A., Sahidu, H., & Gunawan, G. (2017). Pengaruh Model PBL Berbantuan Media Virtual Tehadap Kemampuan Pemecahan Masalah Fisika. *Jurnal Pendidikan Fisika Dan Teknologi*, *2*(3), 129–135.

Jalinus, N., Syahril, & Nabawi, R. A. (2019). A comparison of the problem-solving skills of students in pjBL versus CPjBL model: An experimental study. *Journal of Technical Education and Training*, *11*(1), 36–43. https://doi.org/10.30880/jtet.2019.11.01.005.

Jaya Saragih, M., Mas Rizky Yohannes Cristanto, R., Effendi, Y., & Zamzami, E. M. (2020). Application of Blended Learning Supporting Digital Education 4.0. *Journal of Physics: Conference Series*, *1566*(1), 0–6. https://doi.org/10.1088/1742-6596/1566/1/012044.

Karmana, I. W., Dharmawibawa, I. D., & Hajiriah, T. L. (2020). Efektivitas Strategi PBL Berbasis Potensi Akademik Terhadap Keterampilan Pemecahan Masalah dan Berpikir Kritis Siswa SMA Pada Topik Lingkungan. *Jurnal Ilmiah Mandala*, *6*(1). http://ejournal.mandalanursa.org/index.php/JIME/article/view/1002/1053.

Khasanah, D. R. A. U., Pramudibyanto, H., & Widuroyekti, B. (2020). Pendidikan dalam masa pandemi covid-19. *Jurnal Sinestesia*, *10*(1), 41–48. http://sinestesia.pustaka.my.id/journal/article/view/44.

Kodariyati, L., & Astuti, B. (2016). Pengaruh model PBL terhadap kemampuankomunikasi dan pemecahan masalah matematika siswa kelas V SD. *Jurnal Prima Edukasia*, *4*(1), 93–106. http://staffnew.uny.ac.id/upload/132319829/penelitian/2016 pengaruh model PBL.pdf.

Lawut, S. Y., Kurniawati, M., & Pratiwi, H. Y. (2019). Pengembangan Modul Ipa Fisika Berbasis Pbl Pada Pokok Bahasan Gerak Lurus Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *RAINSTEK : Jurnal Terapan Sains & Teknologi*, *1*(4), 73–79. https://doi.org/10.21067/jtst.v1i4.4119.

Lee, S., Hwang, C., & Moon, M. J. (2020). Policy learning and crisis policy-making: Quadruple-loop learning and COVID-19 responses in South Korea. *Policy and Society*, *39*(3), 363–381. https://doi.org/10.1080/14494035.2020.1785195.

Luck, P., & Norton, B. (2004). Problem Based Management Learning-Better Online? *European Journal of Open, Distance and E-Learning*, *7*(2). https://old.eurodl.org/?p=archives&sp=full&year=2004&halfyear=2&article=156.

Made Sudana, I., Apriyani, D., & Nurmasitah, S. (2019). Revitalization of vocational high school roadmap to encounter the 4.0 industrial revolution. *Journal of Social Sciences Research*, *5*(2), 338–342. https://doi.org/10.32861/jssr.52.338.342.

Mahasneh, A. M., & Alwan, A. F. (2018). The effect of project-based learning on student teacher self-efficacy and achievement. *International Journal of Instruction*, *11*(3), 511–524. https://doi.org/10.12973/iji.2018.11335a.

Mahendra, I., Parmithi, N. N., Suana, I. W., & Sumandya, I. W. (2019). Developing Hots Through Performance. *International Journal of Scientific & Technology Research*, *8*(11), 3004–3007. http://www.ijstr.org/final-print/dec2019/-Developing-Hots-Through-Performance-Assessment-.pdf.

Mrah, I. (2017). Developing Higher Order Thinking Skills: Towards a Rethinking of EFL Coursebooks in Moroccan High Schools. *Journal of English Language Teaching and Linguistics*, *2*(3), 225. https://doi.org/10.21462/jeltl.v2i3.79.

Muppudathi, G., Education, A., John, S., & College, D. B. (2014). Role of Teachers on Helping Slow Learners to Bring Out Their Hidden Skills. *Ijsr -International Journal of Scientific Research*, *3*(2277), 98–99. https://www.academia.edu/download/34288348/Role_of_Teachers_on_Helping_Slow_Learners_to_Bring_out_their_Hidden_Skills.pdf.

Mutohhari, F., Sofyan, H., & Nurtanto, M. (2021). Technological Competencies: A Study on the Acceptance of Digital Technology on Vocational Teachers in Indonesia. *Proceedings of the 1st International Conference on Law, Social Science, Economics, and Education, ICLSSEE 2021*, 1–11. https://doi.org/10.4108/eai.6-3-2021.2305971.

Patricia Aguilera-Hermida, A. (2020). College students' use and acceptance of emergency online learning due to COVID-19. *International Journal of Educational Research Open*, *1*(July), 100011. https://doi.org/10.1016/j.ijedro.2020.100011.

Permatasari, B. D., Gunarhadi, & Riyadi. (2019). The influence of problem based learning towards social science learning outcomes viewed from learning interest. *International Journal of Evaluation and Research in Education*, *8*(1), 39–46. https://doi.org/10.11591/ijere.v8i1.15594.

Putri, C. D., Pursitasari*, I. D., & Rubini, B. (2020). Problem Based Learning Terintegrasi STEM Di Era Pandemi Covid-19 Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Jurnal IPA & Pembelajaran IPA*, *4*(2), 193–204. https://doi.org/10.24815/jipi.v4i2.17859.

Rahmah, N., Lestari, A., Musa, L. A. D., & Sugilar, H. (2019). Quizizz Online Digital System Assessment Tools. *Proceeding of 2019 5th International Conference on Wireless and Telematics, ICWT 2019*, 3–6. https://doi.org/10.1109/ICWT47785.2019.8978212.

Rajendra, I. M., & Sudana, I. M. (2017). The Influence of Interactive Multimedia Technology to Enhance Achievement Students on Practice Skills in Mechanical Technology. *Journal of Physics*, *953*, 1–5. https://doi.org/10.1088/1742-6596/953/1/012104.

Saide, S., & Sheng, M. L. (2020). Knowledge exploration–exploitation and information technology: crisis management of teaching–learning scenario in the COVID-19 outbreak. *Technology Analysis & Strategic Management*, 1–16. https://doi.org/10. 1080/09537 325 .2020.1854714.

Samantha Wells, P. W., & Jackson., K. (2009). Problem based learning (PBL): A conundrum. *Contemporary Nurse*, *33*(2), 191–201. https://doi.org/10.5172/conu.2009.33.2.191.

Saputri, D. Y., Rukayah, R., & Indriayu, M. (2018). Need Assessment of Interactive Multimedia Based on Game in Elementary School: A Challenge into Learning in 21st Century. *International Journal of Educational Research Review*, *3*(3), 1–8. https://doi.org/10.24331/ijere.411329.

Sujarwo, S., Sukmawati, S., Akhiruddin, A., Ridwan, R., & Suharti Siradjuddin, S. S. (2020). An Analysis of University Students' Perspective On Online Learning in The Midst of Covid-19 Pandemic. *Jurnal Pendidikan Dan Pengajaran*, *53*(2), 125. https://doi.org/10.23887/jpp.v53i2.24964.

Supiandi, M. I., & Julung, H. (2016). Pengaruh model problem-based learning (PBL) terhadap kemampuan memecahkan masalah dan hasil belajar kognitif siswa biologi SMA. *Jurnal Pendidikan Sains*, *4*(2), 60–64. http://journal.um.ac.id/index.php/jps/article/view/8183/3736.

Suprayitno, A., & Wahyudi, W. (2020). *Pendidikan karakter di era milenial*. Deepublish.

Suryaman, M., Cahyono, Y., Muliansyah, D., Bustani, O., Suryani, P., Fahlevi, M., Pramono, R., Purwanto, A., Purba, J. T., Munthe, A. P., Juliana, & Harimurti, S. M. (2020). COVID-19 pandemic and home online learning system: Does it affect the quality of pharmacy school learning? *Systematic Reviews in Pharmacy*, *11*(8), 524–530. https://doi.org/10.31838/srp.2020.8.74.

Suryani, M., Jufri, L. H., & Putri, T. A. (2020). Analisis Kemampuan Pemecahan Masalah Siswa Berdasarkan Kemampuan Awal Matematika. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(1), 119–130. https://doi.org/10.31980/mosharafa.v9i1.605.

Wahyuni, E. N., Aziz, R., Wargadinata, W., & Efiyanti, A. Y. (2021). Investigation of Primary School Teacher Readiness in Online Learning during the Covid-19 Pandemic. *Madrasah: Jurnal Pendidikan Dan Pembelajaran Dasar*, *13*(2), 97–113. https://doi.org/10.18860/mad.v13i2.11343.

Wells, S., Warelow, P., & Jackson, K. (2009). Problem based learning (PBL): A conundrum. *Contemporary Nurse*, *33*(2), 191–201. https://doi.org/10.5172/conu.2009.33.2.191.

Yang, S., Fichman, P., Zhu, X., Sanfilippo, M., Li, S., & Fleischmann, K. R. (2020). The use of ICT during COVID -19 . *Proceedings of the Association for Information Science and Technology*, *57*(1), 1–5. https://doi.org/10.1002/pra2.297.

Yunianto, T., Suyadi, S., & Suherman, S. (2020). Pembelajaran abad 21: Pengaruhnya terhadap pembentukan karakter akhlak melalui pembelajaran STAD dan PBL dalam kurikulum 2013. *Premiere Educandum : Jurnal Pendidikan Dasar Dan Pembelajaran*, *10*(2). https://doi.org/10.25273/pe.v10i2.6339.

Yuzulia, I. (2021). The Challenges of Online Learning during Pandemic: Students' Voice. *Jurnal Pendidikan Dan Pengajaran*, *13*(1), 08–12. https://doi.org/10.31294/w.v13i1.9759.