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PENGARUH MODEL PEMBELAJARAN *RICOSRE* TERHADAP KEMAMPUAN PEMECAHAN MASALAH SISWA PADA MATERI VIRUS

THE EFFECT OF THE RICOSRE LEARNING MODEL ON STUDENTS' PROBLEM-SOLVING SKILLS AT VIRUS MATERIAL

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Abstract. This study aims to analyze the effect of Reading, Identifying the problem, Constructing the solution, Solving the problem, Reviewing, and Extending the problem-solving (RICOSRE) learning model on students' problem-solving abilities on virus material. This study is quasi-experimental with a pretest-posttest nonequivalent control group design. The population of the study was all grade X students at SMAN 2 Purbalingga. The sample consisted of 72 students determined by cluster random sampling technique, each with 36 students from class XE as the experimental class and class XD as the control class. Data collection techniques used tests and observations. Data analysis techniques used descriptive analysis, N-Gain, and Mann-Whitney U tests. The results showed that the RICOSRE learning model significantly affected students' problem-solving abilities on virus material of 0.049 <0.05 with an increase of 0.6859 and was categorized as moderate. This result is because students' high-level thinking process skills in solving problems are trained repeatedly through RICOSRE learning model learning activities. The results of this study indicate that the RICOSRE model effectively improves students' problem-solving skills. Teachers can use the results of this study as an alternative learning model to train students' problem-solving skills.
Keywords: Biology, Learning model, Problem solving skills, RICOSRE, Virus

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INTRODUCTION

Currently, education in Indonesia has passed two decades of the 21st century. Students in the 21st century are required to have skills, knowledge, and abilities in the fields of technology, media, and information, as well as learning and innovation skills, as well as life and career skills (Miranda & Wibowo, 2023; Rasyid, 2023; Susilo et al., 2020). Trilling and Fadel (2009) stated that seven skills must be possessed in the 21st century. These skills include critical thinking and problem solving, creativity and innovation, collaboration, teamwork and leadership, cross-cultural understanding, communications, information and media literacy, computing and ICT literacy, and career and learning self-reliance (Trilling and Fadel, 2009). The development of 21st-century skills is included in the implementation of the independent curriculum. In implementing the independent curriculum, the profile of Pancasila students is the goal of developing the character of Indonesian students. There are six dimensions developed to achieve Pancasila students, one of which is critical reasoning (Kemendikbudristek, 2022).

Problem-solving skills are a sub-element thinking process in analyzing and evaluating reasoning in the critical thinking dimension (Diniyyah et al., 2022). Problem-solving skills are one of the skills students need to have in the learning process (Sudrajat et al., 2023). In the process, students need skills to link their knowledge and experience with cognitive, creative, logical, and critical thinking skills to solve problems (Rehman et al., 2024).

However, in reality, research results show that the problem-solving abilities of biology

students in Indonesia are still relatively low. This condition is indicated by the lack of students in mastering problem-solving skills during biology learning (Karmana, 2015; Nurmilawati et al., 2021; Rahmawati et al., 2022; Susiati et al., 2020). In the research of Nurmilawati et al. (2021), it was stated that students' problem-solving skills were still low: only 40%, where students still had difficulty implementing plans and evaluating the problem-solving results. This statement was also reinforced by the results of other studies, which stated that students' problem-solving abilities were still in the poor category, with an average of 48.52 (Rahmawati et al., 2022). This low ability is known because students have difficulty understanding, solving, and re-examining the process and results of problem-solving.

In addition, a biology teacher at a senior high school in Purbalingga said that students' ability to think at a high level is still lacking. This condition is seen in the ability of students in the learning process who are not yet able to think critically, and most students only memorize and remember the material. Meanwhile, the ability to solve problems is closely related to critical thinking (Cahyono, 2005). Students' ability to solve problems can trigger the development of critical thinking skills. The ability to solve problems is also correlated with everyday life, which is an ability that students need to have.

Several factors are suspected to cause students' low ability to solve problems. Susiati et al. (2020) stated that the causes of students' low problem-solving skills are the lack of quality education, the use of inappropriate learning models, the application of less applicable learning models, the lack of training that directs students to think at a high level and creatively to solve a problem, and the lack of mastery of teacher pedagogical skills. Meanwhile, various problems can be raised to train students' problem-solving skills.

In education, a branch of science closely related to the lives of all living things, including humans, animals, plants, and microorganisms, is biology (Ozan et al., 2024). Various problems in the surrounding environment can be linked to biology. Like the COVID-19 pandemic that has shocked the world, it is one example of biology in the material of viruses.

Virus material is included in biology science learning at the high school level at the 10th-grade level. The learning outcomes that must be achieved at the end of learning are that students can create solutions to problems based on local, national, or global issues related to understanding viruses and their roles. These learning outcomes require students to have problem-solving skills.

RICOSRE is a new variation of the problem-oriented learning model. Its acronym indicates the stages of learning: Reading, Identifying the problem, Constructing the solution, Solving the problem, Reviewing the problem, and Extending the problem solution. This learning model encourages students to think analytically, critically, and creatively and improves scientific literacy skills (Zubaidah & Mahanal, 2017). In addition, this study shows that this model has the potential to improve students' high-order thinking skills (HOTS). In addition, in their research, Haka et al. (2023) stated that the RICOSRE learning model positively impacts students' analytical thinking skills and communication skills in class X biology material.

Implementing the RICOSRE learning model can be an alternative solution to improve students' problem-solving abilities to achieve learning outcomes in virus material, namely creating solutions to problems based on local, national, or global issues related to understanding viruses and their roles. The RICOSRE learning model is designed to make students actively involved in solving problems, including understanding and identifying problems, finding solutions, and finding alternative solutions. In several previous studies, the RICOSRE learning model has influenced analytical and creative thinking skills and improved cognitive learning outcomes (Haka et al., 2023; Khasanah et al., 2022; Rahmawati et al., 2022; Sumiati et al., 2018; Zubaidah & Mahanal, 2017). Therefore, this learning model can potentially develop problem-solving skills and learning outcomes to overcome biology learning problems, especially in virus material.

An effort is needed to uncover these problems based on the occurring phenomena. Therefore, it is necessary to conduct a study entitled "The Effect of the RICOSRE Learning Model on Students' Problem-Solving Skills in Virus Material," which is expected to positively impact the biology learning process. Therefore, this study aims to analyze the effect of the RICOSRE learning model (Reading, Identifying the problem, Constructing the solution, Solving the problem, Reviewing and Extending the problem solving) on students' problem-solving skills in virus material for class X SMA Negeri 2 Purbalingga.

METHOD

This type of research is a quasi-experimental study with a pretest-posttest nonequivalent control group design (Creswell & Creswell, 2018). The population of this study was all grade X students at SMAN 2 Purbalingga. The sample in this study amounted to 72 students, as determined by the cluster random sampling technique, consisting of 36 students of class XE as the experimental class and 36 students of class XD as the control class. The study was conducted for three weeks (6 meetings). The pre-test and post-test were given to determine the learning outcomes and problem-solving abilities of the RICOSRE learning model treatment.

The data collection technique was carried out through tests and non-tests. The test was carried out twice, namely the pre-test and post-test, in the form of descriptive questions. The pre-test was used to measure students' initial abilities before treatment, while the post-test aimed to determine their problem-solving abilities after the treatment was given. The students' problem-solving abilities in this study were measured based on five stages of solving and indicators adopted and modified from Krulick and Rudnick (Shodiqin et al., 2020). The problem-solving indicators used in this study are shown in Table 1. Non-test techniques in the form of observations were carried out to observe the suitability and implementation of the RICOSRE learning model syntax on virus material.

Table 1. Indicators of problem-solving ability

No.	Indicator	Description
1.	*Read and think*	Understanding information and problems
2.	*Explore and plan*	Able to plan problem-solving
3.	*Select a strategy*	Developing hypotheses and choosing the right strategy
4.	*Find an answer*	Find the right answer.
5.	*Reflect and extend*	Re-examine answers and get alternative solutions.

The research data were analyzed using descriptive and inferential analysis to test the research hypothesis. N-gain analysis calculates the difference between the pre-test and post-test results, which is interpreted as the level of knowledge increase received by students during learning. N-Gain ranges from 0 to 1, with a value of 1 indicating maximum knowledge increase. The criteria for the N-Gain calculation results to describe the increase in student learning outcomes are shown in Table 2.

Table 2. Criteria N-gain

Value <g>	Criterion
(<g>) ≥ 0.7	High
0.7 > (<g>) ≥ 0.3	Moderate
0.3 > (<g>)	Low

(Firmansyah & Subekti, 2023)

Meanwhile, the level of achievement of students' problem-solving abilities on each indicator is calculated using the average for each indicator. The problem-solving ability value obtained from the calculation is then qualified according to Table 3.

Table 3. Categories of students' problem-solving skills

Installment-War Indicator	Category
85,00 – 100	Excellent
70,00 – 84,99	Good
55,00 – 69,99	Enough
40,00 – 54,99	Less
0 – 39,99	Very Less

(Adopted from Mawaddah & Anisah, 2015)

Several assumptions must be met to be tested further through the t-test; the data must be normally distributed and homogeneous. The normality test is analyzed using the Kolmogorov-Smirnov normality test. The homogeneity test is analyzed using the Levene test. If both of these prerequisites are not met, then non-parametric data analysis is used to conduct a normality test, homogeneity test, and Mann-Whitney test or U test.

RESULTS AND DISCUSSION

Results

The study results obtained data on problem-solving abilities given to both classes through pre-test and post-test questions. At the first meeting, each class used as a research sample was given pre-test questions as a measuring tool to determine students' initial knowledge of the virus material that would be taught, continued by providing material by applying different learning models. The RICOSRE learning model was applied in the experimental class, while the direct learning model was only applied in the control class. After the end of the meeting, both classes will be given the same test in the form of post-test questions. Furthermore, the research data were analyzed through descriptive statistical analysis, N-Gain tests, and inferential statistics (Table 4).

Table 4. Results of Descriptive Analysis of Students' Problem-Solving Abilities

Statistics	Experimental Classes		Control Class	
	Pretest	Posttest	Pretest	Posttest
Number of samples	36	36	36	36
Score Minimum	25	50	25	35
Maximum Score	100	100	100	100
Score Range	75	50	75	65
Average	64,44	88,19	76,39	80,69
Standard Deviation	20,416	13,156	21,634	17,974

The analysis results in Table 4 show that before the treatment with the RICOSRE learning model, the experimental class had a lower average than the control class. After being given the treatment, there was an increase in problem-solving ability for both the control class with the direct learning model and the experimental class with the application of the RICOSRE learning model. The average value of the class with the RICOSRE learning model was better than the control class. In the class with the RICOSRE learning model (experimental class), the average value increased by 23.75, from the initial average of 64.44 to 88.19. In the class with the direct learning model (control class), the average value increased by 4.3, namely from a score of 76.39 to 80.69. Furthermore, an analysis was carried out with N-Gain, shown in Table 5.

Table 5. N-Gain Score Problem-Solving Ability

Class	N-Gain Score		
	Number of Students	Average	Category
Eksperimen	36	0,6859	Moderate
Control	36	0,0610	Low

The results of the N-gain calculation in Table 5 show that the RICOSRE learning model

class has a different score from the control class. Based on the calculation of the difference in pre-test scores before the treatment and post-test scores after the treatment was applied, applying the RICOSRE learning model increased problem-solving ability by 0.6859, which is included in the moderate category, while the control class was only 0.0610 with a low category. Thus, it can be concluded that applying the RICOSRE learning model increases problem-solving ability, which is better than that of the control class. The subsequent analysis determines the student's problem-solving ability level, the results of which are shown in Table 6.

Table 6. Student's Problem-Solving Ability Level

KPM Indicators	Average		Information	
	Control Class	Experimental Classes	Control Class	Experimental Classes
Read and think	85	99	Excellent	Excellent
Explore and plan	89	96	Excellent	Excellent
Select a strategy	74	69	Good	Enough
Find an answer	77	87	Good	Excellent
Reflect and extend	78	90	Good	Excellent

The analysis results in Table 6 show that most students who received learning using the RICOSRE learning model had high problem-solving abilities. Through applying the RICOSRE learning model, four of the five indicators were very good. However, in terms of the ability of students to choose problem-solving strategies, the experimental class became an ability that still needed to be developed because it was still in the moderate category, which was 5 points lower than the control class. Thus, overall, the RICOSRE learning model could hone problem-solving abilities better than the control class.

Inferential statistics was analyzed to find out more about the differences in average problem-solving abilities in classes using the RICOSRE learning model with the direct (conventional) learning model. Before testing the hypothesis with the t-test, a prerequisite test was carried out first as a normality test (Table 7) and a homogeneity test (Table 8).

Table 7. Normality Test Results

	Class	*Tests of Normality Kolmogorov-Smirnova*			
		Statistic	df	Mr.	Conclusion
KPM	*Pre-test* Control	,197	36	,001	Abnormal
	Pre-test experiments	,108	36	,200*	Normal
	Posttest Control	,176	36	,006	Abnormal
	Post-test experiments	,204	36	,001	Abnormal

The normality test of students' problem-solving ability test scores aims to determine whether the data is normally distributed or not. The test was carried out using the Kolmogorov–Smirnov test with a significance level of 5% so that if the significance value is more than 0.05, the data is normally distributed. From the results of the analysis in Table 7, a significance value of <0.05 was obtained in the pre-test and post-test data of the control class and the post-test in the experimental class so that it can be concluded that the data is not normally distributed. At the same time, the pre-test in the experimental class has a sig. value of 0.200> 0.05 so that it can be concluded that the data is normally distributed. Because the data is not normally distributed, the analysis prerequisites are not met.

Table 8. Homogeneity Test Results

		Test of Homogeneity of Variance				
	Class	Levene Statistic	df1	df2	Mr.	Conclusion
KPM	*Pre-test*	,276	1	70	,601	Varians Homogen
	Posttest	2,886	1	70	,094	Varians Homogen

The homogeneity test determines whether the sample data is included in a homogeneous or heterogeneous population characterized by similarities or differences in variance between two groups, namely the experimental and control groups. Based on the table, the significance value of the pre-test score is 0.601, and the post-test is 0.94, both of which obtain a sig value> 0.050. Thus, it can be concluded that the variance of the pre-test and post-test data on problem-solving ability in the experimental and control classes is the same or homogeneous.

Because the normality test is not met as a prerequisite for the t-test, an alternative method is used to test the hypothesis: non-parametric analysis through the Mann-Whitney test or U test (Table 9).

Table 9. Mann-Whitney U Test Results

	KPM
Mann-Whitney U	476,000
Wilcoxon W	1142,000
With	-1,966
Asymp. Sig. (2-tailed)	,049

The analysis of the average differences in both classes in Table 9 shows that the sig value (2-tailed) is $0.049 \leq 0.05$, so it can be concluded that H0 is rejected and H1 is accepted. This result proves a significant average difference in students' problem-solving abilities between classes using the RICOSRE learning model and the control class. From these results, it can be interpreted that the achievement of students' problem-solving abilities using the RICOSRE learning model is better than that of classes using the direct learning model. Thus, the RICOSRE learning model significantly influences students' problem-solving abilities in the virus material of class X SMA Negeri 2 Purbalingga.

Discussion

This study aims to analyze the effect of the RICOSRE learning model on students' problem-solving abilities in virus material. Based on the research that has been done, learning activities on virus material and its role are carried out in two different classes, namely class XE as the experimental class and class XD as the control class. In the control class, learning takes place using a direct learning model, while in the experimental class, the researcher provides treatment by implementing the RICOSRE learning model. Overall, learning on virus material is carried out in 7 meetings.

Using the RICOSRE learning model in learning activities provides opportunities for students to think more deeply and solve problems through discussion activities. Increasing problem-solving abilities are gradually trained through syntax in core learning activities, namely reading, identifying the problem, constructing the solution, solving the problem, and reviewing and extending the solution, which is carried out repeatedly. Kurniawati et al. (2019) mention that problem-solving abilities require habituation to face increasingly complex problems in everyday life so that reasoning and knowledge will be honed. In contrast to learning in the control class, the teacher carries out most of the learning through lectures and group discussion activities that are not problem-oriented.

Direct involvement of students in learning activities will positively impact students. In its application, students in groups share their ideas and thoughts to solve the problems. According to Fadhilah (2022), good learning is when students can be directly involved in developing concepts known by trying. In this case, students are challenged to be able to try to construct their knowledge by taking a role in learning to create solutions to every problem that arises.

The highest ability of all problem-solving skills is in the read and think indicator, which is 99% in the class that applies the RICOSRE learning model. This indicator is assessed by

students' ability to understand the problems in the discourse presented in the questions. This ability cannot be separated from the stages of learning carried out at the beginning of the core activities. The core activities of RICOSRE learning on the material of viruses and their roles begin with reading activities. Reading activities are carried out so students can recognize and understand the problems in the presented discourse. After reading, students write down the information obtained using their language. Reading activities involve intelligence abilities with thinking processes such as remembering, understanding, distinguishing, comparing, finding, and analyzing (Permana, 2019). Through reading activities, students can find and understand problems. In reading activities, students can relate their knowledge and experience to the problems to be solved (Velayati et al., 2017).

After students find information and problems, students will then identify the problems more deeply at the identifying the problem stage. In the learning process, students actively discuss and formulate problems into questions. This condition can be seen from the explore and plan indicator, which allows students to explore problems and plan efforts to solve problems. Both classes have very good levels, namely 96% of classes using the RICOSRE model and 89% in classes using direct learning.

The difference in the results of problem-solving abilities proves that the RICOSRE learning model can significantly improve students' problem-solving abilities, especially in the material of viruses and their roles. This condition is because the syntax in RICOSRE learning supports students to actively understand problems, identify problems, formulate temporary assumptions, develop strategies to solve problems, solve problems with solutions, and find alternative answers to recheck the accuracy of the solution. This learning model can make students accustomed to recognizing and solving problems related to the learning provided. Moreover, the problems are very close to everyday life and the environment. With the concept of the virus material being studied, students become more explorative and deepen the problems and solutions that can be done.

Implementing RICOSRE learning impacts students' problem-solving abilities, especially in developing problem-solving strategies, finding solutions, reflecting and rechecking answers, and looking for other solutions to problems. This change can be seen from the increase in the pre-test average categorized as low, namely 61, 58, and 43, respectively. After using the RICOSRE learning model with systematic problem-solving stages, the final results of the post-test showed that the three indicators increased by 8% in the ability to develop problem-solving strategies, 28% in the ability to find problem-solving solutions, and 47% in the ability to reflect, recheck answers, and look for alternative solutions to problems.

In line with the learning outcomes formulated in the independent curriculum, students can create solutions to the material on viruses and their roles. Students implement the solutions created from the results of learning activities through social media campaigns in cases of chickenpox in children, influenza, rabies, prevention of the spread of the COVID-19 virus, the transmission of HIV (Human Immunodeficiency Virus), which is increasing in Indonesian society, especially among adolescents and adults, and dengue fever which causes death, especially in the rainy season.

The increase in each indicator is inseparable from the problem-oriented learning process. This statement is reinforced by research by Kurniawati et al. (2019), which emphasizes that the learning and practice process is needed for students to master problem-solving skills. In addition, schools have a significant role in helping students improve their high-level thinking skills. Through learning activities with the RICOSRE learning model, students will explore a problem so that they cannot only find solutions but also provide alternative solutions to solve a problem.

CONCLUSION

Based on the results of the research analysis that has been conducted, it can be

concluded that there is a significant influence of the RICOSRE learning model on problem-solving skills in the virus material of class X SMA Negeri 2 Purbalingga of 0.049 <0.05 which provides an increase of 0.6859 and is categorized as moderate. RICOSRE can improve students' problem-solving skills by repeatedly training them through learning activities. The positive influence is implemented from the active involvement of students through systematic steps of RICOSRE learning, which hone students' problem-solving skills in reading and thinking, exploring problems and planning solutions, choosing solution strategies, finding answers, and reflecting and developing solutions.

REFERENCES

Cahyono, B. (2005). Korelasi pemecahan masalah dan indikator berfikir kritis. *Phenomenon: Jurnal Pendidikan MIPA*, 5(1), 15–24. https://doi.org/10.21580/phen.2015.5.1.87

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. In Writing Center Talk over Time* (5th ed.). SAGE Publications. https://doi.org/10.4324/9780429469237-3

Diniyyah, M., Susilo, H., Balqis, B., & Sudrajat, A. K. (2022). Improving critical thinking and problem-solving skills through POGIL combined with digital mind map. *Jurnal Pendidikan Biologi Indonesia*, 8(3), 275–286. https://doi.org/10.22219/jpbi.v8i3.18992

Fadhilah, A. N. (2022). Pembelajaran biologi berbasis steam di era society 5.0. *Prosiding: Konferensi Nasional Matematika dan IPA Universitas PGRI Banyuwangi*, 2(1), 182–190. https://ejournal.unibabwi.ac.id/index.php/knmipa/article/view/1739

Firmansyah, K. F., & Subekti, H. (2023). Implementasi model pembelajaran berbasis penemuan untuk meningkatkan hasil belajar kognitif pada siswa smp. *PENSA: E-JURNAL PENDIDIKAN SAINS*, 11(1), 61–67. https://ejournal.unesa.ac.id/index.php/pensa/article/view/46857

Haka, N. B., Sari, L. K., Supriyadi, Handoko, A., Hidayah, N., & Masya, H. (2023). Model pembelajaran ricosre berbantuan podcast terhadap peningkatan keterampilan komunikasi dan berpikir analisis pada mata pelajaran biologi kelas XI. *Journal Hypermedia & Technology-Enhanced Learning*, 1(1), 15–22. http://dx.doi.org/10.58536/j-hytel.v1i1.23

Karmana, I. W. (2015). Profil kemampuan pemecahan masalah biologi siswa sma di kota mataram. *Jurnal Ilmiah Biologi*, 2(1), 54–61. https://doi.org/10.33394/bioscientist.v2i1.1308

Kemendikbudristek. (2022). Dimensi, Elemen, dan Subelemen Profil Pelajar Pancasila pada Kurikulum Merdeka. https://guru.kemendikdasmen.go.id/dokumen/74r6YnDzK3

Khasanah, M., Roini, C., & Bahtiar, B. (2022). Pengaruh model pembelajaran ricosre berbantuan videoscribe dan quizziz terhadap keterampilan berpikir kreatif siswa sma negeri 8 kota ternate. *Jurnal Bioedukasi*, 5(1), 1–9. https://doi.org/10.33387/bioedu.v5i1.4417

Kurniawati, I., Raharjo, T. J., & Khumaedi. (2019). Peningkatan kemampuan pemecahan masalah untuk mempersiapkan generasi unggul menghadapi tantangan abad 21. *Seminar Nasinal Pascasarjana*, 2(1), 701–707. https://proceeding.unnes.ac.id/snpasca/article/view/360

Mawaddah, S., & Anisah, H. (2015). Kemampuan pemecahan masalah matematis siswa pada pembelajaran matematika dengan menggunakan model pembelajaran generatif (generative learning) di SMP. *EDU-MAT: Jurnal Pendidikan Matematika*, 3(2), 166–175. https://doi.org/10.20527/edumat.v3i2.644

Miranda, D., & Wibowo, Y. (2023). Pengembangan Media Pembelajaran Berbasis Aplikasi Android Pada Materi Sistem Pernapasan Kelas XI SMA. *Jurnal Edukasi Biologi*, 9(1), 77–89. https://doi.org/10.21831/edubio.v9i1.18146

Nurmilawati, M., Modok, S. G., & Budiretnani, D. A. (2021). Profil keterampilan pemecahan masalah siswa sekolah menengah atas berdasarkan greenstein pada materi ekosistem. *Prosiding Seminar Nasional Kesehatan, Sains dan Pembelajaran*, 1(1), 667–674. https://doi.org/10.29407/seinkesjar.v1i1.1294

Ozan, G., Szeinbaum, N., Conlin, P., Chen, K., Fos, S., Garcia, A., Penev, P., Schaible, G., & Trubl, G. (2024). Chapter 5: Major Biological Innovations in the History of Life on Earth. *Astrobiology*, 24, S-107. https://doi.org/10.1089/ast.2021.0119

Permana, A. (2019). Pengaruh kemampuan membaca pemahaman terhadap keterampilan pemecahan masalah matematika (survei pada siswa SMK al ihsan depok). *Jurnal Pendidikan Bahasa Dan Sastra Indonesia*, 3(2), 257–259. https://doi.org/10.30743/bahastra.v3i2.3182

Rahmawati, S., Syamsiah, & Muis, A. (2022). Profil keterampilan pemecahan masalah siswa sma negeri 1 wonomulyo pada mata pelajaran biologi di masa pandemi covid-19. *Biogenerasi: Jurnal Pendidikan Biologi*, 7(2), 215–223. https://doi.org/10.30605/biogenerasi.v7i2.1876

Rasyid, M. (2023). Pengaruh Media Pembelajaran E-Atlas dengan Motivasi Belajar Siswa SMA. *Jurnal Edukasi Biologi*, 9(2), 128–135. https://doi.org/10.21831/edubio.v9i2.19277

Rehman, N., Huang, X., Mahmood, A., AlGerafi, M. A. M., & Javed, S. (2024). Project-based learning as a catalyst for 21st-Century skills and student engagement in the math classroom. *Heliyon*, 10(23), e39988. https://doi.org/https://doi.org/10.1016/j.heliyon.2024.e39988

Shodiqin, A., Sukestiyarno, Wardono, Isnarto, & Utomo, P. W. (2020). Profil pemecahan masalah menurut krulik dan rudnick ditinjau dari kemampuan wolfram mathematica. *Prosiding Seminar Nasional Pascasarjana*, 3(1), 809–820. https://proceeding.unnes.ac.id/index.php/snpasca/article/view/672

Sudrajat, A. K., Andriningrum, H., Supartinah, S., & Anggrella, D. P. (2023). Accelerating pre-service elementary school teacher students' problem-solving skills through online case study discussion. *International Journal of Innovation and Learning*, 34(4), 398–413. https://doi.org/10.1504/IJIL.2023.134749

Sumiati, I. D., Mahanal, S., & Zubaidah, S. (2018). Potensi pembelajaran ricosre pada peningkatan hasil belajar kognitif siswa kelas XI. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 3(10), 1319–1322. http://dx.doi.org/10.17977/jptpp.v3i10.11662

Susiati, A. L., Palennari, M., & Bahri, A. (2020). Profil keterampilan pemecahan masalah siswa SMA pada pembelajaran biologi kelas XI MIA materi sistem ekskresi se-kecamatan biringkanaya kota makassar. *Seminar Nasional Biologi dan Pembelajarannya Ke-VI 2020 Jurusan Biologi, Fmipa, Unimed*, November, 34–40. https://digilib.unimed.ac.id/id/eprint/43848/

Susilo, H., Kristiani, N., & Sudrajat, A. K. (2020). Development of 21st century skills at the senior high school: Teachers' perspective. *AIP Conference Proceedings*, 2215(1), 30018. https://doi.org/10.1063/5.0000559

Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. San Francisco, CA: John Wiley & Sons. https://psycnet.apa.org/record/2009-18745-000

Velayati, N., Muslem, A., Fitriani, S., & Samad, I. (2017). An Exploration of Students' Difficulties in Using Critical Thinking Skills in Reading. *Al-Ta Lim Journal*, 24, 195. https://doi.org/10.15548/jt.v24i3.298

Zubaidah, S., & Mahanal, S. (2017). Model pembelajaran ricosre yang berpotensi memberdayakan keterampilan berpikir kreatif. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 2(5), 676–685. https://doi.org/10.17977/jptpp.v2i5.9180