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Implementation of the Project Based Learning (PjBL) Model to Students' Problem Solving Ability and Entrepreneurial Interest in Environmental Change Material

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Article Info

Abstract

Problem-solving ability and entrepreneurial interest are the kinds of skills that must be owned by the students to face the world of work and citizenship in the 21st century. The PjBL model through waste product development projects as a solution to solving environmental problems is considered a potential learning strategy for developing problem-solving ability and entrepreneurial interest student. The background of SMA Negeri 1 Kersana as an adiwiyata school which has various waste management and processing activities has the potential to implement projects to manage old leaf waste into leaf skeleton craft products. This research aims to analyze the effectiveness of the PjBL model on students' problem-solving ability and entrepreneurial interest in environmental change material, and analyze the relationship between problem-solving ability and entrepreneurial interest in learning the PjBL model. This research used pre experimental design with the one shot case study. The population in this study were class X students of SMA Negeri 1 Kersana who received biology subjects for the 2023/2024 school year. Sampling was carried out using cluster random sampling technique, the sample in this study was class X-2 with 36 students. The test instruments was used to measure students' problem solving ability while questionnaire instruments was used to measure entrepreneurial interest. The average score of problem solving ability was 77.05 and the posttest classical completeness of problem solving ability was 91.67%. The average score of entrepreneurial interest was 83.9 and the criteria level for entrepreneurial interest is good at 27.78%, very good at 72.22%. Based on these results, it can be concluded that PjBL is effective on students' problem-solving ability and entrepreneurial interest in environmental change material. The results of a simple linear regression test between problem solving ability and students' entrepreneurial interest show $t_{count} > t_{table}$, namely $2.466 > 2.032$ and a significance level of $0.019 < 0.05$, so there is a significant positive relationship between problem solving ability and students' entrepreneurial interest in the PjBL learning model.

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INTRODUCTION

Problem-solving abilities and entrepreneurship are two of several abilities that are important for students to be able to face the challenges of life in the 21st century. The challenges of 21st century education emphasize the development of various crucial skills such as environmental awareness, interpersonal intelligence, critical thinking, creative thinking, problem solving, independence, teamwork, and communication (Suriansyah *et al.*, 2021). The Change Leadership Group from Harvard University identified the competencies and survival skills that students need to face the world of work and citizenship in the 21st century, namely: critical thinking skills, problem solving, collaboration and leadership, agility and adaptability, initiative and entrepreneurial spirit, able communicate effectively, be able to access and analyze information and have curiosity and imagination (Zubaidah, 2016). The independent curriculum also emphasizes the development of 21st century skills, including problem-solving abilities and entrepreneurship.

The Project Based Learning (PjBL) learning model can be an alternative solution for creating learning that encourages students' problem-solving abilities and entrepreneurial interest. PjBL is a learning strategy that changes traditional classroom dynamics by actively involving students in learning planning, with an emphasis on creating real products or concrete projects (Yuniartiek *et al.*, 2015). Amel *et al.* (2022) stated that project-based learning can increase students' problem solving and creativity. Abdullahi (2020) stated that project-based learning is one of the most effective learning models for training students' entrepreneurial skills in the industrial era 4.0. In this research, the PjBL model applied is integrated with the bioentrepreneurship approach. The bioentrepreneurship approach is a creative, innovative and contextual learning approach by linking directly to real objects or phenomena around students' environment (Fitriah, 2012).

One of the biology subject topics studied in class X SMA phase E even semester is environmental change. The learning outcomes (CP) that students must achieve in this material are that students have the ability to create solutions to problems based on local or global issues from their understanding of environmental change. In this material, students are faced with various environmental problems and are required to create solutions to existing environmental problems through waste management projects into products that are useful and have economic value. By implementing the PjBL model to environmental change material, the targeted CP can be achieved.

Currently, the main treatment often used for leaf waste is to burn it, but this method actually pollutes the air. Inappropriate waste handling can be a serious threat to the balance of the ecosystem. Burning leaf waste is not an effective solution, and therefore a more sustainable alternative solution needs to be sought. One way to overcome the problem of handling leaf waste is to use it into products that have useful value, such as various leaf skeleton craft products. Pollution due to leaf waste is largely caused by a lack of understanding of the impact of waste on the environment and human health, as well as a lack of skills in waste management and utilization. Therefore, it is important to introduce the concept of managing and utilizing leaf waste to students at school level.

Observation results show that biology learning on environmental change material at SMA Negeri 1 Kersana Brebes has not been oriented to development of 211st century skills such as problem-solving abilities and entrepreneurship. Learning also has not developed students' skills in creating creative and innovative products. Apart from that, the background of SMA Negeri 1 Kersana Brebes as an adiwiyata school which has various waste management and processing activities has the potential to carry out a project to manage old leaf waste into leaf skeleton craft products. With this background, research was conducted with the title "Implementation of the Project Based Learning (PjBL) Model to Students' Problem Solving Ability and Entrepreneurial Interest in Environmental Change Material" which aims to analyze the effectiveness of the PjBL model on students' problem solving ability and entrepreneurial interest in environmental change material, and analyzing the relationship between problem solving ability and entrepreneurial interest in the PjBL learning model.

RESEARCH METHOD

This research was conducted at SMA Negeri 1 Kersana Brebes for the 2023/2024 academic year. This research used a quantitative approach with a pre-experimental design in the form of a one shot case study. The population in this study was all class X of SMA Negeri 1 Kersana Brebes who took biology as a subject. Sampling was carried out using the cluster random sampling technique. The class chosen as the sample class was class X-2 with research subjects totaling 36 students. Data collection techniques use test instruments in the form of essay questions to measure problem solving abilities, non-test instruments in the form of questionnaires (questionnaires) to measure interest in entrepreneurship and observations to measure the implementation of learning in teacher activities. The implementation of the PjBL model with a bioentrepreneurship approach is effective if (1) analysis of classical completeness on the posttest of problem solving ability and entrepreneurial interest $\geq$ 85% (KKTP $\geq$ 70), (2) analysis of the assessment of posttest results in the aspects of problem solving ability and entrepreneurial interest shows the criteria " good" to "very good", (3) the results of the regression test between problem solving abilities and students' interest in entrepreneurship show $t_{count}>t_{table}$ and significance <0.05.

RESULTS AND DISCUSSION
Implementation of PjBL Model Learning (Teacher Activities)

Observation assessment of learning implementation in teacher activities was carried out by observers (biology teachers) to assess whether the learning process implemented by researchers was in accordance with the steps of the PjBL model with a bioentrepreneurship approach which can develop students' problem solving abilitiy and entrepreneurial interest. The results of learning implementation are shown in the following table:

Table 1 Implementation of PjBL Model Learning (Teacher Activities)

Learning Stages		Implementation (%)	Category
Introduction		100	Very good
Core	*Question – Exploring*	93,75	Very good
	Plan – Planning	100	Very good
	Schedule – Planning	100	Very good
	Monitoring – Producing	100	Very good
	Asses – Communicating/marketing	75	Fair
	Evaluating – Reflecting	100	Very good
Closing		75	Fair
	Average	92,68	Very good

Based on table 1, the average percentage of implementation of PjBL model with a bioentrepreneurship approach is 92.68% in the very good category. This shows that the implementation of the PjBL model with a bioentrepreneurship approach is in accordance with steps that can develop students' problem-solving ability and entrepreneurial interest.

At the first meeting the learning stages carried out were question - exploring, plan - planning, and schedule - planning. At the question - exploring stage, the teacher obtained a score of 93.75% from observers in the very good category. The teacher guides students to observe environmental problems in the form of the phenomenon of burning leaf waste which often occurs in the surrounding environment. Students are encouraged to analyze and find appropriate and effective solutions to overcome leaf waste problems. One of the proposed solutions is to utilize leaf waste into various leaf skeleton craft products. The teacher gives students the freedom to create various leaf skeleton craft products according to their abilities and the results of the opportunity analysis that has been carried out. This is in line with Hayatinnufus (2023) that the teacher's role in PjBL learning is to give students the freedom to experiment to find solutions to the problems they face. Teachers also ask essential questions that trigger students' creative and innovative thinking regarding environmental issues. This is in accordance with Nur (2011:2) that the teacher's role in PjBL is to pose various problems, ask questions and facilitate investigation and dialogue.

At the planning stage, the teacher obtained a score of 100% from the observer in the very good category. The teacher divided the class into 6 groups with each group consisting of 6 students. Each group is given an LKPD. Students discuss with their groups to determine the initial project design in the form of products resulting from leaf waste processing based on the opportunities identified and also answer essential questions given by the teacher.

At the second meeting, the learning stages carried out were schedule - planning and monitoring - producing. At the schedule - planning stage, the teacher obtained score of 100% in the very good category. The teacher guides and directs students to create a project timeline, learn about business planning, marketing strategies, and resource management. At the monitoring – producing stage the teacher gets a teacher activity score of 100%, the teacher instructs students to carry out the planned product making project. The stage of creating and innovating products is in line with the Learning Outcomes (CP) to be achieved in environmental change material, namely students create products as solutions to existing environmental problems. Leaf skeleton craft products produced as a solution to environmental problems faced by students are proof of the achievement of the CP competencies they wish to achieve. Project creation can be continued outside biology class hours by continuing to report each group's work progress to the teacher and recorded on the LKPD. Product manufacturing activities continued until the third meeting.

At the fourth meeting, the learning stages carried out were assessing - communicating/marketing and evaluating - reflecting. At the assessment - communicating/marketing stage, the observer gave the teacher activity a score of 75% in the sufficient category. This is due to the lack of implementation of the marketing stages which are still limited to planning and have not yet implemented product marketing directly to consumers. The teacher instructs students to present the results of their project to ensure that their product meets the essential questions and to communicate the marketing strategy for the product that has been created. During presentations in front of the class, responses, suggestions and input given by other group members stimulate students to think about effective ways to market their products so as to improve students' problem solving abilities. This is in accordance with the research results of Atmojo *et al.* (2022), the communication stage can improve students' problem-solving abilities because the results of consumer suggestions and input make students think about effective ways to market products, thereby increasing problem-solving abilities. Next, the evaluating – reflecting, teacher stage obtained a teacher activity score of 100%. The teacher guides the discussion and instructs students from other groups to provide responses such as the advantages & disadvantages of the product, checking the suitability of the product with essential questions. At the fifth meeting, the evaluating – reflecting stage was carried out. The teacher asks students to answer essay questions to test students' problem solving ability after carrying out learning material on environmental change using the PjBL model with a bioentrepreneurship approach. Students are also asked to fill out an entrepreneurial interest assessment scale.

Problem Solving Ability

Students' problem solving abilities after being taught the PjBL model with a bioentrepreneurship approach to environmental change material obtained the following results:

Table 2 Posttest Score Data for Students' Problem Solving Ability

Posttest Data	Result
Average	77,05
Minimum Score	65,9
Maksimum Score	90,9
Std.deviation	6,19347
Variation	38,359

Based on Table 2, it was found that the problem solving ability of Class X-2 students after learning the PjBL model with bioentrepreneurship approach on environmental change material obtained an average score of 77.05, minimum score of 65.9, maximum score of 90.9, standard deviation of 6.19347, and variation of 38.359.

The results of classical learning completeness problem solving ability can be determined by measuring the success rate of learners' learning completeness throughout. Classical learning completeness can be declared successful if students who are complete in learning or get a value of 70 are greater than or equal to 85% of the total number of students. The percentage of students' problem solving ability after implementing the PjBL model with bioentrepreneurship approach is seen in Table 3 below:

Table 3 The Precentage of Classical Learning Outcomes of Problem Solving Ability

Score	Category	Frequency	Precentage
0 ≤ x < 70	Tidak tuntas	3	8,33%
70 ≤ x < 100	Tuntas	33	91,67%

Percentage Based on table 3, it appears that of the 36 research subjects there were 33 students (91.67%) who completed it and 3 students (8.33%) who did not complete it. This shows that classical completeness of problem solving ability is 91.67%. Thus, students can be said to be classically complete because there are ≥ 85% of students who have completed their studies. This shows that the PjBL model with a bioentrepreneurship approach has proven to be effective on students' problem solving ability.

Wrahatnolo & Munoto (2018) stated that problem solving is a life skill that involves the process of analyzing, interpreting, reasoning, predicting, evaluating and reflecting so that a solution to the problem presented is obtained. PjBL with a bioentrepreneurship approach allows students to process information and solve problems (personal skills). This is in line with research conducted by Innayah (2023) which shows the results that the implementation of the Project Based Learning model with the bioentrepreneurship (BEP) approach has an effect on increasing students' life skill abilities with aspects of problem solving skills increasing with an experimental class average of 78 .63 and the control class was 51.74. One aspect of research life skills is problem solving skills.

The PjBL model is a student-centered learning model and places the teacher as a facilitator and motivator, apart from that, students are given the opportunity to work in groups for the continuity of learning (Gunawan & Hardini, 2018). The PjBL model with a bioentrepreneurship approach is able to develop effective problem solving abilities. This is in line with Susiana *et al.* (2017), problem-solving abilities can be further deepened by increasing and implementing a learning process that is only student-centered. Through learning the PjBL model with a bioentrepreneurship approach, students are required to find the right solution through leaf waste management project activities by creating leaf skeleton craft products that can be commercialized and have use value.

The PjBL model with a bioentrepreneurship approach provides students with a more active, interesting and meaningful learning experience. The results of this research are in line with Sudarmin (2017) who stated that project-based learning can improve problem-solving abilities and make students more active and successful in solving complex problems. Wena (2014) also stated that the PjBL model has the advantage of increasing problem solving to solve problems and making students more active and successful in solving complex problems.

Alhayat *et al.* (2023) stated that PjBL will display the unity of problem solving which is realized in real products and produced as students' creative work. In this lesson, students make various products as a solution to the problem of leaf waste in the surrounding environment. Students are trained to process leaf waste into various leaf skeleton craft products that vary according to their skills. Students are also directed to make products that have sales value and develop effective marketing strategies for the resulting leaf waste products. This activity is in line with the learning outcomes (CP) to be achieved in environmental change material, namely students create solutions to problems based on local and global issues from their understanding of environmental change. One of the environmental problems around students is the phenomenon of inappropriate handling of leaf waste. Burning leaf waste can cause pollution and potentially damage the natural balance. The practice of burning leaves is a common method used by the community to deal with piles of leaf waste scattered around. However, this treatment is less effective and has the potential to pollute the environment. Leaf waste can increase greenhouse gas emissions because leaf waste can be a source of methane gas emissions. Methane gas is a greenhouse gas that has a global warming effect 25 times

stronger than carbon dioxide. Leaf waste that is thrown into the environment can be decomposed naturally by anaerobic bacteria. This decay process will produce methane gas. Leaf waste management projects into products can prevent leaf waste from being thrown into the environment or burned. So, this effort can help reduce the methane gas emissions produced.

The PjBL model with a bioentrepreneurship approach is effective for problem solving abilities. This is in accordance with the results of research conducted by Sofyan *et al.* (2018) that the implementation of the project-based learning model is effective on students' problem-solving abilities in Biotechnology material. Siburian *et al.* (2022) that the Flipped Classroom Project Based Learning model has an effect on students' Problem Solving Skills. Malahayati (2015) PjBL can increase problem solving abilities by 3.7%.

Table 4 Level of Achievement Indicators of Problem Solving Ability

Indicators of Problem Solving Ability	Achievement (%)	Category
Define the Problem	96,52%	Very good
Explore the Problem	79,39%	Good
Plan the Solution	88,88%	Very good
Implements the Solution	69,44%	Good
Evaluate	66,49%	Good

Based on table 4, it shows the achievement of problem solving abilities for each indicator in environmental change material after implementing the PjBL learning model with a bioentrepreneurship approach. The problem definition indicator presented in question number 1 obtained the highest achievement percentage of 96.52% in the very good category. In general, students do not experience difficulty in working on question number 1, although not all students succeed in getting a perfect score. This shows that students are able to identify, understand and explain the types of environmental pollution that occur in the surrounding environment very well. Research conducted by Aji & Mahmudi (2018) also shows the same results, The define the problem indicator is an indicator that students are able to master in problem solving ability.

The evaluation indicators presented in questions number 6, 7, 10 and 11 obtained the lowest achievement percentage of 66.49% in the good category. These results show that students are able to assess the effectiveness of solutions to environmental problems that occur and their impact on the economy and ecosystem. One of the factors causing low evaluation indicators is that students are in a hurry to work on the last questions, which makes students less careful, which results in inappropriate answers or answers that are the opposite of the previous questions. Maemanah *et al.* (2019) revealed that the problem solving stage requires quite a long time in the process and cannot be done in a hurry.

Entrepreneurial Interest

Students' entrepreneurial interest after being taught the PjBL model with a bioentrepreneurship approach to environmental change material obtained the following results:

Table 6 Posttest Score Data for Entrepreneurial Interest

Posttest Data	Result
Average	83,9
Minimum Score	78,3
Maksimum Score	93,3
Std.deviation	4,09176
Variation	16,743

Based on Table 6, it was found that the entrepreneurial interest of Class X-2 students after studying the PjBL model with a bioentrepreneurship approach in environmental change material obtained an average score of 83.9, minimum score of 78.3, maximum score of 93.3, standard deviation of 4.09176, and variation of 16.743.

Table 7 Result of Student Entrepreneurial Interest Questionnaire

Criteria			
Poor	Fair	Good	Very Good
0%	0%	27,78%	72,22%

Table 7 shows the results of the analysis of the entrepreneurial interest questionnaire after studying the PjBL model with a bioentrepreneurship approach. Based on the table, it shows that the PjBL model learning with the bioentrepreneurship approach is effective because it meets the entrepreneurial interest criteria level of "good" at 27.78% and "very good" at 72.22%.

The implementation of the PjBL model with a bioentrepreneurship approach presents interesting and interactive learning by involving students in contextual project practice. This learning creates a fun learning environment by providing material related to entrepreneurship and facilitating students to practice directly. This is in line with the results of research conducted by Pratiwi *et al.*, (2018) that the acquisition of high scores on students' entrepreneurial interests is caused by learning that encourages students to better understand matters related to entrepreneurship through the provision of teaching materials and practices directly.

Table 8 Level of Achievement of Entrepreneurial Interest Indicator

Indicators of Entrepreneurial Interest	Achievement (%)	Category
Having self-confidence	77,27%	Good
Risk-taking	80,55%	Good
Creative and Innovative	85,69%	Very good
Discipline and Hard Work	86,11%	Very good
Future-oriented	87,49%	Very good
Having Curiosity	83,33%	Very good
Honest and Independent	91,67%	Very good

Based on Table 8 shows the average achievement of entrepreneurial interest for each indicator in environmental change material after implementing the PjBL learning model with bioentrepreneurship approach. The honest and independent indicator gets the highest percentage of achievement compared to other indicators , which is 91.67% with very good criteria, this shows that students have a very high responsibility and commitment in running their business and are able to independently complete the tasks and responsibilities they have to do business starting from the process of finding business opportunities, product production, marketing and evaluation. If a person has an independent attitude within himself so that he is able to complete the tasks and responsibilities he has without the help of others, then the chances of success in entrepreneurship are very large, causing interest in entrepreneurship (Farida & Nurkhin, 2016).

Indicators have self-confidence gets the lowest percentage of achievement at 77.27% with good criteria, this shows that most students are confident in their ability to start and open a business. One of the causes of this low indicator is because some students feel that they do not have the confidence to be able to carry out entrepreneurial actions. The results of a study conducted by Rahman & Amir (2020) also showed the same results that the self-confidence indicator became the indicator with the lowest increase.

Table 9 Regression Test Results of the Relationship between Problem Solving Abilitiy and Students' Entrepreneurial Interest in the PjBL Learning Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	64,148	8,066		7,953	,000
	Kemampuan Pemecahan Masalah	,257	,104	,389	2,466	,019

a. Dependent Variable: Minat Wirausaha

The results of statistical tests show that there is a significant positive influence between problem solving abilities on students' entrepreneurial interest. The results of the output analysis obtained t_{count} of 2.466 > t_{table} 2.032 (db=34), significance level 0.019 <0.05. So, there is a significant relationship between problem solving abilities and students' entrepreneurial interest in environmental change material in the PjBL learning model with a bioentrepreneurship approach. The higher the problem solving abilitiy posessed by students, the higher the students' entrepreneurial interest in the PjBL learning model with a bioentrepreneurship approach. The form of relationship between problem solving abilities and students' entrepreneurial interest in environmental change material in the PjBL learning model with the bioentrepreneurship approach has a regression equation $\hat{Y} = 64.148 + 0.257X$.

The results of this research are in accordance with research conducted by Kuntowicaksono (2012) which shows that partially the variable ability to solve entrepreneurial problems has a significant and positive effect on entrepreneurial interest because the t_{count} value is greater than t_{table} (8.263 > 1.9847) and the significance value is smaller than alpha (0.00 < 0.05).

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the PjBL model is effective for students' problem solving ability with an average of 77.05 in the "good" category and classical completeness of 91.67% ($\geq$85%). The PjBL model is effective in students' entrepreneurial interest with an average of 83.9 in the "very good" category and the level of entrepreneurial interest criteria is "good" 27.78%, very good "72.22%". There is a significant positive relationship between problem solving ability and students' entrepreneurial interest in environmental change material in the PjBL learning model.

REFERENCES

Abdullahi, I. M., bin Jabor, M. K., & Akor, T. S. (2020). Developing 4IR engineering entrepreneurial skills in polytechnic students: a conceptual framework. *International Journal of Innovative Technology and Exploring Engineering*, *9*(3), 2636-2642.

Aji, R. E. W. , & Mahmudi, A. (2018). Efektifitas Pembelajaran Matematika dengan Strategi Problem Solving untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Kelas VIII SMP. *Jurnal Pendidikan Matematika-S1*, *7*(3), 46–54.

Alhayat, A., Mukhidin, Utami, T., & Yustikarini, R. (2023). The Relevance of the Project-Based Learning (PjBL) Learning Model with Kurikulum Merdeka Belajar. *Dwija Cendekia: Jurnal Riset Pedagogik*, *7*(1).

Amalia, G. R., Kurniasih, S., & Jaenudin, D. (2022). Project-Based Learning on Biotechnology Materials to Enhance High School Students' Creativity and Problem-Solving Skills. *JSEP (Journal of Science Education and Practice)*, *6*(1), 51-64.

Atmojo, I. R. W., Ardiansyah, R., & Saputri, D. Y. (2022). Empowering Science-Based Entrepreneurship (SciPreneur) Skills through CEL-BaDiS Up Learning Model on Food Biotechnology Materials. *International Journal of Instruction*, *15*(3), 83–102. https://doi.org/10.29333/iji.2022.1535a

Farida, S., & Nurkhin, A. (2016). Pengaruh Pendidikan Kewirausahaan, Lingkungan Keluarga, Dan Self Efficacy Terhadap Minat Berwirausaha Siswa Smk Program Keahlian Akuntansi. *Economic Education*

Analysis Journal , *5*(1). http://journal.unnes.ac.id/sju/index.php/eeaj

Fitriah, E. (2012). Pengembangan perangkat pembelajaran bioteknologi berorientasi bioentrepreneurship untuk meningkatkan keterampilan proses sains, minat wirausaha dan hasil belajar siswa. *Scientiae Educatia: Jurnal Pendidikan Sains*, *1*(1), 67–78.

Gunawan, B., & Hardini, A. A. T. (2018). Penerapan Model Pembelajaran Project Based Learning Untuk Meningkatkan Hasil Belajar IPA dan Kemampuan Berfikir Kreatif Siswa Kelas V SD. *JTIEE (Journal of Teaching in Elementary Education)*, *2*(1), 32-46.

Hayatinnufus, D. (2023). Peran Guru Dalam Pembelajaran Project Based Learning Pada Profil Pelajar Pancasila Di Tk Islam Al-Amanah, Jakarta Utara. *Jurnal Raudhah*, *11*(2), 144-153.

Innayah, N. A. (2023). *Pengaruh Model Project Based Learning (Pjbl) Dengan Pendekatan Bio-Entrepreneurship (Bep) Terhadap Kemampuan Literasi Sains Dan Life Skill Peserta Didik*.

Kuntowicaksono, (2012), Pengaruh Pengetahuan Wirausaha dan Kemampuan Memecahkan Masalah Wirausaha Terhadap Minat Berwirausaha Siswa Sekolah Menengah Kejuruan, Journal Of Economic Education, 1 (1), 46-52.

Maemanah, S., Suryaningsih, S., & Yunita, L. (2019). Kemampuan Pemecahan Masalah Melalui Model Flipped Classroom Pada Pembelajaran Kimia Abad Ke 21. *Orbital: Jurnal Pendidikan Kimia*, *3*(2).

Malahayati, E. N. (2015). Meningkatkan Kemampuan Memecahkan Masalah Melalui Metode Project Based Learning Berbasis Lesson Study. *Konstruktivisme: Jurnal Pendidikan dan Pembelajaran*, *7*(1), 52-60.

Nur, Mohamad. 2011. Model Pembelajaran Berdasarkan Masalah. Surabaya : Pusat Sains dan Matematika Sekolah.

Pratiwi, Y. A., Validitas, :, Lkpd, K., & Bio-Entrepreneurship, B. (2018). Validitas Dan Keefektifan Lembar Kegiatan Peserta Didik (Lkpd) Berbasis Bio-Entrepreneurship Pada Materi Bioteknologi Sma Kelas XII. *Berkala Ilmiah Pendidikan Biologi*, *7*(2). http://ejournal.unesa.ac.id/index.php/bioedu

Rahman, A., & Amir, M. (2020). Pengukuran Efektifitas Pembelajaran Kewirausahaan Dalam Meningkatkan Minat dan Tindakan Berwirausaha Mahasiswa. *JPEK (Jurnal Pendidikan Ekonomi Dan Kewirausahaan)*, *4*(2), 217–225. https://doi.org/10.29408/jpek.v4i2.2591

Siburian, J., Tohiri, D., & Mataniari, R. (2022). Implementasi Model Project Based Learning Berbasis Flipped Classroom Terhadap Problem Solving Skills Siswa. *Jurnal Pendidikan Biologi, 13*(2), 113-120. doi:http://dx.doi.org/10.17977/um052v13i2p113-120

Sofyan, N. A., Hamka, L., & Saleh, A. R. (2018). Keefektifan Penerapan Model Pembelajaran Berbasis Proyek terhadap Kemampuan Pemecahan Masalah Peserta Didik pada Materi Bioteknologi. *Jurnal Nalar Pendidikan*, *6*(1), 14-23.

Sudarmin. (2017). *Model Pembelajaran Inovatif Kreatif [Model PAIKEM dalam Konteks Pembelajaran dan Penelitian Sains Bermuatan Karakter]*. CV. Swadaya Manunggal.

Suriansyah, A., Agusta, A. R., & Setiawan, A. (2021). Model Blended learning ANTASARI untuk Mengembangkan Keterampilan Berpikir Kritis dan Memecahkan Masalah. *Journal of Economics Education and Entrepreneurship*, *2*(2), 90. https://doi.org/10.20527/jee.v2i2.4102

Susiana, N., Yuliati, L., & Latifah, E. (2017). Analisis Pembelajaran Berdasarkan Profil Kemampuan Pemecahan Masalah Fisika Siswa Kelas X SMA. *Prosiding Seminar Nasional III Tahun 2017: Pusat Studi Lingkungan Dan Kependudukan (PSLK), Universitas Muhammadiyah Malang*, 210–214.

Wena, M. (2014). *Strategi pembelajaran inovatif kontemporer: Satuan tinjauan konseptual operasional*. Bumi Aksara.

Wrahatnolo, T., & Munoto. (2018). 21 st centuries skill implication on educational system. *IOP Conference Series: Materials Science and Engineering*, *296*, 012036. https://doi.org/10.1088/1757-899X/296/1/012036

Yuniartiek, E., Indriyanti, D. R., & Alimah, S. (2015). Pengembangan Pembelajaran Daur Ulang Limbah Berorientasi Bioentrepreneurship Dengan Model Project Based Learning. *LIK*, *44*(2). http://journal.unnes.ac.id/nju/index.php/LIK

Zubaidah, S. (2016). Keterampilan abad ke-21: Keterampilan yang diajarkan melalui pembelajaran. *In Seminar Nasional Pendidikan*, 1–17.