

# Application of PjBL Model by Utilizing Natural Materials Chemistry to Improve Students' 4C Skills

Harizon\* & Firdiawan Ekaputra

Jambi University, Jambi-Muara Bulian Street, Jambi, 36361, Indonesia

---

## Abstract

The purpose of this study was to examine the effectiveness of implementing a project-based learning model by utilizing natural materials to improve students' 4C skills. 4C skills include critical thinking, communication, collaboration, and creativity skills. The sample used in this study were students who attended the R-001 class of natural material chemistry lectures in the 2023/2024 academic year of the Jambi University Chemistry Education Study Program. This research is a quasi-experimental type research with a one group pretest-posttest scheme design. Data on 4C skills were obtained using a questionnaire before and after the application of the project-based learning model by utilizing natural chemistry. Data on 4C skills were then subjected to paired samples t test. The results of the paired samples t test significance test showed a value of 0.00. These results are smaller than 0.05, so this study shows that the application of the project-based learning model by utilizing natural materials can improve students' 4C skills.

*Keywords:* Project Based Learning Model, Natural Materials Chemistry, 4C Skills.

---

## 1. Introduction

The changing times are increasingly advanced and fast-paced, making someone have to improve their abilities. The world of education as a place to convey knowledge and character building must improve its abilities. The delivery of information that is fast and easily accessible is a demand for the world of education due to technological developments (Fuldjaratman et al., 2023). Lecturers and students must adapt in carrying out active learning, so that learning becomes more meaningful (Haryanto et al., 2023).

Based on observations in the field, chemistry utilization of natural materials is still rarely used. Chemistry is a science that is very important in everyday life, but students do not understand the chemistry of natural materials is very useful in everyday life. Some of the factors that cause the low understanding of 5th semester Jambi University Chemistry Education Study Program students in natural material chemistry are the lack of student knowledge of natural materials, critical thinking skills and student creativity in utilizing natural material chemistry in everyday life which is low. Based on these observations, an effort is needed to improve students' 4C skills in utilizing natural material chemistry through the project-based learning model.

The project-based learning model is learning that makes students the center of attention, strengthens discussions between group members, and makes learning activities run dynamically (Andrini et al., 2019). The application of the learning model will be able to facilitate student learning to discuss with their group members (Yahya et al., 2020). Learning that can involve students directly makes learning active so that learning becomes meaningful (Sanova et al., 2022).

The use of natural ingredients in product mixtures is a breakthrough and innovative step to live healthy and preserve the environment. The use of natural materials in the manufacture of a product is called green chemistry. Green chemistry is a concept to utilize materials available in nature and processed naturally in a product that aims to reduce the substance in the developed product (Mitarlis et al., 2018).

Abundant natural materials in the surrounding environment can be used as a project in learning to be processed to produce a new product. The ability of students to process natural materials increases the ability to think critically and

---

\* Corresponding author.

*E-mail address:* harizon@unja.ac.id

creatively. The use of natural materials to produce a product, of course, students must do it in groups, so that it can indirectly improve their ability to communicate and collaborate.

The provision of 4C skills which include collaborative, critical thinking, communication, and creativity needs to be done to improve student competence (Hendra et al., 2023). 4C skills are needed to face the demands of a rapidly changing era, so they need to be owned by every student (Ekaputra & Widarwati, 2023). Based on the description of the background that has been described, this research problem will focus on the application of the project-based learning model by utilizing natural chemistry to improve students' 4C skills.

## 2. Literature Review

### 2.1. Project Based Learning Model

The project-based learning model is a project-based learning model by facilitating students to make products from projects given according to their respective creativity and present their products (Elisabet et al., 2019). The project-based learning model consists of 6 stages of activities consisting of identifying problems, making project designs, preparing implementation schedules, monitoring projects, testing project results, and evaluating projects that have been carried out (Trimawati et al., 2020). Student understanding of the material presented can be improved using the application of the learning model, so that student learning outcomes will also increase (Ekaputra & Sanova, 2023).

### 2.2. Natural Material Chemistry

Natural Material Chemistry is a branch of chemistry that studies the analysis of secondary metabolite compounds (Vish & Chaturvedi, 2012). The project of isolating secondary metabolites from plants will provide an opportunity for students to prove the truth of a concept (Mujiyanti et al., 2020). Learning based on natural chemistry provides a new experience for students, so that learning motivation increases (Farianti et al., 2020).

### 2.3. 4C Skills

Efforts to improve the quality of graduates are by providing skills that are facilitated in the MBKM curriculum (Ekaputra, 2023). 4C skills are important for the world of education to adapt to an era full of uncertainty (Ardiansyah et al., 2022). Collaboration, critical thinking, communication, and creativity skills or 4C skills are very necessary for students to have (Sari & Trisnawati, 2019). The need for mastery of 4C skills requires good communication between teachers and students, so that learning becomes meaningful (Septikasari & Frasandy, 2018). This is because the teacher not only has the role of delivering learning material, but also assessing and evaluating the course of learning (Bakar et al., 2022).

## 3. Research Method and Materials

This research is a quasi-experimental type of research. The sample used in this study were students who attended natural material chemistry lectures in the 2023/2024 academic year, class R-001, Chemistry Education Study Program, Jambi University. The independent variable in this study is the application of the project-based learning model by utilizing natural chemistry in learning activities. The dependent variable used in this study is 4C skills which consist of critical thinking, communication, collaboration and creativity. Data on 4C skills were obtained using a questionnaire before and after the application of the project-based learning model. The results of the 4C skills questionnaire before the application of the project-based learning model by utilizing natural chemicals were tested for normality. The normality test is intended to determine whether the initial 4C skills data are normally distributed. At the end of the meeting, students again filled out a questionnaire regarding the final 4C skills. Hypothesis testing was carried out on 4C skills data with paired samples t test. There is an increase in students' 4C skills with the application of the project-based learning model by utilizing natural materials if the paired samples t test results are greater than 0.05.

## 4. Results and Discussion

The initial step taken in this study was to collect initial 4C skills data through a questionnaire for students who attended the R-001 class of natural ingredient chemistry lectures. Initial independence data is obtained before students take part

in lecture activities. Data on 4C skills before the application of the project-based learning model by utilizing natural chemistry is presented in Table 1.

**Table 1.** 4C Skills Before the Application of Project Based Learning Model

Indicator	Value
Critical Thinking	67.37
Communication	65.39
Collaboration	68.03
Creativity	68.32
Average	67.28

Students' 4C skills before the application of the project-based learning model showed an average of 67.28. The application of a learner-centered project-based learning model combined with projects that utilize natural chemicals is new to students. The application of the project-based learning model by utilizing natural chemicals that are easily found in the surrounding environment is expected to improve students' 4C skills in the natural materials chemistry course of class R-001 in the 2023/2024 academic year.

The results of the questionnaire regarding students' 4C skills before the application of the project-based learning model were then tested for normality. The results of the normality test in the sample class regarding 4C skills data showed that they were normally distributed. This is evidenced by the significance value of the normality test which is greater than 0.05, which is 0.126.

After the implementation of the project-based learning model in the sample class by utilizing natural chemicals, the questionnaire regarding 4C skills was again filled out by students. The 4C skills questionnaire aims to analyze changes in 4C skills after the application of the project-based learning model. The results of changes in students' 4C skills are presented in Table 2.

**Table 2.** 4C skills before and after the application of the project-based learning model

Indicator	Pretest	Posttest	Gain Skor
Critical Thinking	67,37	84.42	17.05
Communication	65,39	85.13	19.74
Collaboration	68,03	85.26	17.24
Creativity	68,32	83.26	14.95
Average	67,28	84.52	17.24

4C skills after the application of the project-based learning model showed an increase of 17.24. All 4C skill indicators also increased with the largest increase in the communication indicator of 19.74. Data on 4C skills before and after the application of the project-based learning model that has been obtained is tested paired samples t test. The purpose of the paired samples t test is to test whether the increase in 4C skills obtained is a significant increase. The results of the paired samples t test using the SPSS application show a significance value of 0.00. The result is smaller than 0.05, so that in this study there is an increase in 4C skills after the application of the project-based learning model by utilizing natural chemistry. The results of the study are in line with the statement (Saenab et al., 2019) which states that 4C skills can be improved using the project-based learning model. The application of the project-based learning model is able to involve students in the learning process and facilitate students in conveying their ideas (Sholekah, 2020).

The application of the project-based learning model can improve critical thinking skills because it provides opportunities to solve problems from the project given (Winarti et al., 2022). The freedom of students in finding problem solving, makes students have the opportunity to be creative. Learning by using the project-based learning model makes learning activities increase (Riskayanti, 2021). Student involvement in learning is in line with increasing learning activities (Ekaputra, 2022). The high level of student learning activity in learning can be observed through the involvement of students in discussion and presentation activities carried out (Ekaputra & Hasanah, 2021).

In this study, it can be concluded that the application of the project-based learning model by utilizing natural materials can improve students' 4C skills. The project-based learning model by utilizing natural materials is the right learning model to be applied in learning to improve 4C skills, especially for students who take natural material chemistry lectures in class R-001 in the 2023/2024 academic year of the Jambi University Chemistry Education Study Program.

## 5. Conclusion

Based on the results and discussion that has been described, the results of the paired samples t test significance test show a value of 0.00. These results are smaller than 0.05, so this study shows that the application of the project-based learning model by utilizing natural materials can improve students' 4C skills. The project-based learning model by utilizing natural materials is the right learning model to be applied in learning to improve 4C skills, especially for students who take natural material chemistry lectures in class R-001 in the 2023/2024 academic year of the Jambi University Chemistry Education Study Program.

## References

- Andrini, V. S., Pratama, H., & Maduretno, T. W. (2019). The effect of flipped classroom and project based learning model on student's critical thinking ability. *Journal of Physics: Conference Series*, 1171(1). <https://doi.org/10.1088/1742-6596/1171/1/012010>
- Ardiansyah, A. S., Agung, G. H., Cahya, N. D., & Dinasari, A. (2022). Upaya Mengembangkan Keterampilan 4C melalui Challenge Based Learning. *PRISMA, Prosiding Seminar Nasional Matematika*, 5, 627–637. <https://journal.unnes.ac.id/sju/index.php/prisma/>
- Bakar, A., Sanova, A., Yusnaidar, Y., & Ekaputra, F. (2022). Meningkatkan Keterampilan Guru SMAN 2 Sungai Penuh Dalam Mempublikasikan Artikel Ilmiah Ke Jurnal Bereputasi. *Lambung Inovasi: Jurnal Pengabdian Kepada Masyarakat*, 7(4), 489–496. <https://doi.org/10.36312/linov.v7i4.866>
- Ekaputra, F. (2022). Peningkatan aktivitas belajar melalui implementasi media virtual laboratorium kimia pada masa pandemi covid-19. *Tajdidukasi: Jurnal Penelitian Dan Kajian Pendidikan Islam*, 12(1), 22–26. <https://doi.org/10.47736/tajdidukasi.v12i1.334>
- Ekaputra, F. (2023). Efektivitas Penerapan Model Pembelajaran Praktikum Dengan Model Discovery Learning Dalam Meningkatkan Kemampuan Kolaborasi Dan Kreativitas Mahasiswa. *Paedagogia : Jurnal Kajian, Penelitian Dan Pengembangan Kependidikan*, 14(3), 238–242. <https://doi.org/10.31764>
- Ekaputra, F., & Hasanah, E. (2021). Peningkatan aktivitas belajar melalui implementasi media virtual laboratorium kimia pada masa pandemi covid-19. *Tajdidukasi: Jurnal Penelitian Dan Kajian Pendidikan Islam*, 11(1), 11–16. <https://doi.org/10.47736/tajdidukasi.v11i1.348>
- Ekaputra, F., & Sanova, A. (2023). Penerapan Model Pembelajaran Flipped Classroom-Pjbl Dalam Mengurangi Potensi Learning Loss dan Meningkatkan Hasil Belajar Mahasiswa. *Judika (Jurnal Pendidikan Unsika)*, 11(1), 33–43. <https://doi.org/10.35706/judika.v11i1.8312>
- Ekaputra, F., & Widarwati, S. (2023). Discovery Learning Based Practicum Learning in Improving Critical Thinking Skill and Student Creativity. *Tarbiyah: Jurnal Ilmiah Kependidikan*, 12(1), 47–56. <https://doi.org/10.18592/tarbiyah.9183>
- Elisabet, Relmasira, S. C., & Hardini, A. T. A. (2019). Meningkatkan Motivasi dan Hasil Belajar IPA dengan Menggunakan Model Pembelajaran Project Based Learning (PjBL). *Journal of Education Action Research*, 3(3), 285–291. <https://ejournal.undiksha.ac.id/index.php/JEAR/index>
- Farianti, D., Danial, M., Aulia, A., Hardianti, H., Copriady, J., & Haryati, S. (2020). Pengaruh Praktikum Berbasis Bahan Alam melalui Model Discovery Learning terhadap Motivasi dan Hasil Belajar Kimia Peserta Didik. *Chemistry Education Review (CER)*, 3(2), 138–151. <https://doi.org/10.26858/cer.v3i2.13315>
- Fuldariatman, Rusdi, M., Harizon, Dewi, F., & Ekaputra, F. (2023). Pelatihan Pengembangan Media Laboratorium Virtual Berbasis Aplikasi Construct Bagi Guru SMA Negeri 5 Muaro Jambi. *I-Com: Indonesian Community Journal*, 3(3), 1346–1353. <https://doi.org/10.33379/icom.v3i3.3145>
- Haryanto, Ernawati, M. D. W., Fuldariatman, Afrida, & Ekaputra, F. (2023). Implementasi Aplikasi PhET Simulation dalam Pembelajaran MIPA Berbasis Eksperimen. *I-Com: Indonesian Community Journal*, 3(3), 1372–1379. <https://doi.org/10.33379/icom.v3i3.3160>
- Hendra, Candra, A. A., & Ekaputra, F. (2023). Meningkatkan Keterampilan Berpikir Kritis Mahasiswa Melalui Kegiatan Pendampingan Penulisan Gagasan Pada Artikel: Indonesia. *ESTUNGKARA*, 2(1), 24–32.

- Mitarlis, Azizah, U., & Yonatha, B. (2018). Pemanfaatan Indikator Alam Dalam Mewujudkan Pembelajaran Kimia Berwawasan Green Chemistry. *Jurnal Penelitian Pendidikan IPA*, 3(1), 1–7. <http://journal.unesa.ac.id/index.php/jppipa>
- Mujiyanti, A. R., Hakim, A., & Hadisaputra, S. (2020). Pengembangan Modul Praktikum Generik Sains Kimia Bahan Alam: Isolasi Asam Anardat dari Kulit Biji Jambu Mete. *Chemistry Education Practice*, 3(2), 91. <https://doi.org/10.29303/cep.v3i2.1989>
- Riskayanti, Y. (2021). Peningkatan Keterampilan Berpikir Kritis, Komunikasi, Kolaborasi dan Kreativitas Melalui Model Pembelajaran Project Based Learning di SMA Negeri 1 Seteluk. *SECONDARY: Jurnal Inovasi Pendidikan Menengah*, 1(2), 19–26.
- Saenab, S., Yunus, S. R., & Husain. (2019). Pengaruh Penggunaan Model Project Based Learning Terhadap Keterampilan Kolaborasi Mahasiswa Pendidikan IPA. *Jurnal Biology Science & Education*, 8(1), 29–41.
- Sanova, A., Afrida, & Ekaputra, F. (2022). Pengembangan Aplikasi Platform Open Course Berorientasi PjBL Dan Case Study Berbasis Gamifikasi. *Jurnal Penelitian Pendidikan Kimia: Kajian Hasil Penelitian Pendidikan Kimia*, 9(2), 142–150.
- Sari, A. K., & Trisnawati, W. (2019). Integrasi Keterampilan Abad 21 Dalam Modul Sociolinguistics: Keterampilan 4c (Collaboration, Communication, Critical Thinking, Dan Creativity). *Jurnal Muara Pendidikan*, 4(2), 456–466.
- Septikasari, R., & Frasandy, R. N. (2018). Keterampilan 4C Abad 21 Dalam Pembelajaran Pendidikan Dasar. *Jurnal Tarbiyah Al-Awlad*, 8(2), 112–122.
- Sholekah, A. W. (2020). Peningkatan Motivasi Dan Hasil Belajar IPA Materi Pencemaran Lingkungan Melalui Model PjBL Siswa Kelas VII SMPN 9 Salatiga. *JURNAL PENDIDIKAN MIPA*, 10(1), 16–22. <https://doi.org/10.37630/jpm.v10i1.260>
- Trimawati, K., Tjandrakirana, & Raharjo. (2020). Pengembangan Instrumen Penilaian IPA Terpadu Dalam Pembelajaran Model Project Based Learning (Pjbl) Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Kreatif Siswa SMP. *QUANTUM: Jurnal Inovasi Pendidikan Sains*, 11(1), 36–52.
- Visht, S., & Chaturvedi, S. (2012). Isolation of Natural Products. *Current Pharma Research*, 2(3), 584–599.
- Winarti, N., Maula, L. H., Amalia, A. R., Pratiwi, N. L. A., & Nandang. (2022). Penerapan Model Pembelajaran Project Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas III Sekolah Dasar. *Jurnal Cakrawala Pendas*, 8(3), 552–563. <https://doi.org/10.31949/jcp.v8i2.2419>
- Yahya, R., Ummah, S. K., & Mahfud, M. (2020). Pengembangan Perangkat Pembelajaran Flipped Classroom Bercirikan Mini-Project. *SJME (Supremum Journal of Mathematics Education)*, 4(1), 78–91.