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Analysis of the Influence of Project-Based Learning Models on the Learning Outcomes of Vocational High School Students Using Correlation Meta-Analysis

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Abstrak

Berbagai penelitian telah membahas tentang pengaruh model pembelajaran berbasis proyek terhadap hasil belajar siswa di SMK, namun nilai korelasinya berbeda. Penelitian ini berbentuk kajian pustaka. Peneliti menggunakan metode korelasi meta-analisis, yaitu upaya merangkum berbagai hasil penelitian secara kuantitatif berdasarkan hasil penelitian tentang pengaruh model pembelajaran berbasis proyek terhadap hasil belajar siswa SMK. Sampel penelitian terdiri dari 10 artikel yang telah memiliki ISSN, terdiri dari artikel internasional dan nasional. Tujuan penelitian ini adalah untuk mengetahui hubungan antara model pembelajaran berbasis proyek dengan hasil belajar siswa SMK. Hasil penelitian ini menunjukkan bahwa korelasi antara model pembelajaran berbasis proyek dengan hasil belajar siswa berada pada kategori kuat dengan nilai r = -0,014, dan selang kepercayaan berada pada rentang -0,455 hingga 0,440. Hal ini menunjukkan bahwa semakin meningkatnya penggunaan model pembelajaran berbasis proyek akan meningkatkan pula hasil belajar siswa.

Kata kunci: *Analisis Korelasi Meta, Pembelajaran Berbasis Proyek, Hasil Belajar.*

Abstract

Various studies have discussed the effect of project-based learning models on student learning outcomes at vocational high schools, but the correlation values are different. This research is in the form of a literature review. The researcher uses the correlation meta-analysis method, which is an attempt to summarize various research results quantitatively based on the results of research on the effect of project-based learning models on the learning outcomes of vocational high school students. The research sample consisted of 10 articles that already had an ISSN, consisting of international and national articles. The purpose of this study was to determine the correlation between the project-based learning model and the learning outcomes of vocational high school students. The results of this study indicate that the correlation between the project-based learning model and student learning outcomes is in the strong category with a value of r = -0.014, and the confidence interval is in the range of -0.455 to 0.440. This shows that the increasing use of the project-based learning model will also increase student learning outcomes.

Keywords: *Meta Correlation Analysis, Project Based Learning, Learning Outcomes.*

PRELIMINARY

Science and technology (IPTEK) development has been accelerated by the Industrial Revolution 4.0 (IR4.0) [1]. Nanotechnology, biotechnology, computer technology, and intelligent robotics have all profoundly impacted human life and the way we work [2]. Not just the industrial sector, but also people and education are impacted by this transition. This is demonstrated by the sophisticated technology that displaces human labor and has rendered numerous professions obsolete. Future Human Resources (HR) professionals will have excellent chances, particularly those who are competent, well educated, and capable of operating this advanced technology. The creation of qualified graduates is the most crucial aspect in preparing the education sector for the "4.0 revolution" age. Learning must therefore adhere to four key principles: it must be student-centered, collaborative, linked to real-world situations, and have a context or purpose [3].

Vocational schools play a significant role in fostering a learning environment that encourages students to actively pursue the development of their full potential as they serve as institutions of vocational education dedicated to producing graduates qualified to work in specific fields of competence. This is supported by the implementation of the autonomous learning curriculum and the Center for Excellence Vocational School Program, which embody the Freedom to Learn philosophy and focus on enhancing human capital and bridging the gap between the worlds of education and business. This program is anticipated to serve as a catalyst for vocational high school in Indonesia to raise the caliber of students' learning outcomes in line with Dudi's (DUDI) or the standards of the working world. [4].

However, according to Artini [5], students' early school experiences tend to fully transfer knowledge from the teacher's mind to a trained mind in learning, which results in a decline in interest and attention in learning and poor learning outcomes. In order to encourage their ability to learn and innovate and generate work in a context-appropriate manner, teachers must identify ways to support students in learning effectively.

The impact of project-based learning models on student learning outcomes at vocational high school will be examined in this research article. Through direct engagement and organization of project-based learning, students can investigate and apply subject matter to challenging problems related to the professional practice they are preparing for [6]. Project-based learning fosters students' critical thinking abilities, allows for their creativity, promotes teamwork, and instructs them to acquire material independently and present that information. Students participating in project-based learning typically do it willingly and in groups [7].

According to Toledo and Sánchez, since 2010, higher education in Europe has undergone significant changes, with a new model that places a strong emphasis on what students actually do in class. PjBL, an active learning methodology, is a useful tool for helping students acquire knowledge and skills [8]. The PjBL paradigm has the benefit of allowing students to work together to solve problems while learning through scientific investigative techniques [9]. Students' analytical capacity will rise as a result of regular problem-solving practice, which will also improve their critical thinking abilities.

METHOD

Researchers employ the correlation meta-analysis method, an attempt to statistically synthesize numerous study outcomes based on research results, while publishing scientific articles in the form of literature reviews. The meta-analysis method is a quantitative investigation set up as statistical information [10]. Combining several quantitative research results from earlier studies, being able to describe research findings well, and being objective in explaining research data without any subjectivity from the researcher are all benefits of meta-analysis research. The steps that the researcher will take are: (1) using the correlation meta-analysis technique to review study sources; (2) formulating the correlation meta-goals; analysis's (3) developing hypotheses; (4) data collection; (5) data analysis with meta-correlation analysis; and (6) summarizing the results.

The Google Scholar database was used to compile the study's data, which covers the years 2015 through 2022. To evaluate the impact of the project-based learning paradigm on the learning outcomes of vocational high school students, an evaluation of 10 conceptual and empirical papers will be conducted. The articles must meet two requirements in order to be considered: (1) they must include the project-based learning model in vocational high school as the independent variable and student learning outcomes as the dependent variable; and (2) they must include statistical data that will be used to calculate the effect size, such as the values of F, t, and r.

The analysis scheme of the correlation meta-analysis method is as shown in Figure 1 below:

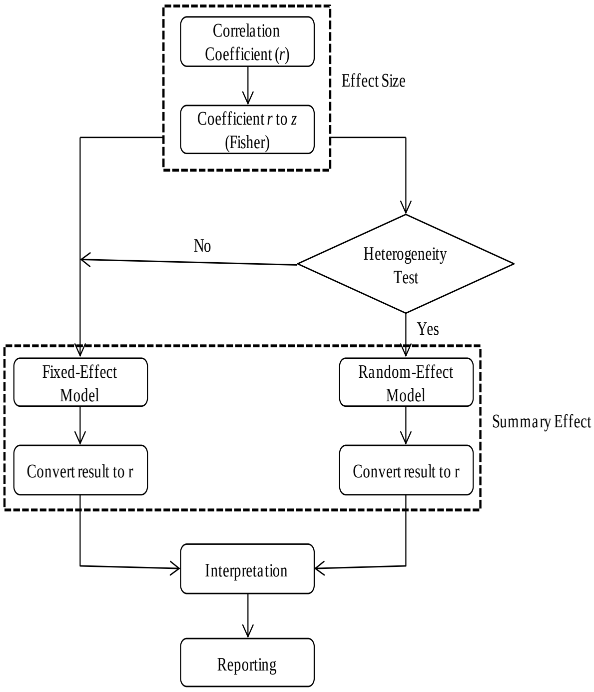

Figure 1. Schematic of the correlation meta-analysis method

RESULTS AND DISCUSSION

The formulation of the objective of the meta-analysis study in this article is: "Is there a correlation between the project-based learning model and the learning outcomes of vocational high school students?" Thus, this study was conducted to determine whether there is a correlation between cooperative learning models and student learning outcomes.

The following is the study's hypothesis:

H0: There is no significant correlation between the project-based learning model and the learning outcomes of vocational high school students (there is a zero effect in each study).

H1: There is a significant correlation between the learning model of project-based learning and the learning outcomes of vocational high school students (there is no zero effect in each study).

Based on the results of primary study data collection with predetermined criteria, a description of the sample data can be found in Table 1.

Based on table 1, it is known that the value of r (effect size) for each study Even though r is the value of the effect size, it cannot be used to perform further analysis (calculating the summary effect), so the value of r needs to be transformed first to Fisher's transformation (z) using the following equation.

Table 1. Sample data description

No	Author	*r*	N	Sample
1	Agus Supandi (2022)	0,708	92	Class XI
2	Yohanes Galih Adhiyoga (2015)	0,526	62	Class X
3	Johan Wiranto & Sukardi (2022)	0,830	14	Class XI
4	Siti Widya Astuti, Sigit Priyono & dan Siti Afifah (2020)	-0,982	56	Class XI
5	Nur Amalinda, Wahyu Sakti Gunawan Irianto, Heru Wahyu Herwanto (2017)	0,919	66	Class XII
6	M. Iwal Mursalin & Samidjo (2021)	0,168	8	Class XI
7	Latifatus Fitria, Dyan Yulianab & Firman Jaya (2021)	0,711	28	Class X
8	lilis suryani1, tri susilawati & harjito (2021)	0,229	23	Class XII
9	Suwandi (2016)	0,700	30	Class XI
10	Fathimatuz Zahroh (2020)	0,670	32	Class XII

$$z = 0,5\ x\ ln + \frac{1+r}{1-r}$$

Then the equation for the variance of z is as follows:

$$Vz = \frac{1}{N-3}$$

and the standard error equation of z is as follows:

$$\mathrm{SEz} = \sqrt{\mathrm{Vz}}$$

If the z coefficient has been obtained, then the next step is calculating the summary effect. The summary effect has two calculation models, namely the fixed-effect model and the random-effect model. To determine the model to be used, it can be done by testing heterogeneity or by assuming that all studies used have the same effect size so that calculations can be carried out using the fixed-effect model.

In this analysis, a heterogeneity test will be carried out to determine the summary effect calculation model used. If the results of the heterogeneity test state that the data used is heterogeneous (different), then the summary effect calculation will be carried out using the random-effect model, whereas if it is not heterogeneous, then the calculation will be continued using the fixed-effect model. The steps for the heterogeneity test are as follows.

Calculating the weight of each study (W)

The calculation can be done using the following equation:

$$\mathrm{Wi} = \frac{1}{Vzi}$$

where Wi is the weight for study i, and Vzi is the variance for study i.

Create data tabulation

The tabulation of the calculated data is presented in Table 2 below.

Table 2. Tabulation of study source data

Article	r	N	z	Vz	W	W.z	W.z²	W²
1	0,708	92	0,883	0,011	89	78,601	69,418	7921
2	0,526	62	0,585	0,017	59	34,491	20,164	3481
3	0,830	14	1,188	0,091	11	13,070	15,528	121
4	-0,982	56	-2,351	0,019	53	-124,589	292,878	2809
5	0,919	66	1,583	0,016	63	99,701	157,782	3969
6	0,168	8	0,170	0,200	5	0,848	0,144	25
7	0,711	28	0,889	0,040	25	22,230	19,767	625
8	0,229	23	0,233	0,050	20	4,663	1,087	400
9	0,700	30	0,867	0,037	27	23,417	20,310	729
10	0,670	32	0,811	0,034	29	23,512	19,062	841
∑	**4,479**	**411**	**4,858**	**0,515**	**381**	**175,943**	**616,140**	**20921**

Heterogeneity test using the parameter Q

Parameter Q is the weighted sum square (weighted sum of squares). The equation for calculating the Q parameter is as follows:

$$Q = \sum_{i=1}^{k} \mathrm{Wi}zi^2 - \frac{(\sum_{i=1}^{k} Wizi)^2}{\sum_{i=1}^{k} Wi}$$

so the value of Q is,

$$Q = 616{,}140 - \frac{(175{,}943)^2}{381} = 534{,}890$$

If the Q value has been determined, the degrees of freedom (df) are calculated as df = k - 1, where k is the number of studies used in the analysis. The hypothesis in this heterogeneity test is as follows:

H0: Each study used has the same true effect (it is not heterogeneous).

H1: Each study used has a true effect that is not the same (heterogeneous).

Then calculate the p-value using Microsoft Excel software with the formula "=CHIDIST (Q, df)". If the p-value is less than 1, then H0 is rejected, and vice versa.

Based on the results of calculations using Microsoft Excel software, the p-value is 1.9295 1029 with df = 9, and the p-value is with = 0.05, indicating that the null hypothesis (H0) is rejected and any of the studies used have unequal true effects.

Based on the results of the heterogeneity test, the random-effect model will be used to calculate the summary effect. The steps in calculating the random-effect model are as follows:

Calculating T^2

The parameters used in calculating T^2 are the parameters Q and C. The Q values have been obtained in the heterogeneity test, and then the values for C and T^2 can be calculated with the following equation:

$$C = \sum_{i=1}^{k} \mathrm{Wi} - \frac{(\sum_{i=1}^{k} Wi)^2}{\sum_{i=1}^{k} Wi}$$

$$\mathrm{T}^2 = \frac{\mathrm{Q} - \mathrm{df}}{C}$$

so the values of C and T2 are,

$$C = 381 - \frac{20921}{381} = 326{,}089$$

and

$$\mathrm{T}^2 = \frac{534{,}890 - 9}{326{,}089} = 1{,}613$$

Reate data tabulation

The equations used in tabulating the random-effect model data are as follows:

$$\mathrm{Wi} *= \frac{1}{Vzi *}$$

$$Vzi *= Vzi + T^2$$

the * sign is a differentiating sign for the random-effect model parameter.

Based on these equations, data tabulation can be presented in table 3.

Calculates the weighted average effect

Making a data tabulation table is an attempt to simplify the calculation of the weighted average effect on the random-effect model.

The equation for calculating the weighted average effect on the random-effects model is as follows:

$$M *= \frac{\sum_{i=1}^{k} Wi * zi}{\sum_{i=1}^{k} Wi *}$$

and the equation for the variance and standard error of the weighted average effect is as follows:

$$VM *= \frac{1}{\sum_{i=1}^{k} Wi *}$$

$$SEM *= \sqrt{VM *}$$

Table 3. Tabulation of random-effect model data

Article	*r*	N	z	Vz	T²	Vz+T²	W*	W*.z
1	0,708	92	0,883	0,011	1,613	1,624	0,616	0,544
2	0,526	62	0,585	0,017	1,613	1,630	0,614	0,359
3	0,830	14	1,188	0,091	1,613	1,704	0,587	0,697
4	-0,982	56	-2,351	0,019	1,613	1,632	0,613	-1,441
5	0,919	66	1,583	0,016	1,613	1,629	0,614	0,972
6	0,168	8	0,170	0,200	1,613	1,813	0,552	0,094
7	0,711	28	0,889	0,040	1,613	1,653	0,605	0,538
8	0,229	23	0,233	0,050	1,613	1,663	0,601	0,140
9	0,700	30	0,867	0,037	1,613	1,650	0,606	0,526
10	0,670	32	0,811	0,034	1,613	1,647	0,607	0,492
∑	**4,479**	**411**	**4,858**	**0,515**	**16,13**	**16,645**	**6,014**	**2,920**

Based on table 3 above, the value of M*, the variance of M*, and the standard error can be calculated as follows:

$$M = \frac{2{,}920}{6{,}014} = 0{,}486$$

$$VM = \frac{1}{6{,}014} = 0{,}166$$

$$SEM = \sqrt{0,166} = 0,407$$

Determine the M* confidence interval

The requirement to determine the M* confidence interval is to first determine the lower and upper limits of the confidence interval. At this point, the researcher employs a significance level of 95% (= 0.05) in order to calculate the lower and upper limits using the following equation:

$$LLM{*}{=}M{*}{-}1{,}96{\times}SEM{*}$$

and

$$ULM{*}{=}M{*}{+}1{,}96{\times}SEM{*}$$

so that the lower limit and upper limit are obtained as follows:

$$LLM{*}{=}0{,}486{-}1{,}96{\times}0{,}407 = -\ 0{,}311$$

$$ULM{*}{=}0{,}486{+}0{,}96{\times}0{,}407 = 1{,}284$$

Based on these calculations, it is known that the confidence interval for M* at the 95% significance level lies in the range of 0.311 to 1.284.

Calculating p-values

This stage serves to test whether the null hypothesis is accepted or rejected. If the p-value is, H0 is rejected, implying that the correlation between the two variables is significant. To find out the p-value, first calculate the Z* value using the following equation:

$$\mathrm{Z} *= \frac{\mathrm{M} *}{SEM *}$$

so that the Z value is obtained as follows:

$$\mathrm{Z} *= \frac{0{,}486}{0{,}407} = 1{,}194$$

Next, a one-tailed test will be carried out using the following equation:

$$p{=}1{-}\Phi(|Z*|)$$

and the p-value is obtained as follows:

$$p{=}1{-}\Phi(|1{,}194|)$$

$$p{=}1{,}3998{\times}10^{-6}$$

The null hypothesis (H0) is rejected based on the p-value calculation results because the p-value with = 0.05 at the 95% significance level. Thus, it can be concluded that there is a significant correlation between the project-based learning model and the learning outcomes of vocational high school students.

Converts the value of M to r

The equation for converting the value of M to r is as follows:

$$\mathrm{r} = \frac{\mathrm{e2} \times \mathrm{M} * -1}{\mathrm{e2} \times \mathrm{M} * +1}$$

Then the equation for determining the lower and upper limits of the confidence interval is as follows:

$$\mathrm{LLr} = \frac{\mathrm{e2} \times \mathrm{LLM} * -1}{\mathrm{e2} \times \mathrm{LLM} * +1}$$

$$\mathrm{ULr} = \frac{\mathrm{e2} \times \mathrm{ULM} * -1}{\mathrm{e2} \times \mathrm{ULM} * +1}$$

so that the value of r and the limit of the confidence interval are obtained as follows:

$$\mathrm{r} = \frac{\mathrm{e2} \times 0{,}486 - 1}{\mathrm{e2} \times 0{,}486 + 1} = 0{,}451$$

$$\mathrm{LLr} = \frac{\mathrm{e}2 \times -0{,}311\ -1}{\mathrm{e}2 \times -0{,}311 + 1} = -0{,}301$$

$$\mathrm{ULr} = \frac{\mathrm{e}2 \times 1{,}284 - 1}{\mathrm{e}2 \times 1{,}284 + 1} = 0{,}858$$

Interpretation

Based on the results of calculations using the random-effect model, it can be concluded that there is a significant relationship between the project-based learning model and the learning outcomes of vocational high school students. This is demonstrated by the p-value, which ranges between 0 and 0.05. While the correlation between the project-based learning model and the learning outcomes of vocational high school students is in the strong category with a value of r = 0.451, the confidence interval is in the range of -0.301 to 0.858. This shows that the increasing use of the project-based learning model will also increase student learning outcomes.

CONCLUSION

Based on the results of the calculations using the random-effect model, it can be concluded that there is a significant relationship between the project-based learning model and the learning outcomes of vocational high school students. This is demonstrated by the p-value, which ranges between 0 and 0.05. Meanwhile, the correlation between the project-based learning model and the learning outcomes of SMK students is in the strong category with a value of r = 0.451, and the confidence intervals are in the range of -0.455 to 0.440. This shows that the increasing use of the project-based learning model will also increase student learning outcomes.

Based on the results of the preparation of scientific articles in the form of this literature review, the suggestions that can be conveyed by the authors are: (1) There is a need for follow-up regarding the development of project-based learning models to find out the truth in this article about project-based learning models. (2) The current project-based learning model should be further developed so that it can be used properly in the future.

REFERENCES

Liao, Y., Loures, E. R., Deschamps, F., Brezinski, G., & Venâncio, A. (2018). The impact of the fourth industrial revolution: a cross-country/region comparison. *Production*, *28*.

Schwab, K. (2017). The Fourth Industrial Revolution. Crow: Business Press.

Asrizal, A., Amran, A., Ananda, A., & Festiyed, F. (2018, April). Effectiveness of adaptive contextual learning model of integrated science by integrating digital age literacy on grade VIII students. In *IOP Conference Series: Materials Science and Engineering* (Vol. 335, No. 1, p. 012067). IOP Publishing.

Artini, N. P. J. (2019). Pengaruh Model Pembelajaran Berbasis Proyek Terhadap Keterampilan Berpikir Kreatif Siswa pada Mata Pelajaran IPA. Jurnal Kajian Pendidikan Widya Accarya FKIP Universitas Dwijendra, (2085-0018).

Kemdikbud. (2021). Kemendikbud Luncurkan Merdeka Belajar Kedelapan: SMK Pusat Keunggulan. Jakarta. https://www.kemdikbud.go.id/main/blog/2021/03/kemendikbud-luncurkan-merdeka-belajar-kedelapan-smk-pusat-keunggulan

Hârtescu, I. (2014, July). Providing technology support for project-based learning. In *The International Scientific Conference eLearning and Software for Education* (Vol. 3, p. 223). " Carol I" National Defence University.

Kolmos, A., & De Graaff, E. (2014). Problem-based and project-based learning in engineering education: Merging models. In *Cambridge handbook of engineering education research* (pp. 141-161). Cambridge University Press.

Zhou, Z. (2018). An Empirical Study on the Influence of PBL Teaching Model on College Students' Critical Thinking Ability. *English Language Teaching*, *11*(4), 15-20.

Miner-Romanoff, K., Rae, A., & Zakrzewski, C. E. (2019). A holistic and multifaceted model for ill-structured experiential problem-based learning: Enhancing student critical thinking and communication skills. *Journal of Problem Based Learning in Higher Education*, *7*(1).

Salari, M., Roozbehi, A., Zarifi, A., & Tarmizi, R. A. (2018). Pure PBL, Hybrid PBL and Lecturing: which one is more effective in developing cognitive skills of undergraduate students in pediatric nursing course?. *BMC medical education*, *18*(1), 1-15.

Supandi, A. (2022). Pengaruh Model Pembelajaran Berbasis Proyek (Project Based Learning) Terhadap Minat Berwirausaha Siswa Kelas Xi Pada Mata Pelajaran Kewirausahaan Di Sekolah Smk Bina Nusa Mandiri Ciracas. Jurnal Review Pendidikan Dan Pengajaran (Jrpp), 5(1), 134-141.

Adhiyoga, Y. G. Peningkatan Kompetensi Perancangan Desain Papan Rangkaian Cetak Berbantuan Perangkat Lunak Orcad Menggunakan Metode Pembelajaran Berbasis Proyek Di Smk N 1 Sedayu.

Wiranto, J., & Sukardi, S. (2022). Efektivitas Model Pembelajaran Project Based Learning Pada Mata Pelajaran Instalasi Penerangan Listrik Di Smk Muhammadiyah 1 Padang. Jurnal Pendidikan Tambusai, 6(2), 16484-16490.

Astuti, S. W., Priyono, S., & Sinta, V. (2020). Pengaruh Model Pembelajaran (Pbl) Project Based Learning Terhadap Hasil Belajar Mata Pelajaran Kewirausahaan Peserta Didik Kelas Xi Smk Muhammadiyah 03 Sukaraja. Utility: Jurnal Ilmiah Pendidikan Dan Ekonomi, 4(02), 46-56.

Amalinda, N., Irianto, W. S. G., & Herwanto, H. W. (2017). Hubungan Penerapan Metode Pembelajaran Project Based Learning Berbasis Grasps Berbantuan Modul Digital Dan Hasil Belajar Siswa Pada Mata Pelajaran Produktif Multimedia Di Smkn 1 Amuntai (Doctoral Dissertation, Universitas Negeri Malang).

Mursalin, M. I., & Samidjo, S. (2021). Analisis Metode Pembelajaran Project Based Learning Untuk Peningkatan Hasil Belajar Siswa Smk.

Fitri, L., Yuliana, D., & Jaya, F. (2021). Pengaruh Project Based Learning Terhadap Kreativitas Siswa Pada Mata Pelajaran Simulasi Digital. Jurnal Pendidikan Teknologi Informasi (Jukanti), 4(2), 39-48.

Susilawati, T. (2021). Inovasi Pembelajaran Blended Learning Dengan Metode Project Based Learning Terhadap Motivasi, Minat Dan Hasil Belajar Siswa Di Masa Pandemi Covid-19.

Suwandi, S. (2016). Pengaruh Model Pembelajaran Berbasis Proyek Terhadap Peningkatan Hasil Belajar Siswa Di Smk Negeri 1 Bone-Bone Kabupaten Luwu Utara. Jurnal Kependidikan Media: Teknologi Pendidikan, 5(3), 92-106.

Zahroh, F. (2020). Pengaruh Model Pembelajaran Project Based Learning Terhadap Kemampuan Berpikir Kritis Siswa Pada Materi Elektrokimia. Phenomenon: Jurnal Pendidikan Mipa, 10(2), 191-203.