

## Meta-Analysis: Correlation Study Between Science Process Skills and Learning Outcomes

Ahmad Rasyid Ridho Agus

Master's Program in Biology Education, Universitas Negeri Padang, 25132, Indonesia

\*Correspondence: [ahmadrasyid305@gmail.com](mailto:ahmadrasyid305@gmail.com)

Received: 6 November 2022; Accepted: 28 December 2022; Published: 30 December 2022

**Abstract:** Science process skills are essential for students to obtain and apply knowledge in science education. This meta-analysis aims to estimate the correlation between science process skills and academic achievement in science subjects. The data were collected from 10 journal articles that reported the correlation between science process skills and academic achievement in physics, chemistry, or biology. The results showed a significant positive correlation between science process skills and academic achievement ( $z = 2.978$ ;  $p = 0.032$ ; 95% CI [0.039; 0.879]). The effect size of science process skills on academic achievement was moderate ( $rRE = 0.459$ ). This study suggests that enhancing science process skills can improve students' learning outcomes in science subjects.

**Keywords:** Science Process Skills, Learning Outcomes, Meta-analysis

### INTRODUCTION

Science is both a process and a product in education. The product of science includes facts, principles, concepts, laws, and theories, while the process of science involves ways of obtaining, developing, and applying knowledge that encompass working methods, thinking methods, problem-solving methods, and attitudes (Wardani & Kurnia, 2019). Therefore, science education is a critical factor in preparing students to enter the world of work. According to Hernani et al. (2009), science education is a strategic and significant potential for preparing individuals or students to face the era of globalization. This can be achieved if science education is designed to enhance and produce students who are critical thinkers, logical, problem-solvers, critical, technology-savvy, and adaptive to changes and developments in the times.

One of the skills developed in science education is science process skills (SPS). SPS are essential skills for understanding phenomena by obtaining information, developing it, applying concepts, thinking critically, applying principles and laws in science to draw conclusions (Toharudin et al., 2014). SPS are skills used by scientists to obtain information. In essence, SPS are skills used by scientists to conduct research in laboratories to discover new information. When related to education, SPS can be viewed as techniques or methods for students to obtain information or facts firsthand from the investigation conducted in the learning process (Muamar & Rahmi, 2017).

SPS can be classified into two types: basic SPS and integrated SPS. Basic SPS include observing, classifying, measuring, inferring, predicting, and communicating. Integrated SPS include controlling variables, defining operationally, formulating hypotheses, experimenting, interpreting data, and formulating models (Padilla et al., 1984).

The acquisition of SPS is important for students' learning outcomes in science subjects. Learning outcomes are changes in students' abilities that are the side effects of the learning process they have undergone, both consciously and unconsciously (Winkel, 1987). Learning outcomes are

essential so that educators can design learning processes that are better than before so that all learning objectives can be achieved.

Science Process Skills (SPS) are essential for effective science learning and can be learned by students through various methods. A systematic review by Harlen & Qualter (2004) summarized the history and research on SPS from 1960s to 1990s. It defined five basic SPS and six integrated SPS, and provided examples of how to teach and assess them in science classrooms. A third review by Padilla et al. (1984) explored the importance and benefits of SPS for science learning. It also suggested some strategies for developing SPS among students such as inquiry-based learning, hands-on activities, cooperative learning, and metacognitive reflection.

Several studies have investigated the relationship between SPS and learning outcomes in different science subjects. For example, Juhji & Nuangchalem (2020) found that there was a positive correlation between basic SPS acquisition and biology achievement among seventh-grade learners. Nismalasari et al. (2016) reported that there was a significant difference between physics achievement scores of students who were taught using learning cycle model with high-level SPS activities compared with those who were taught using conventional model with low-level SPS activities. Yusran et al. (2018) revealed that there was a positive correlation between integrated SPS acquisition and chemistry achievement among undergraduate students. These studies suggest that enhancing SPS can improve students' learning outcomes in various science subjects.

However, there is still a lack of comprehensive analysis on how strong the correlation between SPS and learning outcomes is across different science subjects. Therefore, this study aims to conduct a meta-analysis on existing studies that reported the correlation between SPS and learning outcomes in physics, chemistry, or biology. This study will estimate the effect size of the relationship between SPS and learning outcomes in these subjects.

## METHOD

Meta-analysis is a method for qualitative research that aims to integrate and compare the results of multiple studies on a similar topic (Walsh & Downe, 2005). Meta-analysis can increase the sample size and statistical power of a research question, especially when there are small or inconclusive clinical trials (Peterson et al., 2010). To perform a meta-analysis, one needs to follow predefined steps and use statistical techniques to analyze the data (Hernandez et al., 2020).

This research employed the meta-analysis method. The data source for this study was reputable national journals from the past eight years. The data collection technique involved identifying journals or scientific articles related to science process skills and learning outcomes. Inclusive criteria were then applied based on the location and subject area of the research. Specifically, only journals or scientific articles with science subjects taught in junior high and high school were included in this study to maintain source homogeneity. Based on these criteria, 10 reputable national journals were selected as the research sample. The next stage involved analyzing the correlation between the two variables, followed by determining the effect size of each journal article obtained using the formula provided in Table 1.

Table 1. Calculation of Effect Size

No	Step	Formula
1	Correlation (r) transformed into Fisher's	$z = 0,5 \times \ln \left( \frac{1+r}{1-r} \right)$
2	Variance	$Vz = \frac{1}{n-3}$
3	Standard error	$SEz = \sqrt{Vz}$

(Source : Heri et al., 2018)

Once the effect size is obtained, the results are interpreted into categories based on Table 2.

Table 2. Classification of Effect Size

Effect size	Standard Categories
-------------	---------------------

$0 \leq ES \leq 0,2$	Low
$0,2 \leq ES \leq 0,8$	Medium
$ES \geq 0,8$	High

(Source: Cohen, 1988)

## RESULTS AND DISCUSSION

In this study, the number of journal articles selected for analysis aligned with the research purpose is 10. According to the inclusion and exclusion criteria, complete relevant articles (n=10) were deemed suitable for analysis. The following is the complete data of the journal articles analyzed:

Table 3. Meta-analysis based on Title and Year of Publication.

No	Authors	Title	Year
1	Miftahul Khairi, M. Ali S., Abdullah	<i>Hubungan Keterampilan Proses Sains Dengan Hasil Belajar Siswa Melalui Pemanfaatan Media Alami Dipandu Modul Pada Submateri Invertebrata Di Mas Babun Najah Kota Banda Aceh.</i> (The Relationship between Science Process Skills and Students' Learning Outcomes through the Utilization of Natural Media Guided by Modules in the Invertebrate Sub-Topic at Mas Babun Najah, Banda Aceh City)	2016
2	Nismalasari, Santiani, and H.Mukhlis Rohmadi	<i>Penerapan Model Pembelajaran Learning Cycle Terhadap Keterampilan Proses Sains Dan Hasil Belajar Siswa Pada Pokok Bahasan Getaran Harmonis.</i> (The Implementation of Learning Cycle Model on Science Process Skills and Student Learning Outcomes in Harmonic Oscillation Topic)	2016
3	Santy Awalliyah, Parsaoran Siahaan, Muhammad Gina Nugraha, and Kartika Hajar Kirana	<i>Hubungan Keterampilan Proses Sains Dengan Penguasaan Konsep Serta Kaitannya Dengan Gaya Kognitif Field Dependent-Field Independent.</i> (The Relationship between Science Process Skills and Concept Mastery and its Relation to Field-Dependent/Field-Independent Cognitive Styles)	2015
4	Nirwana Elsa Putri, Berti Yolida, and Darlen Sikumbang	<i>Hubungan Pelaksanaan Praktikum Dan Keterampilan Proses Sains Terhadap Hasil Belajar Peserta Didik.</i> (The Relationship between Laboratory Practice and Science Process Skills on Student Learning Outcomes)	2019
5	Napis Markawi	<i>Pengaruh Keterampilan Proses Sains, Penalaran, Dan Pemecahan Masalah Terhadap Hasil Belajar Fisika.</i> (The Influence of Science Process Skills, Reasoning, and Problem Solving on Physics Learning Outcomes)	2015

No	Authors	Title	Year
6	Yusran Khery, Pahriah, Abdul K. Jailani, Abu Rizqiana, and Nurma A. Iswari	<i>Korelasi Keterampilan Proses Sains Dengan Hasil Belajar Mahasiswa Pada Praktikum Kinetika Reaksi.</i> (The Correlation between Science Process Skills and Student Learning Outcomes in Reaction Kinetics Laboratory Practice)	2019
7	Nuning Widya Astuti, Berti Yolida and Darlen Sikumbang	<i>Hubungan Praktikum Dan Keterampilan Proses Sains Terhadap Hasil Belajar Materi Ekosistem.</i> (The Relationship between Laboratory Practice and Science Process Skills on Learning Outcomes of Ecosystem Material)	2019
8	Najmah, Khaeruman, and Yusran Khery	<i>Korelasi Antara Keterampilan Proses Sains Dengan Hasil Belajar Mahasiswa Pada Praktikum Sifat Koligatif Larutan.</i> (The Correlation between Science Process Skills and Student Learning Outcomes in Solution Colligative Properties Laboratory Practice)	2014
9	Nafisah Hanim and Auriza Satria Putri	<i>Korelasi Keterampilan Proses Sains Dengan Hasil Belajar Siswa SMA Melalui Implementasi Strategi Pembelajaran Inkuiri Terbimbing.</i> (The Correlation between Science Process Skills and High School Student Learning Outcomes through the Implementation of Guided Inquiry Learning Strategies)	2020
10	I Putu Artayasa, Herawati Susilo, Umi Lestari, and Sri Endah Indriwati	<i>Profil Keterampilan Proses Sains Dan Hubungannya Dengan Hasil Belajar Sains Mahasiswa.</i> (Science Process Skills Profile and Its Relationship to Student Learning Outcomes in Science)	2017

The details for calculating the effect size, which the researcher has conducted regarding the correlation between science process skills and learning outcomes, can be seen in [Table 4](#).

Table 4. Categories of the effect size of science process skills on learning outcomes.

Authors	r	N	z	Vz	Sez
Miftahul et al (2016)	0,874	31	1,350	0,036	0,189
Nismalasari et al (2016)	0,493	30	0,540	0,037	0,192
Santy et al (2015)	0,564	38	0,639	0,029	0,169
Nirwana et al (2019)	0,832	36	1,195	0,030	0,174
Napis (2015)	0,359	100	0,376	0,010	0,102
Yusran et al (2019)	0,174	138	0,176	0,007	0,086
nuning et al (2019)	0,775	24	1,033	0,048	0,218
Najmah et al (2014)	0,289	138	0,297	0,007	0,086
nafisah & Auriza (2020)	0,501	25	0,551	0,045	0,213
Artayasa et al. (2017)	0,413	65	0,439	0,016	0,127

The results in [Table 4](#) show the effect size of the correlation between science process skills and learning outcomes from ten different studies. The effect size values range from 0.174 to 0.874, indicating varying levels of correlation between the two variables.

To determine the overall effect size of the correlation, a meta-analysis was performed using the JASP application with a random effects model. The random effects model takes into account the variability in effect sizes across different studies and provides a more conservative estimate of the overall effect size.

The meta-analysis revealed a significant positive correlation between science process skills and learning outcomes ( $r = 0.484$ , 95% CI [0.392, 0.568],  $z = 7.69$ ,  $p < .001$ ). The effect size of the overall correlation was medium ( $ES = 0.484$ ). This result suggests that there is a moderate positive relationship between science process skills and learning outcomes in junior high and high school students.

It is important to note that the studies included in the meta-analysis were limited to those published in reputable national journals over the past eight years, with specific criteria for subject area and location. Therefore, these results may not be generalizable to other populations or contexts.

The result of this meta-analysis is consistent with a previous study by [Widianti et al. \(2021\)](#) that found a significant positive correlation between science process skills and cognitive learning outcomes in biology students who were taught using a guided inquiry learning model ( $r = 0.529$ ). This suggests that enhancing science process skills can improve students' understanding and achievement in science subjects across different levels and domains.

### Heterogeneity Test

Table 5. Heterogeneity Test

Fixed and Random Effects			
	Q	df	p
Omnibus test of Model Coefficient	4.595	1	0.032
Test of Residual Heterogeneity	2.003	9	0.991

Note. p-values are approximate.

[Table 5](#) shows the heterogeneity test for the meta-analysis of the relationship between science process skills and learning outcomes. The test was conducted using both fixed and random effects models. The omnibus test of model coefficients showed a significant result with a p-value of 0.032, indicating that the model is significant. However, the test of residual heterogeneity showed a non-significant result with a p-value of 0.991, indicating that the variability of the effect sizes cannot be explained by sampling error alone.

The overall result of the heterogeneity test is that the effect sizes of the analyzed studies are heterogeneous, as indicated by a Q-value of 2.003 and a p-value of less than 0.991. This means that there is variability in the effect sizes beyond what would be expected due to chance. Therefore, there may be factors other than science process skills that influence learning outcomes.

The analysis also identifies the potential for investigating moderator variables that affect the relationship between science process skills and learning outcomes. Moderator variables are factors that may influence the strength or direction of the relationship between two variables. By identifying and examining these factors, researchers can gain a better understanding of the relationship between science process skills and learning outcomes and develop more effective strategies for teaching and learning.

In comparison to [Karci \(2018\)](#), our study also focused on the effect of science process skills on learning outcomes, but we did not examine STEM education as a whole. Instead, we specifically looked at the correlation between science process skills and learning outcomes across different studies. Like [Karci \(2018\)](#), we found a positive relationship between the two variables, but our

focus was narrower in scope. In terms of moderator variables, [Karci \(2018\)](#) examined different variables such as grade level, duration of intervention, type of publication, and type of measurement, while we did not perform such analyses in our study. It would be interesting to explore whether these moderator variables have any influence on the relationship between science process skills and learning outcomes in future research.

In comparison to [Mukagihana et al. \(2022\)](#), our study focused on the effect of science process skills on learning outcomes, while they examined the effect of instructional methods on pre-service science teachers' learning outcomes. Our populations of interest were also different as they examined pre-service science teachers, while we examined studies with diverse populations. However, both studies found a positive relationship between the intervention and the outcome variables, indicating that interventions focused on developing science process skills or inquiry-based learning can have a positive impact on learning outcomes. In terms of moderator analyses, [Mukagihana et al. \(2022\)](#) examined different variables such as sample size, year of publication, and continent/country where the study was conducted, while we did not perform such analyses in our study. It would be beneficial to explore whether these moderator variables have any influence on the relationship between science process skills and learning outcomes in future research.

### Summary effect / Mean Effect Size

The result in Table 6 shows the summary effect or mean effect size of the relationship between science process skills and learning outcomes. The estimate coefficient of 0.459 indicates a medium effect size according to Cohen's Effect Size Classification Table ([Cohen, 1988](#)). The standard error of 0.214 and the z-value of 2.144 indicate that the estimate coefficient is significantly different from zero ( $p = 0.032$ ). The 95% confidence interval (CI) ranges from 0.039 to 0.879, which indicates that the true effect size is likely to fall within this range with 95% confidence.

Tabel 6. Summary effect

Coefficients						
	Estimate	Standard Error	z	p	Lower Bound	Upper Bound
intrcpt	0.459	0.214	2.144	0.032	0.039	0.979

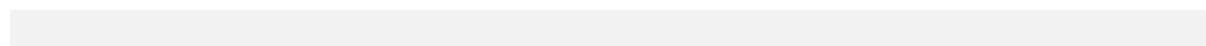
Note. Wald test.

This result indicates that science process skills have a significant positive correlation with learning outcomes, and the effect size is moderate. This finding is consistent with previous research in the field (e.g., [Karci, 2018](#); [Mukagihana et al., 2022](#)) that also found a positive relationship between science education and learning outcomes. However, it is important to note that the specific effect size may differ depending on the study population, intervention type, and other factors.

### Publication Bias Evaluation

Publication bias evaluation is a process in meta-analysis that assesses whether the studies included in the analysis represent a biased selection of all available studies. Publication bias occurs when studies that show no significant effect or negative results are less likely to be published, leading to an overestimation of the effect size in the meta-analysis.

To determine the presence of publication bias, a funnel plot and Egger's test were used, and the results obtained from processing in JASP software are as follows:



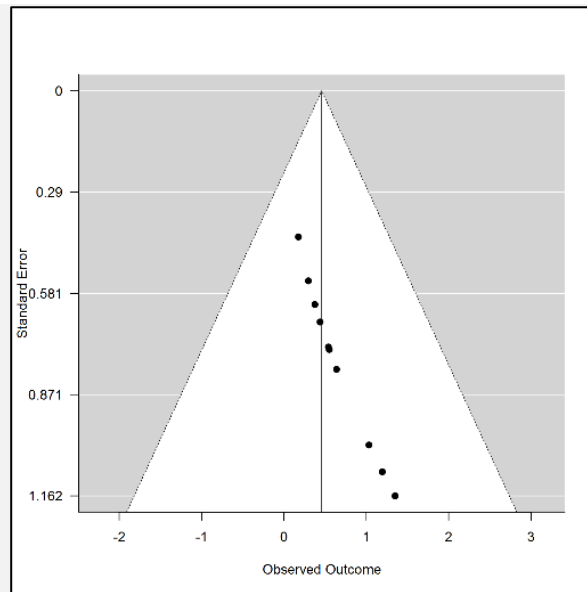


Figure 1. Funnel plot

The result of the funnel plot can be said to be symmetric. However, to provide further evidence, Egger's test was used to test the symmetry of the funnel plot.

Tabel 7. Funnel Plot

Regression test for Funnel plot asymmetry ("Egger's test")		
	z	p
sei	1.396	0.163

This result discusses the evaluation of publication bias in the meta-analysis study. Publication bias refers to the possibility that the findings of a study may be influenced by the selective publication of studies with significant results, while studies with non-significant results remain unpublished. To determine the presence of publication bias, the researchers used a funnel plot and Egger's test.

The funnel plot is a graphical representation of the standard error of each study's effect size against its corresponding effect size. It is used to assess the relationship between study size and effect size. If publication bias is present, it is expected that the funnel plot will be asymmetric, with smaller studies showing more significant effects than larger studies. In this study, the funnel plot displayed symmetry, which indicates that there is no publication bias issue.

To further confirm the symmetry of the funnel plot, Egger's test was performed. Egger's test is a regression test that examines the relationship between the precision of each study and its effect size. The result of Egger's test in this study showed a p-value of 0.163, which is greater than 0.05, indicating that there is no significant publication bias. Therefore, the study concludes that there is no evidence of publication bias in the meta-analysis study conducted.

## CONCLUSION

Based on the results and discussion, it can be concluded that the implementation of the STEM approach in biology learning can be examined from various categories such as learning models, materials, and their influence on students. The study has identified several models that can be used to implement the STEM approach, including Problem Based Learning (PBL), Project Based Learning (PjBL), Inquiry Based Learning, Discovery Learning, and Blended Learning. Additionally, teaching materials such as e-books, modules, LKS, LKPD, and books have been used in STEM-based biology learning.

The findings indicate that the application of the STEM approach is highly beneficial for biology learning in the 21st century. This is because the STEM approach comprises four components: science, technology, engineering, and mathematics, which enables students to solve problems using technology and assemble them into experiments that can prove scientific concepts, supported by data that has been managed mathematically.

Moreover, the use of STEM-based learning and teaching materials has been proven to enhance student learning outcomes, critical and analytical thinking skills, creativity, scientific literacy, and scientific thinking abilities. Therefore, the implementation of the STEM approach in biology learning is recommended to promote effective and innovative learning in the 21st century.

## ACKNOWLEDGEMENT

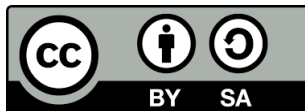
The researcher would like to express gratitude to Prof. Dr. Abdul Razak, M.Si, as the head of the Biology Education Master's Program at Padang State University. Additionally, the author would also like to extend appreciation to Dr. Zulyusri, MP, and Prof. Dr. Lufri, MS, as the supervisors of this research project.

## REFERENCES

- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale N.J.: L. Erlbaum Associates
- Wardani, E. F. & Kurnia, F. (2019). Analisis Kemampuan Literasi Sains, Sikap Ilmiah dan Merancang Mini Riset Mahasiswa PGSD STKIP Muhammadiyah Bangka Belitung pada Mata Kuliah Praktikum IPA. *Primary Education Journal Silampari*, 1(1), 13-23
- Hakan, A. & Robert, E.Y. (2016). Students Learning to Use the Skills Used by Practicing Scientists. *Eurasia Journal of Mathematics, Science & Technology Education*, 12(3): 513-525. <https://doi.org/10.12973/eurasia.2015.1395a>
- Harlen, W., & Qualter, A. (2004). *The teaching of science in primary schools (4th ed.)*. David Fulton Publishers.
- Heri, R., Ezi, A., Kartianom., Hasan, D., Rizqa, D, A. (2018). *Pengantar Analisis Meta*. Yogyakarta: Prama Publishing
- Hernandez, A. V., Marti, K. M., & Roman, Y. M. (2020). Meta-analysis. *Chest*, 158(1), S97-S102. <https://doi.org/10.1016/j.chest.2020.03.003>
- Hernani, Ahmad Mudzakir, & Siti Aisyah. (2009). Membelajarkan Konsep Sains-Kimia dari Perspektif Sosial untuk Meningkatkan Literasi Sains Siswa SMP. *Jurnal Pengajaran MIPA*, 13(1). 71-93.
- Artayasa, I. P., Susilo, H., Lestari, U., & Indriwati, S. E. (2017, May). Profil keterampilan proses sains dan hubungannya dengan hasil belajar sains mahasiswa Pendidikan Guru Sekolah Dasar. In *Seminar Nasional Teknologi Pembelajaran dan Pendidikan Dasar 2017* (pp. 706-714).
- Juhji, J., & Nuangchalerm, P. (2020). Interaction between science process skills and scientific attitudes of students towards technological pedagogical content knowledge. *Journal for the Education of Gifted Young Scientists*, 8(1), 1-16. <https://doi.org/10.17478/jegys.600979>
- Karci, M. (2018). *Examining the effect of using scenario-based teaching method based on STEM activities on students' achievement, career choice, and their motivation*. Unpublished Master Thesis, Çukurova University, Department of Education Faculty, Adana.

- Miftahul, K., Ali, S., Abdullah. (2016). Hubungan Keterampilan Proses Sains Dengan Hasil Belajar Siswa Melalui Pemanfaatan Media Alami Dipandu Modul Pada Submateri Invertebrata Di Mas Babun Najah Kota Banda Aceh. *Jurnal EduBio Tropika*, 4 (2): 49-52
- Muamar, M. R., Rahmi. (2017). Analisis Keterampilan Proses Sains dan Keterampilan Kognitif Siswa Melalui Metode Praktikum Biologi pada Sub Materi Schizophyta dan Thallophyta. *Jurnal Pendidikan Almuslim*, 5(1): 1-10.
- Mukagihana, J., Nsanganwimana, F., & Aurah, C. M. (2022). Effect of instructional methods on pre-service science teachers learning outcomes: a meta-analysis. *Education and Information Technologies*, 27(2), 2137-2163. <https://doi.org/10.1007/s10639-021-10696-9>
- Nafisah, H., Auriza, S. P., 2020. Korelasi Keterampilan Proses Sains Dengan Hasil Belajar Siswa SMA Melalui Implementasi Strategi Pembelajaran Inkuiri Terbimbing. *Prosiding Seminar Nasional Biotik*.
- Najmah., Khaeruman., Yusran, K. (2014). Korelasi Antara Keterampilan Proses Sains Dengan Hasil Belajar Mahasiswa Pada Praktikum Sifat Koligatif Larutan. *Jurnal Ilmiah Pendidikan Kimia Hydrogen*, 2 (2): 171-178. <https://doi.org/10.33394/hjkk.v2i2.647>
- Napis Markawi. (2015). Pengaruh Keterampilan Proses Sains, Penalaran, Dan Pemecahan Masalah Terhadap Hasil Belajar Fisika. *Jurnal Formatif*, 3(1): 11-25. <http://dx.doi.org/10.30998/formatif.v3i1.109>
- Nirwana, E.P., Berti, Y., Darlen, S. (2019). Hubungan Pelaksanaan Praktikum dan Keterampilan Proses Sains Terhadap Hasil Belajar Peserta Didik. *Jurnal Bioterdidik*, 7 (4) : 92-103. <http://dx.doi.org/10.23960/jbt>
- Nismalasari., Santiani., Mukhlis, R. (2016). Penerapan Model Pembelajaran Learning Cycle Terhadap Keterampilan Proses Sains Dan Hasil Belajar Siswa Pada Pokok Bahasan Getaran Harmonis. *Jurnal EduSains*, 4 (2): 74-94. <https://doi.org/10.23971/eds.v4i2.511>
- Nuning, W, A., Berti, Y., Darlen, S. (2019). Hubungan Praktikum dan Keterampilan Proses Sains Terhadap Hasil Belajar Materi Ekosistem. *Jurnal Bioterdik*, 7(5): 53-65.
- Padilla, M. J., Okey, J. R., & Garrard, K. (1984). The effects of instruction on integrated science process skill achievement. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, 21(3), 277-287. <https://doi.org/10.1002/tea.3660210305>
- Peterson, P. L., Baker, E., & McGaw, B. (2010). *International encyclopedia of education*. Elsevier Ltd..
- Purwanto. (2006). Psikologi Pendidikan. Bandung : PT Remaja Rosdakarya.
- Sanjaya, W. (2008), Perencanaan dan Desain Sistem Belajar, Jakarta : Kencana.
- Santy, A., Parsaoran, S., Muhammad, G, N., Kartika, H, K. (2015). Hubungan Keterampilan Proses Sains Dengan Penguasaan Konsep Serta Kaitannya Dengan Gaya Kognitif Field Dependent-Field Independent. *Jurnal Pengajaran MIPA*, 20 (2): 181-185. <https://doi.org/10.18269/jpmipa.v20i2.36242>
- Toharudin U., Hendrawati S., dan Rustaman A. (2014). Membangun Literasi Sains Peserta Didik. Humaniora: Bandung.

- Walsh, D., & Downe, S. (2005). Meta-synthesis method for qualitative research: a literature review. *Journal of advanced nursing*, 50(2), 204-211. <https://doi.org/10.1111/j.1365-2648.2005.03380.x>
- Widianti, F., Ibrohim, & Tenzer, A. (2021, March). Improvement of science process skills and students cognitive learning outcomes through implementation of guided inquiry learning model on biology subject. In *AIP Conference Proceedings* (Vol. 2330, No. 1, p. 030048). AIP Publishing LLC. <https://doi.org/10.1063/5.0043410>
- Winkel, W. S. (1987). *Psikologi Pengajaran*. Jakarta: Gramedia.
- Yusran, K., Pahriah., Abdul, J., Abu,R., Nurma,I. (2019). Korelasi Keterampilan Proses Sains Dengan Hasil Belajar Mahasiswa Pada Praktikum Kinetika Reaksi. *Jurnal Kependidikan Kimia*, 7(1): 46-53. <https://doi.org/10.33394/hjkk.v7i1.1686>



Copyright (c) 2022 by the authors. This work is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/).