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Molecular Docking and ADMET Prediction of Bioactive Compounds from *Centella asiatica*, Coenzyme Q10, and Ethyl Ascorbic Acid Targeting PPAR Receptors as Potential Antioxidant Agents

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Abstract: Excessive ultraviolet exposure induces oxidative stress that accelerates skin aging, yet effective natural modulators of antioxidant pathways remain limited. This study investigated the potential of bioactive compounds from *Centella asiatica*, Coenzyme Q10, and ethyl ascorbic acid as PPAR receptor agonists associated with antioxidant regulation. An in silico approach was applied using molecular docking with Molegro Virtual Docker and ADME prediction analysis. Docking performance was evaluated using rerank scores and interaction analysis with key amino acid residues. Coenzyme Q10 and ethyl ascorbic acid isomers showed the most negative rerank scores (−62.08 and −55.65 kcal/mol), indicating strong receptor affinity. Asiaticoside and madecassoside formed extensive hydrogen and steric interactions with Arg284 and His280. ADME analysis revealed that ethyl ascorbic acid exhibited optimal balance between solubility, permeability, and safety. These findings suggest that ethyl ascorbic acid and Coenzyme Q10 are promising candidates for antioxidant therapy through PPAR activation. This study provides computational evidence supporting the development of natural antioxidant agents targeting oxidative stress–related skin damage.

Keywords: *Centella asiatica*; Coenzyme Q10; Ethyl ascorbic acid; Molecular docking; PPAR-γ

Introduction

Ultraviolet (UV) radiation is a universal environmental factor that significantly contributes to oxidative stress and premature skin aging worldwide. Chronic exposure to UVA and UVB radiation induces excessive production of reactive oxygen species (ROS), which damage cellular macromolecules such as proteins, lipids, and DNA, ultimately accelerating photoaging and increasing the risk of skin disorders (Pathak, 2022). The imbalance between ROS generation and antioxidant defense is recognized as a major mechanism underlying degenerative skin changes and inflammatory responses. This oxidative imbalance not only affects skin integrity but also disrupts cellular signaling pathways involved in tissue repair and regeneration, thereby intensifying long-term dermatological deterioration (Poljsak et al., 2013; Briganti et al., 2024).

The human body maintains redox homeostasis through endogenous antioxidant systems involving enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase. Regulation of these antioxidant defenses is closely linked to Peroxisome Proliferator-Activated Receptors (PPARs), a family of nuclear receptors that modulate gene expression related to lipid metabolism, inflammation, and oxidative stress. Activation of PPAR-α and PPAR-γ has been shown to

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enhance antioxidant enzyme expression and cellular protection mechanisms, positioning PPARs as important molecular targets in anti-aging and dermatological therapies. Through transcriptional regulation, PPAR signaling contributes to cellular adaptation against oxidative injury and supports maintenance of skin homeostasis (Muzio et al., 2021; Camps et al., 2012).

Although numerous natural antioxidants have been reported to protect against UV-induced oxidative damage, their molecular mechanisms of interaction with PPAR receptors remain insufficiently explored. Compounds such as coenzyme Q10, ethyl ascorbic acid, and bioactive triterpenoids from *Centella asiatica* demonstrate strong antioxidant and skin-protective properties. Coenzyme Q10 functions as a mitochondrial antioxidant and supports cellular energy production, while ethyl ascorbic acid offers enhanced stability and bioavailability compared to conventional vitamin C. Meanwhile, *Centella asiatica* contains triterpenoids known for anti-inflammatory and regenerative activities. However, comparative evaluation of their receptor-binding affinity and pharmacokinetic suitability as PPAR modulators has not been comprehensively investigated using integrated computational approaches, creating a gap in understanding their targeted molecular potential (Buranasudja et al., 2021; Golonka et al., 2022).

Recent advances in computational drug discovery enable rapid screening of bioactive compounds through molecular docking and absorption, distribution, metabolism, excretion, and toxicity (ADMET) prediction, providing early insight into receptor interactions and pharmacokinetic behavior. These in silico techniques allow efficient identification of promising compounds before experimental validation, thereby accelerating the development of targeted therapeutic agents. Nevertheless, limited studies have simultaneously examined natural antioxidant compounds targeting PPAR receptors in the context of dermatological oxidative stress. Therefore, this study aims to evaluate the binding affinity and ADMET characteristics of active compounds from *Centella asiatica*, Coenzyme Q10, and ethyl ascorbic acid as potential PPAR agonists. This research is urgent for supporting the development of targeted antioxidant therapies and innovative dermatological formulations based on molecular evidence, contributing to more effective strategies for preventing oxidative skin damage (Sobhon et al., 2023; Thomsen & Christensen, 2006).

Method

Research Design, Time, and Location

This study employed a quantitative in silico computational research design using molecular docking and ADMET prediction approaches. The research was conducted from January to June 2025 at the Computational Chemistry Laboratory, University of Surabaya, using licensed molecular modeling software and validated online pharmacokinetic prediction platforms.

Population and Sample

The research population consisted of natural antioxidant compounds reported to interact with oxidative stress pathways. The sample included eight selected ligands: asiaticoside, madecassoside, asiatic acid, madecassic acid, coenzyme Q10, 2-O-ethyl ascorbic acid, 3-O-ethyl ascorbic acid, and ascorbic acid. The molecular structures of these compounds are presented in Figure 1. The target protein was the three-dimensional structure of Peroxisome Proliferator-Activated Receptor delta (PPAR-δ) obtained from the Protein Data Bank (PDB ID: 3GWX).

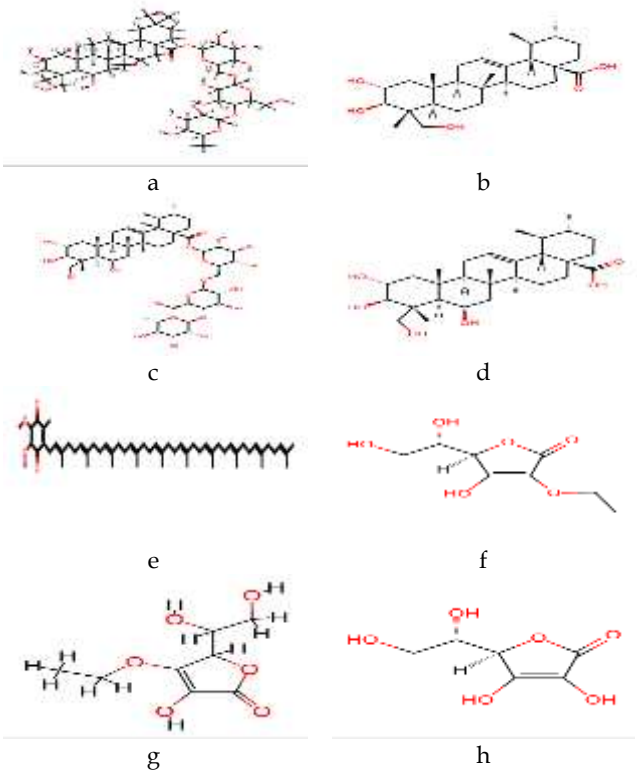

Figure 1. Chemical structure a) asiaticoside, b) asiatic acid, c) madecasosida, d) madesic acid, e) coenzyme Q10, f) 2-O-ethyl ascorbic acid, g) 2-O-ethyl ascorbic acid, h) ascorbic acid

Research Methods

This study integrated ligand preparation, receptor preparation, molecular docking simulation, and ADMET prediction. Molecular docking was performed to evaluate ligand–receptor binding affinity and interaction stability, while ADMET analysis was used to predict pharmacokinetic and toxicity profiles (Morris et al., 2009).

Research Stages

Compound Preparation

Three-dimensional (3D) structures of all ligands were retrieved from the PubChem database in Structure Data File (.sdf) format to ensure standardized molecular representations. The selected compounds included asiaticoside, madecassoside, asiatic acid, madecassic acid, Coenzyme Q10, 2-O-ethyl ascorbic acid, 3-O-ethyl ascorbic acid, and ascorbic acid. Each structure was imported into Chem3D software for geometry optimization using the Merck Molecular Force Field (MMFF94). This force field is widely used for small organic molecules because it provides reliable estimations of molecular energy and geometry. Energy minimization was performed iteratively until a stable lowest-energy conformation was achieved. This step was essential to eliminate steric strain and unrealistic bond angles, ensuring that the ligands adopted biologically relevant conformations prior to docking simulations (Trott & Olson, 2010).

Target Receptor Preparation

The three-dimensional crystal structure of Peroxisome Proliferator-Activated Receptor delta (PPAR-δ) with PDB ID 3GWX was obtained from the Protein Data Bank (PDB). Receptor preparation was conducted using Molegro Virtual Docker (MVD) version 7.0 to ensure proper docking conditions. All crystallographic water molecules, ions, and co-crystallized ligands were removed to prevent interference with ligand binding simulations. Hydrogen atoms were added to stabilize the protein structure, and partial charges were assigned according to the software's default parameters (Saputro et al., 2024). The active binding cavity was identified automatically and verified based on the position of the native ligand in the crystal structure. Proper receptor preparation is critical to maintain structural integrity and ensure accurate prediction of ligand–receptor interactions (Thomsen & Christensen, 2006).

Molecular Docking Simulation

Molecular docking simulations were performed using the MolDock Score [GRID] algorithm integrated in Molegro Virtual Docker. This algorithm applies a guided differential evolution search strategy to explore optimal ligand conformations within the receptor binding pocket. Each ligand was docked into the identified active site using standardized docking parameters, including multiple simulation runs to ensure reproducibility (Elkhattabi, 2023; Errington et al., 2025). The docking process generated several binding poses ranked according to MolDock scores, which represent estimated binding energies. Lower (more negative) MolDock scores indicate stronger predicted binding affinity and greater interaction stability (Thomsen & Christensen, 2006). Interaction analysis was conducted to identify hydrogen bonds, steric interactions, and key amino acid residues involved in ligand binding. The best docking pose for each compound was selected based on the lowest energy score and favorable interaction patterns (Saputro et al., 2024; Damale et al., 2019).

ADMET Prediction

Pharmacokinetic and toxicity properties of the selected compounds were evaluated using multiple computational prediction platforms. DeepPK software was used to estimate absorption and distribution parameters, including lipophilicity (logP) and topological polar surface area (TPSA), which influence membrane permeability. PASS Online was applied to predict the probability of biological activity spectra of the compounds. pkCSM was utilized to assess absorption, distribution, metabolism, excretion, and toxicity (ADMET) profiles using graph-based signatures (Pires et al., 2011). Drug-likeness was evaluated according to Lipinski's Rule of Five, which considers molecular weight, hydrogen bond donors and acceptors, and lipophilicity as indicators of oral bioavailability (Gheidari et al., 2024). Additionally, toxicity class predictions and lethal dose estimations were obtained using the Protox platform. The combined ADMET analysis provided a comprehensive evaluation of the pharmacokinetic suitability and safety profile of each compound (Karakoti et al., 2022).

The biological activity of the compounds was evaluated using PASS Online (Prediction of Activity Spectra for Substances) available at https://www.way2drug.com/PASSOnline/index.php. To assess potential toxicity and bioavailability parameters, further analysis was conducted through pkCSM (Predicting Small-Molecule Pharmacokinetic and Toxicity Properties Using Graph-Based Signatures) at https://biosig.lab.uq.edu.au/pkcsm/. Lipophilicity characteristics and drug-likeness were reviewed based on Lipinski's Rule of Five using the software available at http://www.scfbio-iitd.res.in/software/drugdesign/lipinski.jsp.

Additionally, toxic dose estimates and toxicity class predictions were obtained from the Protox platform. (https://tox.charite.de/protox3/#), which provides structure-based predictions of various toxicological parameters (Chang et al., 2023).

Result and Discussion

Docking Validation Based on RMSD Analysis

Validation of the docking protocol is a critical step to confirm that the computational method can accurately

reproduce ligand binding within the receptor active site. Root Mean Square Deviation (RMSD) analysis was used to compare the re-docked native ligand with its crystallographic position. RMSD values below 2 Å are widely accepted as indicators of reliable docking performance and accurate ligand orientation. This validation ensures that the docking parameters are suitable for screening the tested compounds (Najmi et al., 2023).

The RMSD values of native ligand Eicosapentaenoic Acid (EPA1) on PDB ID: 3GWX were 1,7308 ± 0,1914. The RMSD values were below 2 Å, confirming that the docking protocol was valid and reproducible. Similar RMSD thresholds have been reported in previous docking validation studies, where values under 2 Å indicate accurate prediction of ligand binding poses (Syamsul et al., 2022; Amiri et al., 2025). Therefore, the validated docking system was considered appropriate for further molecular interaction analysis.

Binding Affinity of Test Compounds Toward PPAR Receptor

Following docking validation, the binding affinities of the tested compounds toward the PPAR receptor were evaluated. Each ligand was docked three times to minimize computational variability and obtain reliable average rerank scores (Touny et al., 2025). Binding energy values (rerank scores) provide an estimation of ligand–receptor interaction strength, where more negative values indicate stronger predicted affinity (Rhahmadini et al., 2025).

The rerank scores of all compounds are presented in Table 1. The rerank score values indicate variations in binding affinity between each compound and the receptor. The compound with the most negative binding energy was 2-O-ethyl ascorbic acid (−62.0834 ± 1.877), followed by 3-O-ethyl ascorbic acid (−55.6501 ± 1.808) and ascorbic acid (−53.254 ± 0.590), indicating relatively strong binding affinities. Meanwhile, the native ligand (EPA1) showed a value of −100.262 ± 6.488, serving as a reference with the highest binding affinity.

In contrast, some compounds, such as asiatic acid (−31.5244 ± 8.899), exhibited weaker binding affinity. The high positive values observed for asiaticoside (868.749 ± 26.767), madecassoside (1008.626 ± 62.676), madesic acid (458.374 ± 5.771), and coenzyme Q10 (4590.527 ± 367.954) indicated less stable or unfavorable interactions with the receptor.

Table 1. The Rerank Scores of All Compounds

Compound name	Rerank score (kkal/mol)
Asiaticoside	868,749 ± 26,767
asiatic acid	-31,5244 ± 8,899
Madecasoside	1008,626 ± 62,676
madesic acid	458,374 ± 5,771
coenzyme Q10	4590,527 ± 367,954
2-O-ethyl ascorbic acid	-62,0834* ± 1,877
3-O-ethyl ascorbic acid	-55,6501* ± 1,808
Native ligand (EPA1)	-100,262 ± 6,488
Ascorbid acid	-53,254 ± 0.590

The interaction of test Compounds with amino acid Residues compared to the native ligand in PPAR Receptor (PDB ID: 3GWX) is presented in Table 2. This showed compounds that share similar amino acid residues with the native ligand exhibit better binding potential. 2-O-ethyl ascorbic acid, 3-O-ethyl ascorbic acid, and ascorbic acid shared key residues such as Arg 284, His 280, and Val 281, indicating good binding affinity. Asiatic acid and madesic acid showed more limited similarities, while asiaticoside, madecassoside, and coenzyme Q10 had fewer similarities with reference compound. In general, the greater the similarity of interacting residues with the native ligand, the better the potential interaction and biological activity (Azmal et al., 2024; Broccatelli & Brown, 2014).

Table 2. Interaction of Test Compounds with Amino Acid Residues Compared to the Reference Compound in the PPAR receptor (PDB ID: 3GWX)

Name compound	Hydrogen bond	Sterik bond
asiaticoside	Lys 265, Trp 264, Val 263, Arg 284, Asn 269, Gn 266, Gly 270, His 280, Ser 355, Leu 356, Leu 353, Phe 352	Lys 265, Trp 264, tyr 283, Arg 284, Asn 269, Leu 271, Gn 266, Gly 270, Leu 255, Ile 277, Val 281, His 280, Ser 355, Leu 356, Leu 353, Phe 352
asiatic acid	Val 279, his 280, phe 282, Ile 277, glu 276, arg 284	Val 279, lys 275, tyr283, leu 255, glu 258, trp 2 64, ala 258, ile 249, val 281, his 280, phe 282, Ile 277, glu 276, arg 284
madecasosida	Leu 262, gly 261, lys 260, val 263, glu 259	Trp 264, Leu 262, gly 261, ile 249, lys 260, leu 255, val 263, ala 258, glu 259, phe 352, arg 284, val 281, leu 353, asn 269, leu271, his 280, ile 277, val 279, phe 282, ser 278, thr 463, glu 276, tyr 283, phe 260, lys 257
madesic acid	Ser 278, phe 282, tyr 283, his 280, val 279, glu 276, ile 277	Ser 278, gln 266, phe 282, tyr 283, his 280, glu 259, arg 284, val 341, trp 264, val 348, val 279, glu 276, ile 277, ser 278
coenzyme Q10		Leu 262, trp 264, ser 278, thr 463, arg 357, glu 460, thr 459, thr 461, pro 359, phe360, val 279, ile 277, his 280, val 281, gln 266, leu 255, glu 259, val 263, arg 284, ala 258, gly 261,leu 262

Name compound	Hydrogen bond	Sterik bond
2-O-ethyl ascorbic acid	Arg 284, His 280, Val 281	Arg 284, His 280, Val 281, Glu 259, Trp 264, Leu 255, Ser 278, ile 277
3-O-ethyl ascorbic acid	Arg 284, gin266, his 280, glu 259	Leu 255, val 281, ile 277, ser 278, his280, arg284, glu 255, trp 254
Ascorbic acid	Val 281, his 280, arg 284	Val 281, his 280, arg 284, leu 255, glu 253

Physicochemical and ADME Properties

Evaluation of physicochemical parameters is important to predict compound absorption and bioavailability. Properties such as molecular weight, lipophilicity, hydrogen bonding capacity, and topological polar surface area influence membrane permeability and pharmacokinetic behavior. Balanced ADME characteristics are essential for therapeutic development.

The predicted physicochemical properties are presented in Table 3.

Table 3. Physicochemical Parameters Based on In Silico Predictions

Name compound	MW	Log P	RB	HBA	HBD	PSA
asiaticoside	959.133	-1,033	10	19	12	315.21
asiatic acid	488.709	5033	2	5	4	97.99
madecasosida	975.132	-2.062	10	20	13	335.44
madesic acid	504.708	4.004	2	6	5	118.22
coenzyme Q10	863,365	17.854	31	4	0	52.6
2-O-ethyl ascorbic acid	204.178	-0.929	4	6	3	96.22
3-O-ethyl ascorbic acid	204.178	-0.929	4	6	3	96.22
Ascorbic acid	176.124	-1.407	2	6	4	107.22

The analysis of predicted ADME parameters in Table 3 reveals significant differences in pharmacokinetic characteristics among the test compounds. Asiaticoside and madecassoside have very high molecular weights (959.13 and 975.13 Da, respectively) and large Topological Polar Surface Area (TPSA) values (>300 Å²), indicating high polarity and a low likelihood of passive cell membrane penetration. Nevertheless, their high number of hydrogen bond donors (HBD) and acceptors (HBA) support the formation of strong hydrogen bonds with the active site of PPAR receptors. Overall, these properties make asiaticoside and madecassoside more suitable for topical applications than for oral absorption.

On the other hand, Coenzyme Q10 is extremely lipophilic with a logP value of 17.854 and very high structural flexibility (31 rotatable bonds). Such a high logP suggests poor water solubility and limited oral absorption without a special delivery system, such as a lipid-based formulation. However, its low TPSA (52.6 Å²) supports cellular penetration if properly formulated.

Meanwhile, ethyl ascorbic acid (both 2-O and 3-O isomers) and ascorbic acid exhibit the most balanced ADME parameters. They have relatively low molecular weights (<210 Da), near-neutral logP values, and optimal TPSA (<107 Å²), supporting both oral absorption and skin penetration. Their moderate HBA and HBD values also allow for sufficient hydrogen bonding without compromising permeability.

Ethyl ascorbic acid derivatives demonstrated the most balanced ADME characteristics among the tested compounds, indicating favorable pharmacokinetic behavior. These compounds exhibited optimal molecular weight, polarity, and hydrogen bonding capacity, which are essential parameters for membrane permeability and oral bioavailability. Balanced solubility and permeability are critical factors in determining drug-likeness and biological effectiveness.

Previous pharmacokinetic studies have shown that stabilized derivatives of vitamin C possess improved chemical stability and enhanced transdermal and systemic delivery compared to native ascorbic acid. Research by Pullar et al. (2017) reported that vitamin C derivatives improve bioavailability and antioxidant performance due to increased molecular stability and cellular uptake. Similarly, demonstrated that modified vitamin C compounds exhibit enhanced penetration properties, supporting their pharmaceutical and cosmetic applications (Makrantonaki & Zouboulis, 2007).

In contrast, large glycosidic compounds such as asiaticoside and madecassoside showed high molecular weight and elevated polar surface area, which may limit passive diffusion across biological membranes. Previous studies on Centella asiatica phytochemicals indicate that these glycosides are more suitable for topical formulations due to restricted systemic permeability but strong local antioxidant and anti-inflammatory activity (Gray et al., 2018; Aszrin et al., 2024). These findings are consistent with the current ADMET prediction results.

The results revealed that madecassoside and asiaticoside were highly effective in their molecular

interactions with PPAR receptors but have limited permeability, making them more suitable for topical use. Coenzyme Q10 has the strongest receptor affinity but presents pharmacokinetic challenges due to its extreme lipophilicity. Ethyl ascorbic acid and ascorbic acid offer the most balanced profiles in terms of affinity, solubility, and distribution, making them promising candidates for both systemic and dermatological antioxidant therapy.

Toxicity Prediction

Safety evaluation represents an essential stage in early drug discovery to minimize potential adverse effects before experimental validation. Computational toxicity prediction provides an efficient approach to screen mutagenicity, hepatotoxicity, and skin sensitization risks. All tested compounds were assessed using in silico toxicity platforms to estimate their safety profiles. The predicted toxicity profiles are summarized in Table 4.

The computational results indicate that none of the evaluated compounds exhibit predicted mutagenic or hepatotoxic effects. This outcome is consistent with experimental toxicological studies reporting the safety of natural antioxidant compounds. For instance, safety evaluations of Centella asiatica extracts have demonstrated low toxicity and good tolerability in biological systems (Johnson et al., 2023; Orhan, 2012). Likewise, Coenzyme Q10 has been widely documented as a safe antioxidant with minimal adverse effects in clinical applications (Hidaka et al., 2008). Vitamin C and its derivatives are also recognized for their high safety margin and low toxicity in pharmacological use (Pullar et al., 2017).

These findings collectively support the continued development of the studied compounds as potential antioxidant agents targeting PPAR receptors.

Table 4. Predicted Toxicity Profiles of Test Compounds

Compound name	Ames toxicity	Hepatotoxicity	Skin sensitization	LD_{50} (mg/kg, oral)[2]	Class tox
Asiaticoside	No	No	No	2000	4
Asam asiatika	No	No	No	2000	4
Madecassoside	No	No	No	5000	5
Asam madekasik	No	No	No	2000	4
Coenzym Q10	No	No	No	5000	5
2-O-Asam etil askorbat	No	No	No	2000	4
3-O-Asam etil askorbat	No	No	No	2000	4
Asam askorbat	No	No	No	2000	4

Conclusion

The in silico study results demonstrated that asiaticoside, madecassoside, Coenzyme Q10, and ethyl ascorbic acid exhibit potential as PPAR receptor agonists associated with antioxidant gene regulation. Molecular docking analysis confirmed that these compounds interact with key active-site residues of the PPAR receptor, including Arg284, His280, and Tyr283. Coenzyme Q10 and ethyl ascorbic acid isomers showed the strongest binding affinity, while ADME predictions indicated that ethyl ascorbic acid presents the most balanced pharmacokinetic profile in terms of solubility, bioavailability, and safety. From a broader scientific perspective, these findings support the exploration of natural antioxidant compounds as modulators of PPAR signaling pathways in dermatological and oxidative stress–related therapies. The identification of ethyl ascorbic acid as a promising candidate may contribute to the development of targeted antioxidant formulations with improved therapeutic efficacy and safer pharmacological profiles. Molecular docking and ADMET predictions cannot fully capture the complexity of biological interactions in living systems, including receptor dynamics, metabolism, and cellular responses. Therefore, future research should focus on in vitro and in vivo experimental studies to validate receptor activation, antioxidant activity, and safety profiles. Further investigation into formulation strategies, drug delivery systems, and long-term pharmacokinetic behavior is also necessary to optimize the clinical application of these compounds.

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Author Contributions

Conceptualization, D.K. and N.L.D.A; methodology, N.K., D.K. and N.L.D.A; conduct of the experiment, N.K; writing—original draft preparation, N.K., D.K. and N.L.D.A.; writing—review and editing, N.K., D.K. and N.L.D.A.; supervision, D.K. and N.L.D.A.

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Conflicts of Interest

The authors declare no conflict of interest.

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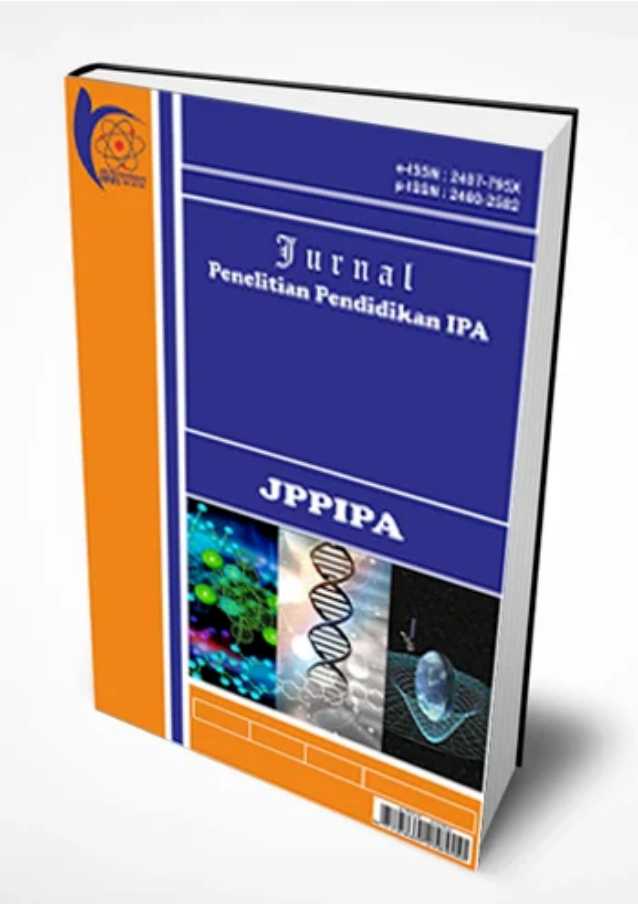

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Research Articles Review

Section: **Research Articles** Open Access Peer Reviewed

Development of Deep Learning-Oriented Google Sites Interactive Learning Media to Support SDG 4: Quality Education in High School English Learning

Rosnilawati , Alwen Bentri , Zelhendri Zen , Mutiara Felicita Amsal , Rayendra

1-5

DOI: 10.29303/jppipa.v12i6.15080
Statistics: 20 | 39
Citations 0

PDF

Epistemological Beliefs about Physics Learning: The Role of Gender, Grade Level, and Ethnicity Background toward Quality and Inclusive Education

Oktavina Pandango , Sentot Kusairi , Sujito

6-14

DOI: 10.29303/jppipa.v12i6.14855
Statistics: 5 | 23
Citations 0

PDF

Transforming Academic Emotions and Critical Thinking Through Augmented Reality in PBL: A Rasch Stacking-Racking Analysis

Khaerani , Lukman A.R Laliyo , Rustam I Husain

15-21

DOI: 10.29303/jppipa.v12i6.15194
Statistics: 6 | 12
Citations 0

PDF

The Effectiveness of Digital Teaching Materials Based on Cognitive Conflict Integrated with Augmented Reality and Nias Ethnoscience to Improve Critical Thinking in Work and Energy

Elman Ikhtiar Ronaldo Waruwu , Fatni Mufit , Asrizal , Emiliannur

22-29

DOI: 10.29303/jppipa.v12i6.15115
Statistics: 18 | 19
Citations 0

PDF

Soil Insect Diversity and Community Structure as Bioindicators in the Semi-Arid Ecosystem of Madapangga Nature Park, Indonesia

Olahairullah , Ariyansyah , Mulisa

30-40

DOI: 10.29303/jppipa.v12i6.15282
Statistics: 7 | 15
Citations 0

PDF

Development of Teaching Materials to Improve Student Learning Outcomes Using Learning Videos for Grade V Elementary School

Emi Liarni , Ramalis Hakim , Abna Hidayati , Zuwirna

41-46

DOI: 10.29303/jppipa.v12i6.12460

Statistics: 4 | 8

Citations 0

PDF

Promoting Critical Thinking through an SDG-Integrated STEAM E-Module for Grade X High School Students

Pauzi , Rayendra , Abna Hidayati , Ulfia Rahmi

47-52

DOI: 10.29303/jppipa.v12i6.12484

Statistics: 4 | 6

Citations 0

PDF

Development and Expert Validation of the PjBL-STEAM-IC Model for SOLO-Based Thinking Skills and Environmental Awareness in Coastal Schools

Srilesnawati Lalusu , Elya Nusantari , Frida Maryati Yusuf , Abubakar Sidik Katili , Hartono Mamu , Muhammad Rifai Katili , Masra Latjompoh

53-64

DOI: 10.29303/jppipa.v12i6.14704

Statistics: 4 | 9

Citations 0

PDF

Development of Deep Learning-Based E-LKPD in Physics Learning to Improve Critical Thinking and Creative Thinking Skills of High School Students

Linda Khoiro , Yohandri , Fatni Mufit , Emiliannur

65-72

DOI: 10.29303/jppipa.v12i6.15156

Statistics: 8 | 14

Citations 0

PDF

Quality Stability of Spent Laying Hen Patties Supplemented with Lemongrass Powder During Refrigerated Storage for Sustainable Meat Product Development

Nimas Dwi Sukmawardani , Herly Evanuarini , Dedes Amertaningtyas , Ria Dewi Andriani , Eko Widodo

73-82

DOI: 10.29303/jppipa.v12i6.15213

Statistics: 8 | 13

Citations 0

PDF

Development of a Multimedia-Oriented Problem-Based Learning Model to Support SDG 4: Quality Education for Grade IV Elementary School Students

Endang Saputra , Alwen Bentri , Jasrial , Ulfia Rahmi , Rayendra

83-88

DOI: 10.29303/jppipa.v12i6.15059

Statistics: 6 | 6

Citations 0

PDF

Application of Utopia and Graxpert AI in Studying Celestial Objects to Support Research and Education Interests at the High School Level, and Public Outreach

Iwan Maryawan , Robiatul Muztaba , Herpratiwi , Sowiyah , Melya Riniarti , Ririn Andriyani , Aditya Abdillah Yusuf

89-96

DOI: 10.29303/jppipa.v12i6.14499
Statistics: 5 | 16
Citations 0

PDF

Development of SDG-Oriented Natural and Social Sciences Teaching Materials Using Mind Mapping for Grade IV Elementary School Students

Idrus Salam , Ramalis Hakim , Darmansyah , Zelhendri Zen

97-101

DOI: 10.29303/jppipa.v12i6.12476
Statistics: 1 | 4
Citations 0

PDF

The Challenges of New Town Development at High-Speed Rail Transit Oriented Development: Case of Jakarta–Bandung HSR

Raden Anggara , Hayati Sari Hasibuan , Chrisna T Permana

102-111

DOI: 10.29303/jppipa.v12i6.15202
Statistics: 6 | 8
Citations 0

PDF

Analysis of Factors Affecting Rubber Production in Koto Alam Village, Pangkalan Koto Baru District, Lima Puluh Kota Regency, West Sumatra Province

Helentina Situmorang , Ermi Tety

112-117

DOI: 10.29303/jppipa.v12i6.15344
Statistics: 4 | 5
Citations 0

PDF

STEM-PBL Instructional Materials to Support Quality Education through Chemical Literacy in Thermochemistry

Dwy Puspita Sari , Mutiara Agustina Nst , Ani Sutiani , Ratu Evina Dibyantini , Alfira Julian Pratiwi

118-127

DOI: 10.29303/jppipa.v12i6.15152

Statistics: 5 | 10

Citations 0

PDF

Guided Inquiry with STEAM: Fostering Critical Thinking on Fluid Statics Concepts

Prima Warta Santhalia , Diane Noviandini

128-135

DOI: 10.29303/jppipa.v12i6.14876

Statistics: 3 | 7

Citations 0

PDF

Nanogel Formulation of Butterfly Pea Flower Extract (Clitoria ternatea L.) Against Propionibacterium acnes Bacteria Inhibitory Test

Niluh Puspita Dewi , Radhika , Magfirah , Indah Kurnia Utami , Yasinta Rakanita , Nur Ramadhani , Nuraisya , Ni Ketut Marlina

136-145

DOI: 10.29303/jppipa.v12i6.15211

Statistics: 16 | 11

Citations 0

PDF

From Biomass Waste to Functional Iron Oxides: Mechanistic Understanding, Structure Engineering, and Environmental Applications

Dewi Kurnianingsih Arum Kusumahastuti , November R. Aminu , Agung R. Gintu , Emmanuel Hernanda Yustisia Susanto , Gecia Ovi Wulandari

146-155

DOI: 10.29303/jppipa.v12i6.14780

Statistics: 11 | 12

Citations 0

PDF

Correlation Analysis between Understanding Biochemistry Concepts and Chemistry Education Students' Problem-Solving Skills through Validated HOTS Instruments

Mariati , Insan Nuhari

156-163

DOI: 10.29303/jppipa.v12i6.14982

Statistics: 11 | 9

Citations 0

PDF

Nested-local Wisdom Model for Sustainable Science Education: Enhancing Students' Conceptual Knowledge and Communication Skills

Andi Asmar , I Gusti Putu Suryadarma , Yuliyanti , Lakilo Laruli

164-176

DOI: 10.29303/jppipa.v12i6.13865

Statistics: 5 | 6

Citations 0

PDF

Impact of Plant Growth Promoting Rhizobacteria (PGPR) on Nitrogen Uptake and Yield of Palu Local Shallots

Lisa Indriani Bangkele , Sri Sudewi , Idris , Ratnawati , Arfan

177-184

DOI: 10.29303/jppipa.v12i6.14802

Statistics: 7 | 13

Citations 0

PDF

The Influence of Augmented Reality-Based Play Activities on Children's Social and Emotional Skill Moderated by Parental Involvement

Kusmaladewi , Jamil

185-190

DOI: 10.29303/jppipa.v12i6.15266

Statistics: 19 | 12

Citations 0

PDF

Development of an E-Module Adapted to the Independent Curriculum Informatics Subject on the Basic Elements of Technology and Information for Phase E Grade 10 Students

Afri Ola Dewi , Hendri , Yasdinul Huda , Rizky Ema Wulansari

191-196

DOI: 10.29303/jppipa.v12i6.12564

Statistics: 6 | 7

Citations 0

PDF

The Effects of Tourist Activities on Bird Species Diversity in the Tambing Lake Area, Lore Lindu National Park, Central Sulawesi, Indonesia

Sustri , Sri Ningsih , Naharuddin , Rukmi , Alam Ansary

197-205

DOI: 10.29303/jppipa.v12i6.15129

Statistics: 8 | 8

Citations 0

PDF

Physical and Chemical Characteristics of Soil in the Habitat of Gymnostoma rumphianum (Miq.) L.A.S. Johnson in Tojo Una-Una Regency, Central Sulawesi

Rahmawati , Yusran , Zulkaidhah , Retno Wulandari , Rukmi , Ramadanil Pitopang

206-216

DOI: 10.29303/jppipa.v12i6.15120

Statistics: 1 | 8

Citations 0

PDF

Isolation and Antibacterial Activity Test of Lactid Acid Bacteria (LAB) from Pliek U and Pliek U Oil (Minyeuk Brok)

C Yulvizar , Y S Ismail , Amalina , S Mahzura , S A Zazila , A Haq , Fahrinnisa

217-222

DOI: 10.29303/jppipa.v12i6.14942

Statistics: 7 | 7

Citations 0

PDF

Development of a Web-Based CBT Worksheet for Routine Motorcycle Maintenance

Naufal , Arwizet K , Wawan Purwanto , Ika Parma Dewi , Abdul Habib Arrasyidi Desky

223-230

DOI: 10.29303/jppipa.v12i6.15243

Statistics: 3 | 4

Citations 0

PDF

An Analysis of the Needs for Developing a CPS–EIS (Collaborative Problem Solving for Environmental Issue-Based Socio-Scientific Issues) Based Environmental Change E-Module as an Effort to Improve Students' Critical Thinking Skills

Endah Pratiwi , Baskoro Adi Prayitno , Umi Fatmawati

231-240

DOI: 10.29303/jppipa.v12i6.14893
Statistics: 4 | 7
Citations 0

PDF

The Effect of Liquid Organic Fertilizer Made from Gamal Leaves (Gliricidia sepium) on the Growth of Stone Begonia (Begonia sp.) Cuttings

Rahmi , Ramal Yusuf , Nadine , Rahmat , Moh. Ilwan

241-246

DOI: 10.29303/jppipa.v12i6.15235
Statistics: 1 | 14
Citations 0

PDF

Synergistic Effect of Amino Acids and NPK on Growth Dynamics, Yield Components, and Grain Productivity of Inpari 32 Rice Variety (Oryza sativa L)

Tita Kartika Dewi , Wirja , Chalvyn Silasa Pakidi , Ida Marina , Mukhlis

247-259

DOI: 10.29303/jppipa.v12i6.15131
Statistics: 4 | 4
Citations 0

PDF

The Effect of Android-Based Learning and Learning Motivation on Learning Outcomes in Computer Science in the 10th Grade at SMK Negeri 1 Sumatera Barat

Novita Sari , Rizky Ema Wulansari , Syahril , Ika Parma Dewi , Abdul Habib Arrasyidi Desky , Liza Mahera

260-266

DOI: 10.29303/jppipa.v12i6.15001
Statistics: 6 | 5
Citations 0

PDF

Qualitative and Quantitative Traits of Thin Tail Ewes in Bojonegoro East Java, Indonesia

Irida Novianti , Mashudi , M. Halim Natsir , Poespitasari H. Ndaru , Veronica Margareta Ani Nurgiartiningsih , Sambas Widiyanto

267-271

DOI: 10.29303/jppipa.v12i6.4662

Statistics: 4 | 3

Citations 0

PDF

Optimizing Sustainable Wastewater Treatment: Kinetic and Parametric Study of Methylene Blue Removal Using Electrocoagulation

Amir Husin , Dermala Tito A , Fadhila Fadhila , Lies Setyowati , Deny Supriharti

272-278

DOI: 10.29303/jppipa.v12i6.15127

Statistics: 2 | 3

Citations 0

PDF

Chemistry Identity Profiles Across Entry Cohorts Among Prospective Chemistry Teachers: Implications for Quality Education

Azwa Fadilla Wafiq , Oktavia Sulistina , Anugrah Ricky Wijaya

279-290

DOI: 10.29303/jppipa.v12i6.14799

Statistics: 4 | 5

Citations 0

PDF

Advancing SDG 4 Quality Education: Needs Analysis and Automated PjBL Essay Assessment Design for Projek IPAS in Vocational High Schools

Sayid Juni Riauan , Darmansyah , Zelhendri Zen , Fetri Yeni J

291-300

DOI: 10.29303/jppipa.v12i6.15088

Statistics: 6 | 3

Citations 0

PDF

Integration of Local Potential in Project-Based Learning: Its Impact on Critical Thinking and Scientific Attitudes of Students of SMAN 1 Darussalam

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301-310

DOI: 10.29303/jppipa.v12i6.15170

Statistics: 6 | 5

Citations 0

PDF

Affective–Cognitive Disparity in Contextual Science Learning: Evidence from Baduy Local Wisdom

Eiftien Yuliar Rasyidin , Asri Widowati , Ismail Fikri Natadiwijaya

311-324

DOI: 10.29303/jppipa.v12i6.15241

Statistics: 6 | 5

Citations 0

PDF

Bridging the Gap in Abstract Biology Concepts: A Needs Analysis for STEM-Integrated Argument-Driven Inquiry (ADI) Photosynthesis Learning

Fitriyani , Neni Hasnunidah , Kartini Herlina , Chansanah Diawati , Noor Fadiawati

325-336

DOI: 10.29303/jppipa.v12i6.14445

Statistics: 2 | 2

Citations 0

PDF

Enhancing Educational Quality Through the P4 Budgeting Model Based on BAA: A SWOT Perspective

Sonny Muhammad Ikhsan Mangkuwinata , Marwan , Munawar , Saiful Bahri , Najmudin , Jamaluddin

337-346

DOI: 10.29303/jppipa.v12i6.15251

Statistics: 12 | 6

Citations 0

PDF

Local Wisdom-Based Rice Field Conservation Through Meugoe Customary Practices in Aceh Besar, Indonesia

Evi Apriana , Erdi Surya , Nurul Akmal , Elvrida Rosa , Elfa Yeni

347-354

DOI: 10.29303/jppipa.v12i6.14900

Statistics: 4 | 3

Citations 0

PDF

Virtual Reality Media in IPAS: A Problem-Based Learning Development Study for Grade 5 Students' Critical Thinking

Lailatuz Zahra , Desyandri , Ardipal , Yeni Erita

355-362

DOI: 10.29303/jppipa.v12i6.15047

Statistics: 5 | 5

Citations 0

PDF

Development of Canva-Based Digital Physics Worksheets on Motion to Enhance Students' Scientific Literacy

Eni Sumanti Nasution , Sri Utami Kholilla Mora Siregar , Kasmawati , Randy Sanjaya , Ferawati Artauli Hasibuan

363-373

DOI: 10.29303/jppipa.v12i6.15128

Statistics: 3 | 6

Citations 0

PDF

Fostering Humanistic Decision-Making in Elementary Science Education Amid Artificial Intelligence Disruption: A Case Study of a School Principal

Abubakar , Aspin , Eko Saputra Nurdiansyah

374-383

DOI: 10.29303/jppipa.v12i6.15511

Statistics: 9 | 11

Citations 0

PDF

Development of an Ethno-STEM Integrated Problem Based Learning Physics E-Module to Improve High School Students' Creative Thinking Skills

Gusdilam Sari , Usmeldi , Desnita , Akmam

384-394

DOI: 10.29303/jppipa.v12i6.15237

Statistics: 4 | 4

Citations 0

PDF

Development of Science Teaching Materials Assisted by Augmented Reality to Improve Students' Ability in V Grade

Firstyansa Heriyanto , Eka Titi Andaryani

395-403

DOI: 10.29303/jppipa.v12i6.14384
Statistics: 3 | 4
Citations 0

PDF

The Integration of Fiqh and Science through Inquiry-Based Learning in the Merdeka Belajar Curriculum

Mahyarni Junida Nasution , Risnawati , Alpizar

404-413

DOI: 10.29303/jppipa.v12i6.14999
Statistics: 2 | 3
Citations 0

PDF

The Relationship Between Science Literacy and Critical Thinking Skills Among Students at Public Senior High Schools in Bone Regency

Andi Nurhidayah , Eda Lolo Allo , Halimah Husain

414-421

DOI: 10.29303/jppipa.v12i6.15648
Statistics: 5 | 3
Citations 0

PDF

Effects of PQ4R-Based Microlearning on Scientific Literacy and Biology Achievement: A Quasi-Experimental Study Controlling Prior Knowledge

Andi Nurfaizah Yusuf , Firdaus Daud , Ismail , Rachmawaty , Faisal

422-431

DOI: 10.29303/jppipa.v12i6.15098
Statistics: 14 | 6
Citations 0

PDF

Exploring Students' Perceptions and the Need for STEM-Based Games Box Learning Media on Environmental Pollution to Support Creative Thinking in High School Physics

Selvia Mariska Syahputri , Ida Sriyanti , Ismet

432-440

DOI: 10.29303/jppipa.v12i6.15089

Statistics: 3 | 5

Citations 0

PDF

The Effect of Self-Concept and Achievement Motivation on Students' Biology Learning Outcomes in Public Senior High Schools

Tri Widya Ramadhani AY , Muhiddin Palennari , Muhammad Arsyad , Firdaus Daud , Halimah Husain

441-451

DOI: 10.29303/jppipa.v12i6.14995

Statistics: 6 | 2

Citations 0

PDF

Digital Extension Strategies for Empowering Rice Farmers in West Bangka Regency Admid The Agricultural of Era 4.0 Transformation

Yulia , Robika , Fika Dewi Pratiwi

452-459

DOI: 10.29303/jppipa.v12i6.15543

Statistics: 11 | 8

Citations 0

PDF

Needs Analysis for the Development of a Contextual Physics Interactive E-Module Based on Deep Learning to Enhance Critical Thinking Skills

Etri Alga Vrimesty , Ratnawulan , Ahmad Fauzi , Emiliannur
460-467

DOI: 10.29303/jppipa.v12i6.15111
Statistics: 4 | 3
Citations 1

PDF

Heyzine Flipbook Based E-Book for Enhancing Students' Critical Thinking Skills of Junior high school: A Study Development

Sriyanti , Eges Triwahyuni , I Wayan Wesa Atmaja
468-475

DOI: 10.29303/jppipa.v12i6.14968
Statistics: 5 | 5
Citations 0

PDF

The Effect of Learning Attitudes and Study Habits on Students' Biology Learning Outcomes in Public Senior High Schools

Nabila Nur Syahirah , Muhiddin Palennari , Muhammad Arsyad , Firdaus Daud , Halimah Husain
476-485

DOI: 10.29303/jppipa.v12i6.15037
Statistics: 5 | 6
Citations 0

PDF

Development of Augmented Reality-Assisted Learning Materials on the Coordination System to Enhance Systems Thinking Skills

Yesica Renita Putri , Dewi Lengkana , Noor Fadiawati , Viyanti
486-492

DOI: 10.29303/jppipa.v12i6.14418
Statistics: 4 | 9
Citations 0

PDF

Electronic Nose-Based Classification of Breath Odor in Fasting and Non-Fasting Individuals Using Principal Component Analysis

Imam Tazi , Muthmainnah , Wiwis , Yahya , Yusril

493-497

DOI: 10.29303/jppipa.v12i6.14994

Statistics: 9 | 9

Citations 0

PDF

Assessing the Integration of Environmental Management Systems and Green Supply Chain Management for Sustainable Supply Chains: A Green SCOR Gap Analysis

Putu Widya Purnama Dewi , I Made Gunamantha , Dewa Made Atmaja

498-511

DOI: 10.29303/jppipa.v12i6.15832

Statistics: 7 | 3

Citations 1

PDF

The Impact of Land Use on Flood Management: A Case Study of the Banjir Kanal Barat River in Semarang with HEC-RAS

Shevananda Arifianto , Ussy Andawayanti , Sumiadi

512-523

DOI: 10.29303/jppipa.v12i6.15149

Statistics: 5 | 8

Citations 1

PDF

Integrating Augmented Reality Based Comics into Chemical Bonding Instruction to Enhance Students' Thinking Skills

Risqah Amaliah Kasman , Muhammad Fuad , Hastuti Agussalim , Imranah Imranah , Muhamad Fadli , Nudia Tuljannah , Siti Yasya Ey Fathanah

524-530

DOI: 10.29303/jppipa.v12i6.15189

Statistics: 5 | 4

Citations 0

PDF

An Intelligent Curriculum Management and Career Development Framework Integrating AI and Competency Standards in TVET

Nurtjahyadi , Deviana Ridhani , Syahril , Sukardi , Refdinal , Rijal Abdullah , Elfi Tasrif

531-543

DOI: 10.29303/jppipa.v12i6.15114

Statistics: 9 | 9

Citations 0

PDF

The Effect of Arabica Coffee Extract (Coffea arabica L.) on the Expression of Inflammatory Biomarkers and Histopathological Features of the Liver-Pancreas in Alloxan-Induced Diabetic Mice

Suyarta Efrida Pakpahan , Putri Miftahur Rizki , Putri Najwa Az-Zahra , Rendi Ramdhani

544-553

DOI: 10.29303/jppipa.v12i6.15586

Statistics: 13 | 7

Citations ?

PDF

Game Based Learning in The Context of Physical Education in Indonesia

Rohmad Subagio , Yayat Ruhiat , Nani Maryani

554-558

DOI: 10.29303/jppipa.v12i6.15233

Statistics: 18 | 11
Citations ?

PDF

PhET-Aided Blended Problem Based Learning Rotation Model to Improve Junior High School Students' Higher-Order Thinking Skills

Rai Sujanem , K. Suma , P. Yasa , I. Yuliana , P. Sarini

559-569

DOI: 10.29303/jppipa.v12i6.14040
Statistics: 9 | 11
Citations 0

PDF

Carrying Capacity Based on Environmental Services for Food Supply in Talaga City

Talha Dangkua , Sofyan Muzakir Djibu , Ahmad Syamsu Rijal S , Irawan Matalapu , Indrawan , Karina Meiyanti Maulana

570-582

DOI: 10.29303/jppipa.v12i6.15161
Statistics: 5 | 7
Citations 0

PDF

Curriculum Construction of Traditional Islamic Boarding Schools in Padang Lawas Regency, North Sumatra Province

fahmi Anwar Nasution , Mas'ud Zein , Alpizar Alpizar

583-593

DOI: 10.29303/jppipa.v12i6.15002
Statistics: 13 | 6
Citations 0

PDF

The Relationship Between Socioeconomic Status and Public Perception of Waste Management and the Quality of Environmental Sanitation in Makassar District, Makassar City

St. Nuryati R , Firdaus Daud , Halimah Husain , Muhiddin Palennari , Muhammad Arsyad

594-602

DOI: 10.29303/jppipa.v12i6.15000

Statistics: 13 | 8

Citations 0

PDF

The Relationship between Discipline and Learning Motivation and the Science Learning Achievement of State Junior High School Students in Luwu Regency

Fadhilah Utami A , Firdaus Daud , Halimah Husain , Muhiddin Palennari , Muhammad Arsyad

603-612

DOI: 10.29303/jppipa.v12i6.15265

Statistics: 10 | 3

Citations 0

PDF

Toward a Pedagogically Driven Framework for Designing a Socioscientific Inquiry-Based Learning (SSIBL) Digital Platform

Muhamad Yusup , Hamdi Akhsan , Murniati , Devi Ardiantini , Desilawati

613-625

DOI: 10.29303/jppipa.v12i6.14941

Statistics: 2 | 2

Citations 0

PDF

The Influence of Emotional Intelligence, Learning Independence, and Learning Motivation on Science Learning Outcomes of Junior High School Students in

State Schools

Alifya Suci Poetry Naf'an , Muhiddin Palennari , Muhammad Arsyad , Firdaus Daud , Halimah Husain

626-636

DOI: 10.29303/jppipa.v12i6.15038

Statistics: 6 | 5

Citations 0

PDF

Ecological index of gastropods in the Tananan River, Mamasa Regency

Andi Nur Samsi , Irnayanti Bahar

634-640

DOI: 10.29303/jppipa.v12i6.14137

Statistics: 6 | 2

Citations 0

PDF

Integrating Islamic Psychology and Developmental Neuroscience in Early Childhood Islamic Education: A Holistic Fitrah-Based Approach

Nurhayati , Juni Mahanis , Yuli Fatimah Warosari

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DOI: 10.29303/jppipa.v12i6.14970

Statistics: 7 | 3

Citations 0

PDF

Genetic Parameters of Quantitative Characters OF Self-Produced Lines of the Fifth Generation of Corn Plants in Dry Land

I Wayan Sutresna , I Wayan Sudika , Dwi Ratna Anugrahwati

649-654

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Statistics: 3 | 4

Citations 0

PDF

Development of Quality Criteria and Proposed Specification Limits for Moringa Leaf Powder Through an Integrated Stakeholder and Evidence-Based Approach

Windri Widyaningsih , Mulyorini Rahayuningsih , Muslich

655-670

DOI: 10.29303/jppipa.v12i6.15861

Statistics: 7 | 6

Citations 0

PDF

Integrating STEM and Deep Learning in Renewable Energy Learning to Foster Elementary Students' Scientific Literacy

Najla Delfina Andarawan , Wati Sukmawati

671-679

DOI: 10.29303/jppipa.v12i6.15602

Statistics: 9 | 10

Citations 0

PDF

Effectiveness of C-R-E-A-T-E Model based on Deep Learning, ESD, and AI to Build High School Students' Multiple Creativity in Green Chemistry

Wawan Wahyu , Rosi Oktiani

680-688

DOI: 10.29303/jppipa.v12i6.15238

Statistics: 8 | 8

Citations 0

PDF

Development of Augmented Reality (AR) Based Pop-Up Book Interactive Learning Media to Improve Class V Science Learning Outcomes

Sasa Mutmainah , Sri Sami Asih

689-698

DOI: 10.29303/jppipa.v12i6.15280

Statistics: 3 | 4

Citations 0

PDF

Land Suitability Evaluation for Rubber Cultivation on Hilly Land in Nagari Sitanang, Lareh Sago HalabanDistrict, Lima Puluh Kota Regency, West Sumatra

Riza Syofiani , Dyah Puspita Sari , Giska Oktabriana

699-709

DOI: 10.29303/jppipa.v12i6.15444

Statistics: 1 | 8

Citations 0

PDF

Analysis of the Suitability of Quick-Type Hand Tractors and Power Requirements for Wetland Cultivation in Lima Puluh Kota Regency, West Sumatra Province

Zulnadi , Irwan A , Sri Lismawati

710-718

DOI: 10.29303/jppipa.v12i6.15153

Statistics: 4 | 3

Citations 0

PDF

Development of E-Teaching Materials for Science on the Topic of the Form of Matter and Its Changes Integrated with Ethnoscience with the Help of Augmented Reality to Improve the Learning Outcomes of Elementary School Students

Fatza Hermayanti , Ani Rusilowati

719-731

DOI: 10.29303/jppipa.v12i6.15165
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Citations 0

PDF

Optimizing Lime Mordant Conditions for Cotton Dyeing with Dragon Fruit Peel Extract

Syamsuddin , Jusman , Indriani , Ni Ketut Sumarni , Yulina Christien Morokuhi

732-739

DOI: 10.29303/jppipa.v12i6.8474
Statistics: 19 | 13
Citations 0

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The Potential of South Sumatra Local Wisdom as a Source of Science Learning in Schools to Education Sustainable Development

Elsi Adelia Fitri , Anggie Marsyaelina , Demi Romawina

740-752

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Statistics: 23 | 17
Citations 0

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Education Environment as a Preventive Measure Pollution Plastic waste

Asramid Yasin

753-758

DOI: 10.29303/jppipa.v12i6.15475
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Citations 0

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The Effect of Complete Feed on Dry Matter Intake (DMI), Crude Protein Intake (CPI) and Metabolite Status in Female Fat-Tail Sheep

Poespitasari Hazanah Ndaru , Veronica Margareta Ani Nurgiartiningsih , M. Halim Natsir , Mashudi , Irida Novianti , John Miftah Ahmad

759-766

DOI: 10.29303/jppipa.v12i6.4659

Statistics: 14 | 5

Citations 0

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Breast Pain Reduction Techniques Using Cabbage Leaves

Uswatun Kasanah , Ana Rofika , Eviyati Aini Muriana , Irfana Tri Wijayanti , Retno Wulan , Iin Tri Marlinawati

767-774

DOI: 10.29303/jppipa.v12i6.15081

Statistics: 12 | 9

Citations 0

PDF

The Effect of Knowledge and Attitudes on Waste Management among the Community in Manggala District, Makassar City

Dewi Yuyun , Muhiddin Palennari , Muhammad Arsyad , Firdaus Daud , Halimah Husain

775-782

DOI: 10.29303/jppipa.v12i6.14993

Statistics: 12 | 5

Citations 0

PDF

Development of a Google Sites-Based Escape Room Media in Science Learning for Grade VIII Junior High School

Syamsuriyani , Firdaus Daud , Halimah Husain , Muhiddin Palennari , Muhammad Arsyad

783-792

DOI: 10.29303/jppipa.v12i6.14947
Statistics: 6 | 4
Citations 0

PDF

Development of a Local-Content-Based Interactive Science E-Book in Chemistry Education: Matter and Its Changes Material to Enhance Elementary School Students' Science Literacy

Nena Puspita Sari , Helmi Suardi , Budi Rizka

793-800

DOI: 10.29303/jppipa.v12i6.12877
Statistics: 2 | 3
Citations 0

PDF

The Effect of Microalgae Extract as a Biostimulant on Arabica Coffee (Coffea arabica L.) Callus Induction

Patria Prasasya , Sutini , Saefur Rohman

801-809

DOI: 10.29303/jppipa.v12i6.14746
Statistics: 2 | 4
Citations 0

PDF

The Impact of the Expository Method on Biology Learning Activities and Outcomes in Class XI

Risnawati , Firdaus Daud , Halimah Husain , Muhiddin Palennari , Muhammad Arsyad

810-818

DOI: 10.29303/jppipa.v12i6.15019
Statistics: 11 | 4
Citations 0

PDF

The Relationship between Parental Involvement and Learning Motivation with Science Learning Achievement of Public Junior High School Students in Kendari City

Adinda Maharani , Muhiddin Palennari , Muhammad Arsyad , Firdaus Daud , Halimah Husain

819-829

DOI: 10.29303/jppipa.v12i6.15039

Statistics: 7 | 3

Citations 0

PDF

Development of Inclusive-Adaptive Disaster Mitigation Educational Media Based on Audio Visual and Sign Language to Improve Self-Rescue for Students with Disabilities

Serly Mahoklory

830-835

DOI: 10.29303/jppipa.v12i6.15182

Statistics: 9 | 3

Citations 0

PDF

A Comparison of the SAVI and VAK Learning Models on IPAS Learning Outcomes in Grade 5

Aby Rafdi Auzan Ramadhan , Ika Yatri

836-844

DOI: 10.29303/jppipa.v12i6.15867

Statistics: 0 | 0

Citations 0

PDF

Ethnobiological Study of Postpartum Ritual Plants and Animals of the Malay Tribe in Semalah Village, Kapuas Hulu Regency

Desi Ratnasari , Surya Aspita , Hilda Aqua Kusuma Wardhani , Agus Muliadi

845-857

DOI: 10.29303/jppipa.v12i6.13788

Statistics: 1 | 3

Citations 0

PDF

Practical Tools Review Based on Physics, Chemistry, and Biology Parameters to Train Systems Thinking Skills

Nur Ainun Hariyanto , Kartini Herlina , Chansyanah Diawati , M. Setyarini

858-863

DOI: 10.29303/jppipa.v12i6.13079

Statistics: 0 | 2

Citations 0

PDF

Development of Physics Electronic Student Worksheets (E-LKPD) based on Problem Based Learning (PBL) to Improve Critical Thinking Skills of Grade X Students

Nisrina Hasna Mustofa , Pujianto , Jumadi

864-873

DOI: 10.29303/jppipa.v12i6.11675

Statistics: 0 | 2

Citations 0

PDF

Analysis of Cost Factors and Family Motivation on Adherence to Follow-up Treatment for Patients After Cardiac Catheterization at NTB Provincial Hospital

Heri Herdiansyah Akbar , Saimi , M. Karjono

874-880

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Statistics: 1 | 1
Citations 0

PDF

Acid-Catalyzed Synthesis of Biodiesel from Calabash (Crescentia cujete) Seed Oil

Nelson Gaspersz , Matheis F. J. D. P. Tanasale , Chalvin Marco Paula , Mimi Salamawati , Priska Marisa Pattiasina

881-891

DOI: 10.29303/jppipa.v12i6.13763
Statistics: 2 | 3
Citations 0

PDF

Species Diversity and Morphological Identification of Freshwater Shrimps in Lentic and Lotic Ecosystems of Ogan Ilir Regency

Stilaf Terbit Galih Walsandy , Arum Setiawan , Kodri Madang

892-898

DOI: 10.29303/jppipa.v12i6.15160
Statistics: 4 | 4
Citations 0

PDF

The Effect of Project-Based Learning (PjBL) Integrated with STEAM on the Creative Thinking Skills of Fifth-Grade Elementary School Students Regarding the Human Respiratory System

Camilia Habibah , Wati Sukmawati

899-907

DOI: 10.29303/jppipa.v12i6.15787
Statistics: 0 | 1
Citations 0

PDF

Enhancing Fifth-Grade Students' Conceptual Understanding of the Human Respiratory System Through the PAREPIA Teaching Aid

Firda Ruhul Aflah , Wati Sukmawati

908-917

DOI: 10.29303/jppipa.v12i6.15863

Statistics: 0 | 1

Citations 0

PDF

Hoek & Brown Collapse Criteria Method on The Road Section of Lende Tovea Village, Sirenja District, Donggala Regency

Muhammad Sarjan Djalil , Muslimin U. Botjing , Nunik Rezkiarti Janat

918-924

DOI: 10.29303/jppipa.v12i6.15350

Statistics: 1 | 0

Citations 0

PDF

Gelam Wood Design as a Water Level Measurement Sensor to Support Green Electronics Realization

Khairul Saleh , Iskhaq Iskandar , Assaidah

925-933

DOI: 10.29303/jppipa.v12i6.11738

Statistics: 1 | 0

Citations 0

PDF

Molecular Docking and ADMET Prediction of Bioactive Compounds from Centella asiatica, Coenzyme Q10, and Ethyl Ascorbic Acid Targeting PPAR Receptors as Potential Antioxidant Agents

Nur Khofifah , Dini Khofifah , Ni Luh Dewi Aryani

934-941

DOI: 10.29303/jppipa.v12i6.12362

Statistics: 7 | 0

Citations 0

PDF

The Implementation of Science Process Skill (SPS)-based Matriculation to Equalize Scientific Literacy of Prospective Elementary Teacher

Hanifah Mulyani , Rizki Hadiwijaya Zulkarnaen , Nenden Permas Hikmatunisa , Iik Iklimah , Tiar Mutiarani

942-931

DOI: 10.29303/jppipa.v12i6.12963

Statistics: 1 | 1

Citations 0

PDF

The Effectiveness of Project-Based Learning in Developing Sustainability Awareness and Critical Skills in High School

Ni Gusti Ayu Putu Eka Sri Wahyuni , Emy Nuriyani , Ebi Rahmat Indar Maya , Nurasyah Dewi Napitupulu , I Komang Werdhiana

952-957

DOI: 10.29303/jppipa.v12i6.13861

Statistics: 1 | 0

Citations 0

PDF

The Influence of Mind Mapping Learning Strategies on Creativity and Sustainability Awareness of Elementary School Students in Motion Energy Learning

Hana Adawiyah , Wati Sukmawati
958-969

DOI: 10.29303/jppipa.v12i6.15865
Statistics: 0 | 0
Citations 0

PDF

Advancing SDG 4 Through AI-Integrated Deep Learning Project-Based Learning: Enhancing Critical Thinking Skills and Scientific Literacy Among Primary School Teacher Education Students

Dedi Holden Simbolon , Eka Kartika Silalahi , Rupina Magdalena br Tarigan
970-985

DOI: 10.29303/jppipa.v12i6.15005
Statistics: 7 | 2
Citations 0

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Application of The Case-Based Method to Critical Thinking Based on Learning Motivation in Students of The Population Geography Course

Yurni Suasti , Rahmanelli , Bigharta Bekti Susetyo , Bayu Wijayanto , Ahyuni
986-998

DOI: 10.29303/jppipa.v12i6.15449
Statistics: 2 | 5
Citations 0

PDF

Local Wisdom in Traditional Medicinal Plant Utilization: An Ethnobotanical Study in Sonraen Village, Kupang Regency

Nur Aini Bunyani , Eleonora A.P Hija , Abdonia Finmeta , Nardi Leo
999-1005

DOI: 10.29303/jppipa.v12i6.15421
Statistics: 1 | 2
Citations 0

PDF

Effectiveness of Science Evaluation Questions on Animal Classification Material on Learning Outcomes and Problem Solving of Third Grade Elementary School Students

Esti Suciati , Elyas Djufri , Didi Supriadi

1006-1012

DOI: 10.29303/jppipa.v12i6.14535

Statistics: 1 | 2

Citations 0

PDF

Supporting SDG 11 Through Green Stormwater Infrastructure: SWMM-Based Flood Mitigation in a Tropical Watershed

Anik Sarminingsih , Nurhaliza Prasetyani , Andito Dharma Atmaja , Adrian Hartanto , Budi Prasetyo Samadikun

1013-1024

DOI: 10.29303/jppipa.v12i6.15480

Statistics: 2 | 2

Citations 0

PDF

The Effectiveness of Implementing PBL and Susan Loucks Horsley Syntax Combination with the Deep Learning Approach to Science Process Skills in Junior High School

Rosaniya E Rehiara

1025-1033

DOI: 10.29303/jppipa.v12i6.15296

Statistics: 0 | 2

Citations ?

PDF

Consumption-Based Water Footprint Analysis of Food and Non-Food Sectors for Sustainable Management of the Jambo Aye Watershed

Nabila Sam Dwitara , Purwana Satriyo , Syahrul

1034-1043

DOI: 10.29303/jppipa.v12i6.14912

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