

# Mobile Based Learning to Enhance Attitudes and Knowledge About Herpetofauna in Prospective Biology Teachers

Dian Samitra<sup>1\*</sup>, Endang Widi Winarni<sup>2</sup>, Fitria Lestari<sup>1</sup>

<sup>1</sup> Biology Education Program, Universitas PGRI Silampari, Lubuklinggau, Indonesia.

<sup>2</sup> Department of Elementary Education, Universitas Bengkulu, Bengkulu, Indonesia.

Received: February 20, 2024

Revised: May 04, 2024

Accepted: June 20, 2024

Published: June 30, 2024

Corresponding Author:

Dian Samitra

[dsamitra@unpari.ac.id](mailto:dsamitra@unpari.ac.id)

DOI: [10.29303/jppipa.v10i6.7268](https://doi.org/10.29303/jppipa.v10i6.7268)

© 2024 The Authors. This open access article is distributed under a (CC-BY License)



**Abstract:** Students and the public have a negative perception or dislike of herpetofauna. The solution to this problem is to introduce herpetofauna through mobile learning. The research aimed to determine the effect of mobile based learning towards attitudes and knowledge about herpetofauna in prospective biology teachers. The research method used Pre-experimental Design with the form of research one-group Pretest Posttest Design. Attitude data was collected using questionnaires and knowledge using tests. The data obtained were analyzed using the Wilcoxon Signed Rank Test. The research results obtained asymp. Sig 0.00 < 0.05. There are differences in attitudes between men and women. It can be concluded that mobile based learning to enhance attitudes and knowledge about herpetofauna in prospective biology teachers.

**Keywords:** Attitude; Herpetofauna; Mobile learning; Online learning

## Introduction

In the 21<sup>st</sup> century technological progress is very rapid. This progress has implications for the curriculum, learning materials, learning resources and teaching process (Herzberg et al., 2023; Mardiana, 2020; Park & Kwon, 2023). These advances have also drastically changed learning patterns for teachers and students (Festiyed et al., 2023; Siahaan, 2020). In traditional learning using a blackboard, printed teaching materials have changed using technology. The integration of technology in learning has grown rapidly. The forms of technology that have been used in the learning process are e-learning, virtual laboratories, game-based learning, interactive multimedia (Alneyadi, 2019; Papanastasiou et al., 2019; Troussas et al., 2020).

Media or technology-based learning resources have the advantage of overcoming learning problems and facilitating learning activities (Jannah et al., 2020). The use of technology in learning has an impact on increasing motivation and self-confidence (Honarзад & Rassaei, 2019; Menon et al., 2020; Shanmugam &

Balakrishnan, 2019). Technology provides many advantages such as making education fascinating and facilitating students' engagement in learning (Zhang, 2022). Apart from that, the use of technology in learning improves the ability of learners with 21<sup>st</sup>-century skills (Roemintoyo et al., 2022).

Learning media can facilitate students in increasing understanding, knowledge and literacy (Dibyantini et al., 2023; Alika & Radia, 2021; Bustanil et al., 2019). This is because when learning using technology, the senses of sight and hearing work to obtain information (Chan et al., 2023; Yafie et al., 2020). Apart from that, technology-based teaching media plays an important role in developing attitudes (Isnaeni et al., 2021). A positive attitude towards animals is one of the learning outcomes in biology learning.

Attitudes towards animals will have an impact on conservation and the environment. It is hoped that the understanding given about animals and the environment will raise awareness to learn to be responsible and have a positive attitude towards the environment. The more often conservation values are

### How to Cite:

Samitra, D., Winarni, E. W., & Lestari, F. (2024). Mobile Based Learning to Enhance Attitudes and Knowledge About Herpetofauna in Prospective Biology Teachers. *Jurnal Penelitian Pendidikan IPA*, 10(6), 3092-3098. <https://doi.org/10.29303/jppipa.v10i6.7268>

given to students, the more positive impact it will have on environmental sustainability.

In fact, research results show that students and the public have negative perceptions or dislike towards herpetofauna (Brom et al., 2020; da Silva et al., 2023; de Oliveira et al., 2019; Pereira et al., 2023). Herpetofauna will be chased and killed by humans (da Silva et al., 2021). All of this happens because of fear, cultural differences, emotional reactions, and lack of knowledge (Frynta et al., 2023; Riós-Orjuela et al., 2020). The solution to this problem is to introduce herpetofauna through mobile learning.

Many studies have been conducted on the use of mobile learning to improve process skills, critical thinking skills, interest in independent learning and literacy (Bakhri et al., 2023; Demir & Akpınar, 2018; Kurniasih et al., 2020; Nuri et al., 2023; Talakua & Elly, 2020). However, research into the effect of using mobile learning on attitudes and knowledge towards herpetofauna has never been carried out. For this reason, research needs to be carried out with the aim of finding out the effect of mobile learning on attitudes and knowledge towards herpetofauna.

**Method**

*Research Design*

The research uses the Pre-experimental Design method with the One-Group Pretest Posttest Design. The research stages in figure 1, the experimental class used in the research carried out a pre-test to determine initial knowledge and attitudes. Then the class was given treatment with mobile learning in the lesson. After that, a posttest is held to find out the final results, so that the conditions before and after can be compared. Participants in this research were 20 students (16 women and 4 men) taking vertebrate zoology courses at Biology Education, Universitas PGRI Silampari in 2023.



**Figure 1.** Research design

*Instruments and Data Analysis*

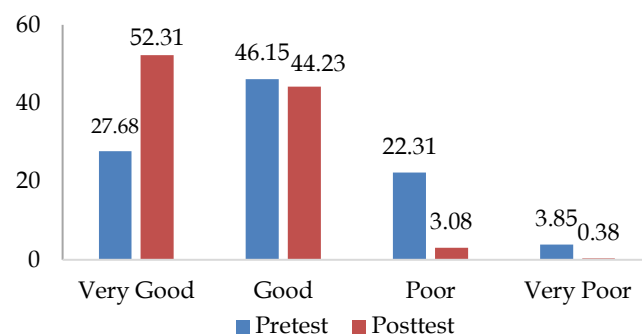
The instruments used in this research were questionnaires to measure attitudes and essay tests to measure knowledge. The questionnaire contains several parts. The first part, gender, and sources of information about herpetofauna. The second part measures attitudes towards herpetofauna. The attitude instrument framework towards herpetofauna was adapted from Herzog et al. (2015). The instruments used are constructively and empirically valid. Attitude and

knowledge data were analyzed using the Wilcoxon Signed Rank Test using the SPSS 25.0.

**Result and Discussion**

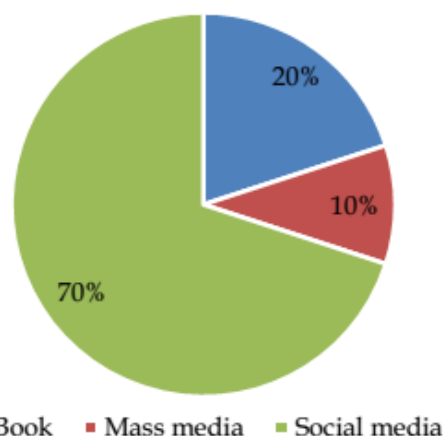
*Attitudes towards Herpetofauna*

Based on the questionnaire given to students, attitude data towards herpetofauna was obtained (Figure 1). After using mobile learning, students' attitudes towards herpetofauna changed. Students who gave good responses decreased by 1.92%, unfavorable responses decreased by 19.23% and unfavorable responses decreased by 3.47%. This decrease had a good impact because students who had very good attitudes increased by 24.63%.

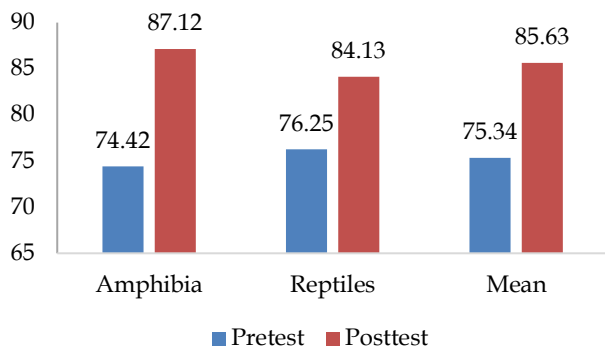


**Figure 2.** Student attitudes towards herpetofauna

The existence of poor and unfavorable attitudes towards herpetofauna is likely influenced by the source of initial information obtained by students. Social media is the dominant source of information (Figure 3). Social media contains information that has not been verified, so it can cause misinformation for students.



**Figure 3.** Sources of information about herpetofauna



**Figure 4.** Student attitude data before and after using mobile learning

In Figure 4, the overall data on student attitudes towards herpetofauna before using mobile learning was an average of 75.34%. After using mobile learning, it became 85.53%. This increase is confirmed by analysis using the Wilcoxon Signed Rank Test to obtain asymp. Sig 0.00 < 0.05 (Table 1). From the results of this analysis, it can be interpreted that there is an influence of mobile learning on students' attitudes towards herpetofauna.

**Table 1.** Results of Attitude Analysis towards Herpetofauna

Test Statistics <sup>a</sup>	
Z	Post - Pre -3.922 <sup>b</sup>
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test  
b. Based on negative ranks.

Improved attitudes because in mobile learning there is verified information. This information causes changes in students' attitudes towards herpetofauna, for example the information that not all snakes are venomous. This is reinforced by the statement of Nilsson et al. (2020) information influences attitudes and behavior. Media are tools to support students' learning experiences (Fajri et al., 2024; Wideasanti et al., 2023). Furthermore, the existence of activities in mobile learning that guide students to learn outside the classroom and come into direct contact with herpetofauna causes students' attitudes to change. This is reinforced by the statement of Pirchio et al. (2021), learning outside the classroom can develop positive attitudes.

Attitude data between students based on gender towards herpetofauna has differences in every aspect (Tables 2 and 3). Female students have lower interest and concern compared to male students. However, the aspect of appreciating the scientific method in solving herpetofauna problems is higher for female students than for male students. Gender influences almost all dimensions of attitudes and knowledge towards

animals. Men and women have different emotions and knowledge towards animals (da Silva et al., 2021). This difference also includes a phobia of herpetofauna whose members are venomous animals. This is confirmed by research results that fear and disgust cause a person to become phobic about herpetofauna (Landová et al., 2020; Rádlová et al., 2020).

**Table 2.** Data on Attitudes of Men and Women towards Amphibians

Aspect	Men		Women	
	Pretest	Posttest	Pretest	Posttest
Interest	71.24	89.25	70.53	84.37
Caringness	81.25	93.75	75.39	87.50
Appreciate the Scientific Method	87.50	87.50	82.03	90.62

**Table 3.** Data on Attitudes of Men and Women towards Reptiles

Aspect	Men		Women	
	Pretest	Posttest	Pretest	Posttest
Interest	82.14	85.71	65.84	81.25
Caringness	82.81	85.93	84.76	84.76
Appreciate the Scientific Method	75.00	87.50	87.50	89.84

Mobile learning contains herpetofauna material and learning activities. This information and activities can increase literacy regarding herpetofauna. This is in accordance with the statement from Rosidah et al. (2021) technology-based learning media can increase literacy. An increase in literacy causes changes in attitudes and motivation (Missa et al., 2023).

Education in schools is an important part of efforts to enhance conservation attitudes (Rahmadani et al., 2023; Ratnasari et al., 2022). Education can produce a better understanding of the benefits between protection and development, so that it can support preserving ecosystems (Saroyo et al., 2019; Torkar & Krašovec, 2019). Teachers who have good attitudes and understanding will cause students and society as a whole to have good attitudes and understanding as well (Nousheen et al., 2020). This happens because teachers transfer knowledge and attitudes to students and society.

*Knowledge of Herpetofauna*

Based on the results of tests carried out on students, data was obtained in table 4. The average student score before using mobile learning was 23.08. The average student score after using mobile learning was 87.60. Knowledge data analyzed by Wilcoxon Signed Rank Test obtained asymp. Sig 0.00 < 0.05 (Table 5). Based on the results of this analysis, it can be interpreted that there

is an influence of mobile learning on students' knowledge of herpetofauna.

**Table 4.** Knowledge Data about Herpetofauna

Learning Material	Pretest	Posttest
Amphibia	23.27	85.19
Reptiles	22.88	90.00
Mean	23.08	87.60

Increased knowledge because students learn using mobile learning teaching materials. Online-based learning has an impact on learning outcomes (Putri et al., 2021; Sukmawati et al., 2022). The results of this study are in line with the research results of Troussas et al. (2020), online learning media can increase knowledge.

**Table 5.** Results of Knowledge Analysis about Herpetofauna

Test Statistics <sup>a</sup>	Post - Pre
Z	-3.924 <sup>t</sup>
Asymp. Sig. (2-tailed)	.000
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Online learning media can increase knowledge. This is because online learning media can motivate student learning (Awwaliyah et al., 2021; Purwowidodo, 2023). Learning using learning media in the form of an Android-based application can enable student participation in class and can even access it at home or anywhere, facilitating the learning process without limits of time, space and place (Ardiansyah & Nana, 2020). Mobile learning has become a new choice for effective planning and learning strategies in an effort to achieve learning goals (Auliyah & Sari, 2021; Maasawet et al., 2023; Rahmat et al., 2023).

Prospective teachers who have attitudes and knowledge towards herpetofauna are expected to be able to transfer it to students. This causes the next generation to have good attitudes and knowledge towards herpetofauna. A teacher is obliged to educate students to be knowledgeable and sensitive to the environment, thereby making them have a better attitude towards natural resources (Larashati et al., 2022).

## Conclusion

Based on the results, it can be concluded that mobile based learning can improve the attitudes and knowledge of prospective biology teachers towards herpetofauna.

## Acknowledgments

Thank you to all parties who have helped in this research so that this article can be published.

## Author Contributions

All authors contributed to writing this article.

## Funding

No external funding.

## Conflicts of Interest

No conflict interest.

## References

- Alika, O., & Radia, E. H. (2021). Development of Learning Media Based on Cross Puzzle Game in Science Learning to Improve Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, 7(2), 173–177. <https://doi.org/10.29303/jppipa.v7i2.667>
- Alneyadi, S. S. (2019). Virtual lab implementation in science literacy: Emirati science teachers' perspectives. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(12). <https://doi.org/10.29333/ejmste/109285>
- Ardiansyah, A. A., & Nana, N. (2020). Peran Mobile Learning sebagai Inovasi dalam Meningkatkan Hasil Belajar Siswa pada Pembelajaran di Sekolah. *Indonesian Journal Of Educational Research and Review*, 3(1), 47–56. <https://doi.org/10.23887/ijerr.v3i1.24245>
- Auliyah, N., & Sari, P. M. (2021). Pengembangan Aplikasi Mobile Learning Appy Pie Android Berbasis Kemampuan Berpikir Kreatif di Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 3(6), 3866–3876. <https://doi.org/10.31004/edukatif.v3i6.1127>
- Awwaliyah, H., Rahayu, R., & Muhlisin, A. (2021). Pengembangan E-Modul Berbasis Flipbook Untuk Meningkatkan Motivasi Belajar Siswa Smp Tema Cahaya. *Indonesian Journal of Natural Science Education (IJNSE)*, 4(2), 516–523. <https://doi.org/10.31002/nse.v4i2.1899>
- Bakhri, S., Tsuroya, N. H., & Pratama, Y. (2023). Development of Learning Media with QuickAppNinja Android-Based (Guess Image & Find Words) to Increase Elementary School Teachers' Digital Literacy. *Jurnal Penelitian Pendidikan IPA*, 9(7), 4879–4884. <https://doi.org/10.29303/jppipa.v9i7.3574>
- Brom, P., Anderson, P., Channing, A., & Underhill, L. G. (2020). The role of cultural norms in shaping attitudes towards amphibians in Cape Town, South Africa. *PLoS ONE*, 15(2), 1–18. <https://doi.org/10.1371/journal.pone.0219331>
- Bustanil S, M., Asrowi, & Adianto, D. T. (2019).

- Pengembangan Media Pembelajaran Interaktif Berbasis Video Tutorial Di Sekolah Menengah Kejuruan. *JTP - Jurnal Teknologi Pendidikan*, 21(2), 119-134. <https://doi.org/10.21009/jtp.v21i2.11568>
- Chan, S. H. M., Qiu, L., & Xie, T. (2023). Understanding experiences in metaverse: How virtual nature impacts affect, pro-environmental attitudes, and intention to engage with physical nature. *Computers in Human Behavior*, 149, 107926. <https://doi.org/10.1016/j.chb.2023.107926>
- da Silva, A. R., Braga-Pereira, F., Borges, A. K. M., de Oliveira, J. V., da Silva, M. X. G., & Alves, R. R. N. (2023). Bioecological representations and social characteristics of students influence their attitudes toward wild vertebrates. *Journal of Ethnobiology and Ethnomedicine*, 19(1), 1-14. <https://doi.org/10.1186/s13002-023-00593-5>
- da Silva, M. X. G., Braga-Pereira, F., da Silva, M. C., de Oliveira, J. V., de Faria Lopes, S., & Alves, R. R. N. (2021). What are the factors influencing the aversion of students towards reptiles? *Journal of Ethnobiology and Ethnomedicine*, 17(1), 1-10. <https://doi.org/10.1186/s13002-021-00462-z>
- de Oliveira, J. V., Lopes, S. de F., Barboza, R. R. D., & Alves, R. R. N. (2019). To preserve, or not to preserve, that is the question: urban and rural student attitudes towards wild vertebrates. *Environment, Development and Sustainability*, 21(3), 1271-1289. <https://doi.org/10.1007/s10668-018-0083-5>
- Demir, K., & Akpınar, E. (2018). The effect of mobile learning applications on students' academic achievement and attitudes toward mobile learning. *Malaysian Online Journal of Educational Technology*, 6(2), 48-59. <https://doi.org/10.17220/mojet.2018.04.004>
- Dibyantini, R. E., Amdayani, S., Siregar, M. I., & Syafriani, D. (2023). Application of STEM-PjBL Based Chemistry Module to Improve Science Literacy and Student Learning Motivation. *Jurnal Penelitian Pendidikan IPA*, 9(SpecialIssue), 95-102. <https://doi.org/10.29303/jppipa.v9ispecialissue.5872>
- Fajri, N., Sriyati, S., & Rochintaniawati, D. (2024). *Global Research Trends of Digital Learning Media in Science Education : A Bibliometric Analysis*. *Jurnal Penelitian Pendidikan IPA*, 10(1), 1-11. <https://doi.org/10.29303/jppipa.v10i1.6248>
- Festiyed, Daulay, H., & Ridhatullah, M. (2023). Influence of Interactive Multimedia Teaching Materials on Cognitive Learning Outcomes of Students in Science Lessons: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, 9(8), 387-396. <https://doi.org/10.29303/jppipa.v9i8.2693>
- Frynta, D., Elmi, H. S. A., Rexová, K., Janovcová, M., Rudolfová, V., Štolhoferová, I., Král, D., Sommer, D., Berti, D. A., & Frýdlová, P. (2023). Animals evoking fear in the Cradle of Humankind: snakes, scorpions, and large carnivores. *Science of Nature*, 110(4). <https://doi.org/10.1007/s00114-023-01859-4>
- Herzberg, T. S., Rosenblum, L. P., Osterhaus, S. A., Larkin, S. K., & McBride, C. R. (2023). Online Synchronous Professional Development to Support Teachers of Students With Visual Impairments in Learning Nemeth Code Within Unified English Braille Contexts. *Journal of Visual Impairment & Blindness*, 117(6), 440-452. <https://doi.org/10.1177/0145482X231216>
- Herzog, H., Grayson, S., & McCord, D. (2015). Brief measures of the animal attitude scale. *Anthrozoos*, 28(1), 145-152. <https://doi.org/10.2752/089279315X14129350721894>
- Honarzad, R., & Rassaei, E. (2019). The role of efl learners' autonomy, motivation and self-efficacy in using technologybased out-of-class language learning activities. *JALT CALL Journal*, 15(3), 23-42. <https://doi.org/10.29140/jaltcall.v15n3.170>
- Isnaeni, W., Sujatmiko, Y. A., & Pujiasih, P. (2021). Analysis of the Role of Android-Based Learning Media in Learning Critical Thinking Skills and Scientific Attitude. *Jurnal Pendidikan IPA Indonesia*, 10(4), 607-617. <https://doi.org/10.15294/jpii.v10i4.27597>
- Jannah, M., Prasajo, L. D., & Jerusalem, M. A. (2020). Elementary School Teachers' Perceptions of Digital Technology Based Learning in the 21st Century: Promoting Digital Technology as the Proponent Learning Tools. *Al Ibtida: Jurnal Pendidikan Guru MI*, 7(1), 1. <https://doi.org/10.24235/al.ibtida.snj.v7i1.6088>
- Kurniasih, S., Darwan, D., & Muchyidin, A. (2020). Menumbuhkan Kemandirian Belajar Matematika Siswa Melalui Mobile Learning Berbasis Android. *Jurnal Edukasi Matematika dan Sains*, 8(2), 140. <https://doi.org/10.25273/jems.v8i2.7041>
- Landová, E., Peléšková, Š., Sedláčková, K., Janovcová, M., Polák, J., Rádlová, S., Vobrubová, B., & Frynta, D. (2020). Venomous snakes elicit stronger fear than nonvenomous ones: Psychophysiological response to snake images. *PLoS ONE* 15(8), 1-31. <https://doi.org/10.1371/journal.pone.0236999>
- Larashati, L., Sukarmin, & Annisa Nur Khasanah. (2022). Analysis of Attitudes towards the Environment in Students of Adiwiyata and Non-Adiwiyata Schools. *Jurnal Penelitian Pendidikan IPA*, 8(5), 2247-2252. <https://doi.org/10.29303/jppipa.v8i5.1534>
- Maasawet, E. T., Candra, K. ., Putra, H. P., & Kolow, J. C. (2023). Practicality and Effectiveness of Student

- Learning Using Smart Apps Creator Media to Improve Critical Thinking Abilities and Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, 9(SpecialIssue), 136-142. <https://doi.org/10.29303/jppipa.v9ispecialissue.6358>
- Mardiana, H. (2020). Lecturers' Adaptability To Technological Change And Its Impact On The Teaching Process. *JPI (Jurnal Pendidikan Indonesia)*, 9(2), 275. <https://doi.org/10.23887/jpi-undiksha.v9i2.24595>
- Menon, D., Chandrasekhar, M., Kosztin, D., & Steinhoff, D. C. (2020). Impact of mobile technology-based physics curriculum on preservice elementary teachers' technology self-efficacy. *Science Education*, 104(2), 252-289. <https://doi.org/10.1002/sce.21554>
- Missa, H., Djaló, A., Ndukang, S., Dede, V. A., Sawu, G., & Marselina, S. (2023). Penguatan Literasi dan Numerasi di SDI Bonen Desa Baumata, Kupang-NTT. *Jurnal Pengabdian Kepada Masyarakat Nusantara*, 4(2), 1118-1127. <https://doi.org/10.55338/jpkmn.v4i2.1005>
- Nilsson, D., Fielding, K., & Dean, A. (2020). Achieving conservation impact by shifting focus from human attitudes to behaviors. *Conservation Biology*, 34(1), 93-102. <https://doi.org/10.1111/cobi.13363>
- Nousheen, A., Yousuf Zai, S. A., Waseem, M., & Khan, S. A. (2020). Education for sustainable development (ESD): Effects of sustainability education on pre-service teachers' attitude towards sustainable development (SD). *Journal of Cleaner Production*, 250, 119537. <https://doi.org/10.1016/j.jclepro.2019.119537>
- Nuri, L. N. N., Wahyuni, S., & Ridlo, Z. R. (2023). Development of an Android-Based Mobile Learning Module to Improve the Students Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 9(7), 4991-4998. <https://doi.org/10.29303/jppipa.v9i7.2944>
- Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2019). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. *Virtual Reality*, 23(4), 425-436. <https://doi.org/10.1007/s10055-018-0363-2>
- Park, W., & Kwon, H. (2023). Implementing artificial intelligence education for middle school technology education in Republic of Korea. *International Journal of Technology and Design Education*, 34(1), 109-135. <https://doi.org/10.1007/s10798-023-09812-2>
- Pereira, H. M., Braga-Pereira, F., Azeredo, L. M. M., Lopez, L. C. S., & Alves, R. R. N. (2023). Assessing factors influencing students' perceptions towards animal species conservation. *PeerJ*, 11, 1-21. <https://doi.org/10.7717/peerj.14553>
- Pirchio, S., Passiatore, Y., Panno, A., Cipparone, M., & Carrus, G. (2021). The Effects of Contact With Nature During Outdoor Environmental Education on Students' Wellbeing, Connectedness to Nature and Pro-sociality. *Frontiers in Psychology*, 12(May), 1-9. <https://doi.org/10.3389/fpsyg.2021.648458>
- Purwowododo, A. (2023). M-Learning-E-Book: Higher Level Thinking Skills, Retention, Motivation of Junior High School Students. *Jurnal Iqra': Kajian Ilmu Pendidikan*, 8(2), 300-324. <https://doi.org/10.25217/ji.v8i2.3395>
- Putri, E. R., Chatri, M., Syamsurizal, S., & Irdawati, I. (2021). The Effect of Biology Online Learning Based on Edmodo Group WhatsApp on Learning Outcomes Based on the Learning Motivation of Students. *Jurnal Penelitian Pendidikan IPA*, 7(4), 556-561. <https://doi.org/10.29303/jppipa.v7i4.775>
- Rádlová, S., Polák, J., Janovcová, M., Sedláčková, K., Peléšková, Š., Landová, E., & Frynta, D. (2020). Emotional Reaction to Fear- and Disgust-Evoking Snakes: Sensitivity and Propensity in Snake-Fearful Respondents. *Frontiers in Psychology*, 11(January), 1-13. <https://doi.org/10.3389/fpsyg.2020.00031>
- Rahmadani, N. A., Widodo, T., Prabowo, Y., Wahidah, N. N., Pangestu, S. H., & Utomo, A. P. Y. (2023). Pengaruh Pembelajaran Pendidikan Konservasi Terhadap Perilaku Konsumen Hijau (Green Consumers Behavior) Mahasiswa Fakultas Ekonomi Angkatan 2021 di Universitas Negeri Semarang. *Indonesian Journal of Conservation*, 11(2), 84-92. <https://doi.org/10.15294/ijc.v11i2.37485>
- Rahmat, A. D., Kuswanto, H., & Wilujeng, I. (2023). Integrating Technology into Science Learning in Junior High School: Perspective of Teachers. *Jurnal Penelitian Pendidikan IPA*, 9(5), 2391-2396. <https://doi.org/10.29303/jppipa.v9i5.2922>
- Ratnasari, D., Mahrawi, M., Wahyuni, I., & Risdatika, V. (2022). Pengaruh Augmented Reality Berbasis Web Dengan Model Problem Based Learning Terhadap Sikap Konservasi Peserta Didik. *Al-Ulum: Jurnal Sains Dan Teknologi*, 8(1), 6. <https://doi.org/10.31602/ajst.v8i1.7904>
- Riós-Orjuela, J. C., Falcón-Espitia, N., Arias-Escobar, A., Espejo-Urbe, M. J., & Chamorro-Vargas, C. T. (2020). Knowledge and interactions of the local community with the herpetofauna in the forest reserve of Quinini (Tibacuy-Cundinamarca, Colombia). *Journal of Ethnobiology and Ethnomedicine*, 16(1), 1-11. <https://doi.org/10.1186/s13002-020-00370-8>
- Roemintoyo, R., Miyono, N., Murniati, N. A. N., & Budiarto, M. K. (2022). Optimising the utilisation of

- computer-based technology through interactive multimedia for entrepreneurship learning. *Cypriot Journal of Educational Sciences*, 17(1), 105–119. <https://doi.org/10.18844/cjes.v17i1.6686>
- Rosidah, U. A., Marwoto, P., & Subali, B. (2021). Analysis of the Need for Android Based Mobile Learning Development to Improve Student Science Literations. *Jurnal Penelitian Pendidikan IPA*, 7(4), 601–606. <https://doi.org/10.29303/jppipa.v7i4.805>
- Saroyo, S., Siahaan, P., Langoy, M. L. D., & Koneri, R. (2019). Pendidikan Konservasi Satwa Endemik Sulawesi bagi Siswa Sekolah Dasar di Kelurahan Batuputih Bawah, Kecamatan Ranowulu, Kota Bitung, Sulawesi Utara. *Vivabio: Jurnal Pengabdian Multidisiplin*, 1(3), 26–30. <https://doi.org/10.35799/vivabio.1.3.2019.26743>
- Shanmugam, K., & Balakrishnan, B. (2019). Motivation in information communication and technology-based science learning in tamil schools. *Jurnal Pendidikan IPA Indonesia*, 8(1), 141–152. <https://doi.org/10.15294/jpii.v8i1.16564>
- Siahaan, M. (2020). Dampak Pandemi Covid-19 Terhadap Dunia Pendidikan. *Jurnal Kajian Ilmiah*, 1(1), 73–80. <https://doi.org/10.31599/jki.v1i1.265>
- Sukmawati, W., Sari, P. M., & Yatri, I. (2022). Online Application of Science Practicum Video Based on Local Wisdom to Improve Student's Science Literacy. *Jurnal Penelitian Pendidikan IPA*, 8(4), 2238–2244. <https://doi.org/10.29303/jppipa.v8i4.1940>
- Talakua, C., & Elly, S. S. (2020). Pengaruh Penggunaan Media Pembelajaran Biologi Berbasis Mobile Learning terhadap Minat dan Kemampuan Berpikir Kreatif Siswa SMA Kota Masohi. *Biodik*, 6(1), 46–57. <https://doi.org/10.22437/bio.v6i1.8061>
- Torkar, G., & Krašovec, U. (2019). Students' attitudes toward forest ecosystem services, knowledge about ecology, and direct experience with forests. *Ecosystem Services*, 37(June), 1–8. <https://doi.org/10.1016/j.ecoser.2019.100916>
- Troussas, C., Krouska, A., & Sgouropoulou, C. (2020). Collaboration and fuzzy-modeled personalization for mobile game-based learning in higher education. *Computers and Education*, 144, 11–18. <https://doi.org/10.1016/j.compedu.2019.103698>
- Widiasanti, I., Ramadhan, N. A., Alfarizi, M., Fairus, A. N., Oktafiani, A. W., & Thahur, D. (2023). Utilization of Multimedia Facilities and Internet Media as Effective Learning Tools. *Jurnal Penelitian Pendidikan IPA*, 9(6), 148–153. <https://doi.org/10.29303/jppipa.v9i6.3805>
- Yafie, E., Nirmala, B., Kurniawaty, L., Bakri, T. S. M., Hani, A. B., & Setyaningsih, D. (2020). Supporting cognitive development through multimedia learning and scientific approach: An experimental study in preschool. *Universal Journal of Educational Research*, 8(11C), 113–123. <https://doi.org/10.13189/ujer.2020.082313>
- Zhang, W. (2022). The Role of Technology-Based Education and Teacher Professional Development in English as a Foreign Language Classes. *Frontiers in Psychology*, 13(June), 1–7. <https://doi.org/10.3389/fpsyg.2022.910315>