

The biology teacher profile of junior and senior high school and the use of learning models in Ternate Indonesia

Ilham Majid^{a,1,*}, Aloysius Duran Corebima^{b,2}, Hadi Suwono^{a,3}, Susriyati Mahanal^{a,4}

^aDepartment of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Jl. Semarang 5, Malang, East Java 65145, Indonesia

^bGraduate School, Universitas PGRI Kanjuruhan Malang, Jl. S. Supriadi No.48, Malang, East Java 65148, Indonesia

¹ilhammajid153@yahoo.co.id; ²durancorebima@gmail.com; ³hadi.suwonofmipa@um.ac.id;

⁴susriyati.mahanal.fmipa@um.ac.id;

Abstract:

The implementation of instructional models in the classroom significantly impacts students' learning abilities and achievements. The adoption of a teacher-centered learning approach might lead to reduced student engagement in the learning process, consequently influencing their ability to acquire life skills. The current study aimed to determine the educational attainment, teaching experience, utilization of learning media and application of learning models by junior and senior high school biology teachers in Ternate, Indonesia. This study employed a qualitative research method that utilized survey questionnaires. The respondents were 25 biology teachers of junior high school and 30 biology teachers of senior high school. The research findings showed that (1) 84% of the junior high school biology teachers have the undergraduate education and 16% of them have the master education; 69.77% of those of the senior high school have the undergraduate education and 30.23% of them have the master education. (2) Both the junior and the senior high school biology teachers have over 15 years of teaching experience. (3) Among the junior high school biology teachers, the use of student worksheet is only 20%, and the use of learning media is 14%; Among the senior high school biology teachers, the use of student worksheet is 36.66% and the use of learning media is 23.33%. (4) The uses of conventional learning and the use of cooperative learnings among junior high school biology teachers are 83% and 17%, respectively; where as among those of senior high school are 73.34% and 26.66%, respectively. In conclusion, the educational qualifications of junior and senior high school biology teachers in Ternate have satisfied the necessary criteria for teaching. However, the teachers have not been able to enhance the quality of education in the city. This highlights the importance of developing innovative learning models to improve the learning abilities and achievements.

Keywords: biology teacher; junior high school; learning models; senior high school

*For correspondence:

ilhammajid153@yahoo.co.id

Article history:

Received: 27 February 2024

Revised: 7 May 2024

Accepted: 13 May 2024

Published: 13 May 2024

 10.22219/jpbi.v10i2.32494

© Copyright Majid *et al.* This article is distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by-sa/4.0/)



p-ISSN: 2442-3750

e-ISSN: 2537-6204

How to cite: Majid, I., Corebima, A. D., Suwono, H., & Mahanal, S. (2024) The biology teacher profile of junior and senior high school and the use of learning models in Ternate Indonesia. *JPBI (Journal Pendidikan Biologi Indonesia)*, 10(2), 374-382.

<https://doi.org/10.22219/jpbi.v10.2.32494>

Introduction

The education quality in Indonesia is still far from the expectation. Various efforts have been conducted to improve the quality of national education, such as through improving the quality of teachers, improving curriculum, providing books and learning media, improving the educational facilities and infrastructure, as well as improving the quality of school management. However, various indicators of the education quality have not been able to show adequate improvement (Husamah & Pantiwati, 2014). Learning materials are an important part of a learning process, but it cannot be denied that many teachers still do not prepare their learning material in the teaching and learning process. The learning materials are only used in the interests of school administration and formality. The learning materials greatly facilitate a

teacher in the teaching and learning process. By using learning materials, a teacher can easily teach the material, just by glancing at the learning materials without having to think a lot and remember about what to be done next (Gambari & Yusuf, 2014). Teacher's efficient communication can facilitate students' achievement of learning goals and make a substantial contribution to the learning process (Amin et al., 2024). Students with critical thinking are more capable of making informed judgments in their daily lives, thus enhancing their capabilities to communicate and present efficiently (Saad et al., 2024). Individuals often exhibit a proclivity for selecting specific learning strategies in order to effectively accomplish learning objectives (Adiansyah et al., 2023).

Based on the results of preliminary observations on junior and senior high school biology teachers in Ternate City, it was found that the learning process was still teacher-centered, which made the students less active in learning and less active to interact with other students'. The students only memorized facts or information from books, and they were less directed to observe and to interact with objects and students' real-world environment. The students lack the opportunity to build knowledge through interaction with objects and the environment, so that the students' participation during the learning process tended to only record and listen to the teacher's explanation causing the learning atmosphere to be boring. Moreover, the teacher has not utilized the students' skills and abilities maximally, so that the teaching methods used so far can cause the students to be passive and less motivated to think creatively (Kumar & Singh, 2016). Teacher's proficiency in utilizing diverse models, approaches, strategies, and methods in teaching profoundly impacts students' learning experiences (Amin, 2023b). Thus, teachers must pay special attention to ensure the successful attainment of learning goals and the adequacy of instructional materials to meet the specific needs of students (Zunaidah et al., 2024).

Additionally, teachers should consider students' readiness to design learning that can increase their acceptance and adaptability to an instructional model (Tian et al., 2023). Enhancing students' self-confidence can be regarded as a means to foster the development of thinking skills, new ideas, and problem-solving abilities among students (Nguyen et al., 2024). Thinking skills have always been part of the curriculum and daily teaching which requires a consistent planning, empowerment, and training process. To guarantee the implementation of teaching the 21st century skills, a holistic approach that considers content, pedagogy, assessment, and systemic training is urgently needed (Fitriati et al., 2023). Ensuring that students receive a high standard of education is essential for achieving educational success, prosperity, and harmony (Shukor et al., 2023). The education level and teaching experience of a teacher was very important to improve student achievement in order to achieve the expected educational goals; it was reported too that the education level and teaching experience of a teacher can improve students' learning achievement, as well as other variables, such as learning environment, training, motivation, leadership, and morale (Meihami, 2019).

The elementary schools until the high schools, teachers often implemented conventional learning in teaching the concepts of biology (Hasan et al., 2013). 100% of senior high school biology teachers in Ternate knew various learning models but they did not implement those models in the learning process (Bahtiar, 2014). An instructional technique that heavily relies on lectures and encourages passive listening among students is ineffective in developing their communication skills (Nurmala & Priantari, 2017). Learning that involves rote memory can hinder students' ability to engage in critical thinking (Istiqomah et al., 2022). Learning strategies that can develop students' potential in critical thinking and metacognition have not been fully optimized, resulting in a suboptimal learning process (Adiansyah et al., 2022).

One of the ways to overcome the problems is by using interesting learning models. The application of a learning model would have a major influence on students' ability to educate them and further more successful teachers are those who involve students in tasks that are full of cognitive content (Tran, 2014). Education primarily aims to cultivate in students the ability to learn and analyze reliable information to substantiate claims, as well as to foster a sense of responsibility towards personal growth and making meaningful contributions to both oneself and society (Amin, Karmila, et al., 2023). A supportive learning model can assist the development of students' creative thinking (Cahya et al., 2024). Besides, an appropriate pedagogical framework has the potential to enhance students' comprehension of scientific principles (Fatmawati et al., 2024). Creating questions will direct students' attention to the learning content, and help them assess their knowledge of the information covered (Amin et al., 2022).

Based on the elaboration above, this research was aimed at determining the teachers' profiles and the use of learning models used by biology teachers in junior and senior high schools in Ternate. The results of the research are expected to provide information for local governments to be used as a basis for developing policies to improve the quality of education and the professionalism of teachers, especially in Ternate.

Method

This research is descriptive research supported by a survey method. This research was conducted in February 2017. The research samples were 25 junior high school biology teachers and 30 senior high

school biology teachers. Sampling was conducted using the purposive sampling technique. The data collection instrument was in the form of a questionnaire. The research instrument had undergone the validation process and had been deemed valid prior to collecting the data. The research questionnaire contained questions and items to identify participants' (or teachers in this case) education level, teaching experience, the use of learning media and the implementation of learning models in the classroom. The questionnaire was used as the main tool for collecting the data related to the profiles of biology teachers and the use of learning models (Singh, 2006). The data obtained from the respondents were then analyzed descriptively and qualitatively using percentage techniques. The research data were presented in graphs and charts. Thus, the description of the profiles of junior and senior high school biology teachers as well as the use of learning models in the biology teaching, and learning process can be determined.

Results and Discussion

The profile of biology teachers based on the level of education

The results of the survey on 25 junior high school biology teachers and 30 senior high school biology teachers in Ternate show that the education level of 84% of the junior high school biology teachers is bachelor of biology education (S1), and the education level of the remaining of the junior high school biology teachers (16%) is master of biology education (S2). Whereas the education level of the senior high school of 69.77% of the biology teachers is bachelor of biology education (S1), and that of the remaining (30.23%) is master in biology education (S2). The percentage of the junior and senior high school biology teachers in Ternate based on their educational qualifications can be seen in Figure 1.

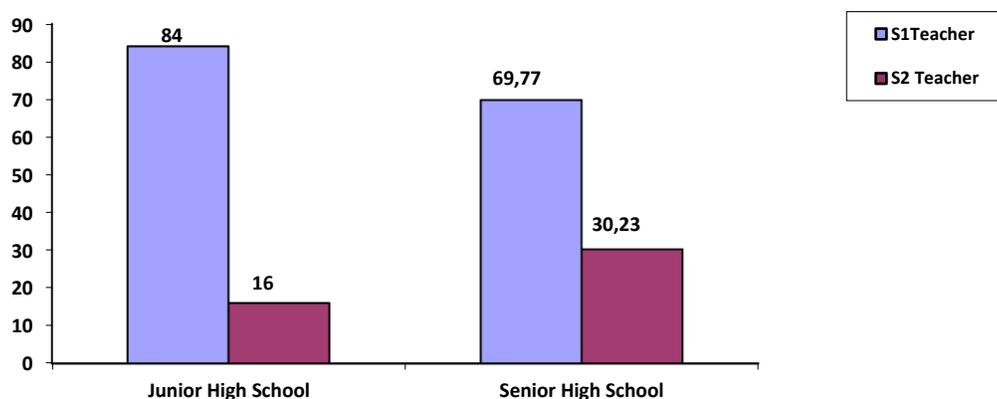


Figure 1. Profiles of junior and senior high school biology teachers in Ternate based on the levels of education

The profiles of biology teachers based on teaching experience

The results of the survey show that 28% of junior high school biology teachers have a teaching experience of 5 to 10 years, 36% of them have teaching experience of 11 to 14 years, 20% of them have teaching experience of 16 to 20 years, and 16% of them have teaching experience of more than 21 years. Whereas 11.62% of the senior high school biology teachers have teaching experience of 5 to 10 years, 9.30% of them have teaching experience of 11 to 15 years, 48.83% of them have teaching experience of 16 to 20 years, and 30.23% of them have teaching experience of more than 21 years. The percentage of the junior and senior high school biology teachers in Ternate based on their teaching experience can be seen in Figure 2.

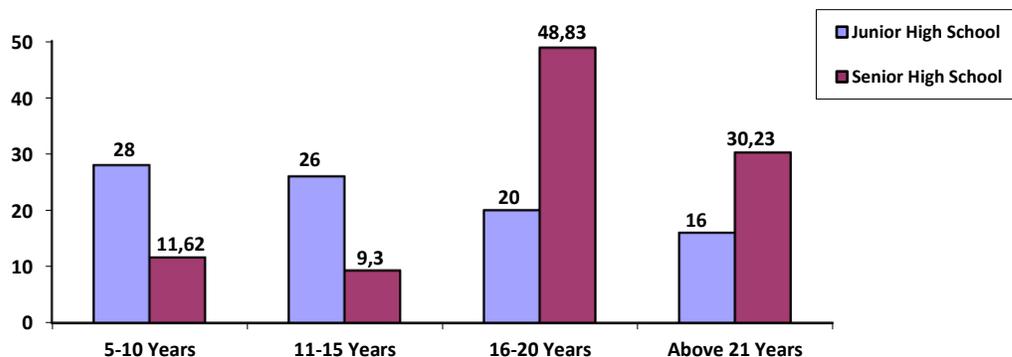


Figure 2. Profile of junior and senior high school biology teachers in Ternate based on their teaching experience

Profile of the utilization of learning materials by biology teachers

Related to the use of learning materials, all junior and senior high school biology teachers in Ternate (100%) already have used syllabus and lesson plans for the biology learning. The results of the survey also show that only 20% of the junior high school biology teachers use student worksheet, and the remaining teachers (80%) do not use student worksheet. Moreover, 14% of them use learning media, and 86% of them do not use learning media. Whereas related to the senior high school biology teachers, 63.33% of them use student worksheet and the remaining teachers (36.66%) do not use student worksheet. Moreover, 23.33% of the senior high school biology teachers use learning media and the remaining teachers (76.66%) do not use learning media. The percentage of the junior and senior high school teachers based on in the use of learning materials is presented in [Figure 3](#).

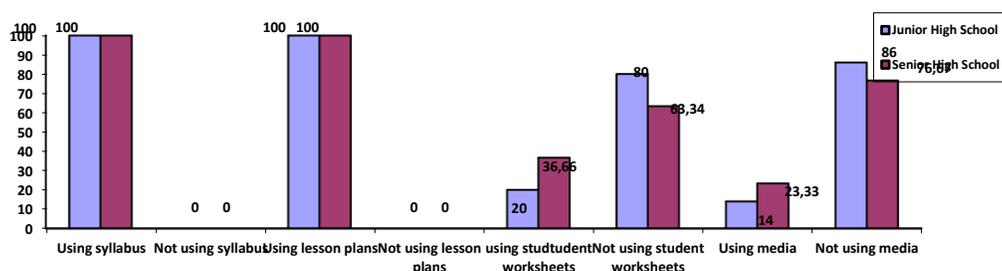


Figure 3. The profiles of junior and senior high school biology teachers in Ternate based on the use of learning materials

The use of learning models by biology teachers in Ternate

Related to the use of learning models, 83% of the junior high school biology teachers use conventional learning, 17% of them use cooperative learning models. Whereas among the senior high school biology teachers, 73.34% of the teachers use conventional learning, and 26.66% of the teachers use cooperative learning models. The use of the learning models by the junior and senior high school teacher in Ternate can be seen in [Figure 4](#).

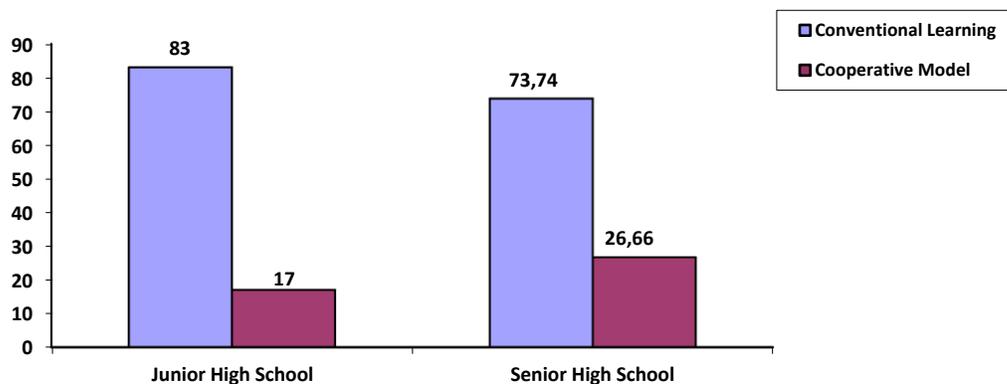


Figure 4. The use of learning models by the junior and senior high school teachers in Ternate

Based on research results, the education levels of the junior and senior high school biology teachers in Ternate have met the criteria, but they do not have sufficient intellectual competence in the form of knowledge in carrying out tasks professionally. Ministry of Education and Culture indicating that the quality of education in North Maluku province ranks 33 out of 34 provinces (Culture, 2018). Such teacher condition also occurs in other countries. a teacher could be determined as a professional teacher or an unprofessional teacher based on two perspectives related to the use of learning media as well as related to the mastery of teaching and learning materials, classroom management, managing students, and giving student guidance in addition, teachers must have intellectual competence as well as knowledge and skills (Mentz & van Zyl, 2016) Learning models that are going to be implemented in the classroom must be designed in harmony with the nature and type of learning content, learning goals, and students' ability levels (Sugiharto et al., 2024). Interactions between the teacher and students, students and students, facilities and infrastructure have a substantial impact on students' creativity (Suryandari et al., 2021). Current learning models and teaching materials are still inadequate to address the educational needs of students in 21st century (Pramasdyahsari et al., 2023).

The results of the survey show that on the average, the junior and senior high school biology teachers in Ternate have over 15 years of teaching experience, but the working experience is not comparable with the expected results. Ministry of Education and Culture reported that the teachers' standard competence and basic competence at Biology subject is in the unsatisfactory category (Culture, 2018). It only reaches 57.5% with a completion level of <60%. The longer the teacher's tenure is, the longer the teacher's teaching experience will be. Nevertheless, it does not necessarily have a positive correlation with the teacher's professionalism. Learning designs developed in Indonesia have yet involved the activities that can cultivate students' skills and creativity. In fact, most educators often prioritize information delivery and comprehension over the practical application, analysis, synthesis, and evaluation of knowledge (Supena et al., 2021). The actuality observed in the field also demonstrates that the instructional practices used by instructors lack novelty and diversity, resulting in a teacher-center approach to learning. The current methodology employed remains traditional, failing to acknowledge the active participation of students in the learning process (Adijaya et al., 2023). Thus, it is anticipated that teachers can employ pedagogical innovations to align classroom learning with the learning requirements of the twenty-first century (Amin, 2023a).

The results of the survey which indicate the low use of learning materials by the junior and the senior high school biology teachers in Ternate, especially on the use of student worksheets and learning media are caused by: 1) teachers lack of the ability to transfer learning materials in lesson plans, 2) teachers find many difficulties in using learning media. In fact, some teachers feel that using learning media will increase the teacher's workload, because they are not capable of using the learning media, and they lack of the creativity to deliver the learning materials through learning media. In addition, the teachers only prepare the learning materials for the sake of completing the school administration. The low use of learning materials and the poor quality of the lesson plans prepared by the junior and senior high school biology teachers in Ternate cause the classroom learning process to be less optimal and less suitable with the character of the learning subject and the students' development. Instructional material that have been designed properly can function as a means to strengthen teacher-student communication, lesson planning, learning resources, and learning assessment tools (Lestari et al., 2021). Learning material can also serve to help students understand new concepts (Widarti et al., 2020). Furthermore, the mastery of using visual media is thought to support the professionalism of teachers (McKenney et al., 2015). Conversely, if the teacher has low mastery in using learning media, it will be an obstacle for teachers in developing their professionalism. In order to face the new environment and the challenges of an increasingly advanced era, qualified science teachers are needed, including the mastery of using

learning media (Barthlow & Watson, 2014). Science education should aim to foster a more profound understanding in pupils, going beyond just rote memorization of information. It is crucial for students to develop the capacity to use their scientific knowledge in real-life scenarios that demand problem-solving skills and the ability to make informed decisions (Markula & Aksela, 2022).

The low mastery of implementing innovative learning models by junior and senior high school biology teachers in Ternate, especially the cooperative learning model, causes the learning process to be teacher-centered. The learning process nowadays still uses the old paradigm of learning, which is still satisfied with the teacher centered learning by choosing direct learning. These problems are caused by: (1) the students are not exposed with problems in the learning process; (2) the students do not give adequate responses when the teacher delivers the learning material, (3) the teachers still use conventional learning in the teaching and learning process. The use of conventional learning in biology learning caused the students did not participate actively in the learning process, so that the students became passive. Utilizing suitable learning models can enhance students' competencies in the age of education 4.0. Thus, there is an urgency to develop educational frameworks that can align with students' needs and the demands of the contemporary job market (Hastuti et al., 2022). The growing demand for school and teachers to address the problems posed by the era has been driven by the desire to enhance students' employability in the current labor market, which requires them to possess advanced knowledge, skills, and competencies (Duc et al., 2022). Teachers should pose questions that can stimulate students' prior knowledge and facilitate their concentration on information acquisition (Amin, Adiansyah, et al., 2023).

Conventional learning methods may diminish students' enthusiasm for learning and hampers the development of their scientific literacy (Afriana et al., 2016). Poor academic achievement is also linked to the ineffective learning model employed by teachers in the classroom (Marsiti et al., 2023). Teachers that employ traditional teaching methods do not utilize media that can captivate students' interest in the learning content (Nurlaela et al., 2021). The application of these learning methods may influence students' academic performance as they fail to engage students actively in the learning process. In the traditional classroom, the majority of students solely depend on material provided in textbooks and are reluctant to seek knowledge from diverse sources. Consequently, most students struggle to comprehend the concepts taught by their teachers (Rochim et al., 2022). Teaching in the view of constructivism was not only the process of transferring knowledge from the teachers to the students, but also creating an activity that allowed students to construct their own knowledge (Dipalaya et al., 2016).

Teachers must adjust to the evolving educational aims and objectives in the digital age, which integrates communication and literacy. Teachers need to adapt quickly to technological advancements that broaden the range of learning environments and enhance communication (Cinar, 2021). The goal of education in the 21st century is to cultivate and enhance students' cognitive abilities in order to empower them to effectively address the challenges they encounter in their environment. Intelligence in practical situations entails not just acquiring knowledge but also effectively solving problems that are pertinent, meaningful, and contextual to pupils (Desgamalia & Syamsurizal., 2019). In the 21st century, the study of biology necessitates students to cultivate their creativity in the learning process, rather than solely concentrating on acquiring a thorough understanding of topics (Hehakaya et al., 2022). To maximize students' ability to master concepts, it is necessary to incorporate suitable learning procedures (Sigit et al., 2022). In today's education system, pupils are expected to excel in the cognitive domain and possess 21st century abilities (Nurhidayah et al., 2021). Designing learning environments that are suitable for 21st century pupils pose a significant challenge for educators in the present day. Students require critical thinking and problem-solving skills that are applicable not only inside the classroom setting but also in future work environments that are dynamic (Ahmed, 2022).

Conclusion

Based on the results of this research, it can be concluded that the education level of the junior and senior high school biology teachers in Ternate has met the criteria, but it has not been able to improve the quality of education. The junior and senior high school biology teachers on the average have more than 15 years of teaching experience. The low use of learning materials as well as the poor quality of the lesson plans prepared by the junior and senior high school biology teachers in Ternate cause the classroom learning to be less optimal and not suitable with the characteristics of the learning subject and the students' development. The lack of mastery on implementing innovative learning models by the junior and senior high school biology teachers in Ternate, especially the cooperative learning model, causes the learning to be teacher-centered learning.

One of the ways to improve the quality of biology learning is by improving the learning models used by teachers in the teaching. The use of appropriate learning models can improve efficiency and effectiveness in the teaching and learning process. It must also be prepared through learning tools to prepare meaningful learning processes and make students more active during the learning process.

Acknowledgement

We would like thank to Ministry of Research Technologi and Higher Education of the Republic of Indonesia who have provided funding suport in the completion of this study (Decree number: 1265.27/E4.4/2015).

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

- Adiansyah, R., Amin, A. M., Yani, A., & Safitri, D. (2023). The correlation between metacognitive awareness and cognitive learning outcomes based on gender of biology education students. *Biosfer: Jurnal Pendidikan Biologi*, 16(2), 244–259. <https://doi.org/10.21009/biosferjpb.26765>
- Adiansyah, Romi, Amin, A. M., Ardianto, A., & Yani, A. (2022). Metacognitive skill profile of biology education students at institute of teachers' education in South Sulawesi, Indonesia. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 8(2), 150–158. <https://doi.org/10.22219/jpbi.v8i2.20732>
- Adijaya, M. A., Widiana, I. W., Parwata, I. G. L. A., & Antara, I. G. W. S. (2023). Bloom's taxonomy revision -oriented learning activities to improve procedural capabilities and learning outcomes. *International Journal of Educational Methodology*, 9(1), 261–270. <https://doi.org/10.12973/ijem.9.1.261>
- Afriana, J., Permanasari, A., & Fitriani, A. (2016). Project based learning integrated to stem to enhance elementary school's students scientific literacy. *Jurnal Pendidikan IPA Indonesia*, 5(2), 261–267. <https://doi.org/10.15294/jpii.v5i2.5493>
- Ahmed, M. A. (2022). Business English instruction: Empowering learners with the 4Cs of the 21st century. *Frontiers in Education*, 7(998987), 1–15. <https://doi.org/10.3389/educ.2022.998987>
- Amin, A. M. (2023a). The potential of RQANI for shaping preservice biology teachers' character at Islamic university. *AL-ISHLAH: Jurnal Pendidikan*, 15(4), 5384–5394. <https://doi.org/10.35445/alishlah.v15i4.2725>
- Amin, A. M. (2023b). The understanding of metacognitive skills among biology teachers and lectures in Makassar, South Sulawesi, Indonesia. *AIP Conference Proceedings*, 2540(020009), 1–10. <https://doi.org/10.1063/5.0107389>
- Amin, A. M., Adiansyah, R., & Hujjatusnaini, N. (2023). The contribution of communication and digital literacy skills to critical thinking. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 11(3), 697–712. <https://doi.org/10.24815/jpsi.v11i3.30838>
- Amin, A. M., Adiansyah, R., Mustami, M. K., Yani, A., Hujjatusnaini, N., & Ahmed, M. A. (2024). The influence of We-Are (Warm-Up, Exploring, Argumentation, Resume) model integrated with 21st-century skills on prospective biology teachers' communication Skills. *Jurnal Pendidikan IPA Indonesia*, 13(1), 12–28. <https://doi.org/10.15294/jpii.v13i1.47911>
- Amin, A. M., Ahmad, S. H., Zulkarnaim, & Adiansyah, R. (2022). RQANI : A learning model that integrates science concepts and islamic values in biology learning. *International Journal of Instruction*, 15(3), 695–718. <https://doi.org/10.29333/iji.2022.15338a>
- Amin, A. M., Karmila, F., Laode, Z. A., Ermin, E., Akbar, A. Y., & Ahmed, M. A. (2023). The WE-ARE model's potential to enhance digital literacy of preservice biology teachers. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 9(1), 36–45. <https://doi.org/10.22219/jpbi.v9i1.23061>
- Bahtiar, B. (2014). Pengaruh pembelajaran Think Pair Share (TPS) dan Reading Questioning Answering (RQA) terhadap sikap sosial, keterampilan metakognisi dan penguasaan konsep biologi untuk pendidikan multi etnis siswa SMA di Ternate. In *Unpublished doctoral dissertasion*. Universitas Negeri Malang, Malang.
- Barthlow, M. J., & Watson, S. B. (2014). The effectiveness of process-oriented guided inquiry learning to reduce alternative conceptions in secondary chemistry. *School Science and Mathematics*, 114(5), 246–255. <https://doi.org/10.1111/ssm.12076>
- Cahya, D. M., Zubaidah, S., & Munzil, M. (2024). Exploring Students' creative thinking skills when learning biology through the reading concept mapping team quiz (Remap-TQ). *International Conference On Mathematics And Science Education, KnE Social Sciences, 2024*, 70–82. <https://doi.org/10.18502/kss.v9i8.15488>
- Cinar, M. (2021). The conceptual integration of 21st century skills into ELT. *LOTUS International Journal of Language and Translation Studies*, 1(1), 51–57.
- Culture, M. of E. and. (2018). *Neraca pendidikan daerah*. <http://www.npd.kemdikbud.go.id/?appid=ukg>

- Desgamalia, P., & Syamsurizal. (2019). Effect of project based learning (PjBL) model on biology psychomotor competence of X grade natural science class students in SMAN 1 Kapur IX. *International Journal of Progressive Sciences and Technologies (IJPSAT)*, 15(2), 68–71. <https://doi.org/http://ijpsat.ijshj-journals.org>.
- Dipalaya, T., Susilo, H., Ibrohim, & Corebima, A. D. (2016). Pengaruh strategi pembelajaran pdeode (predict-discuss-explain-observe-discuss-explain) pada kemampuan akademik berbeda terhadap hasil belajar siswa SMA di Kota Makassar. *Proceedings of Seminar Nasional II Tahun 2016, Kerjasama Prodi Pendidikan Biologi FKIP Dengan Pusat Studi Lingkungan Dan Kependudukan (PSLK) Universitas Muhammadiyah Malang*.
- Duc, C. N., Thi, P. N., Hoang, T. N., Thanh, T. N. T., & The, T. N. (2022). A literature review of the project-based teaching method in the education of Vietnam. *International Journal of Educational Methodology*, 8(3), 567–584. <https://doi.org/10.12973/ijem.8.3.567>
- Fatmawati, A., Zubaidah, S., Mahanal, S., Sutopo, S., Bilad, M. R., & Shahrill, M. (2024). Students' concept mastery in plant physiology course using learning cycle multiple representation model. *Pegem Jurnal of Education and Instruction*, 14(3), 91–102. <https://doi.org/10.47750/pegegog.14.03.09>
- Fitriati, F., Rosli, R., Iksan, Z., & Hidayat, A. (2023). Exploring challenges in preparing prospective teachers for teaching 4C skills in mathematics classroom: A school-university partnership perspectives. *Cogent Education*, 11(2286812), 1–21. <https://doi.org/10.1080/2331186X.2023.2286812>
- Gambari, I. A., & Yusuf, M. O. (2014). Effects of three cooperative learning strategies on the performance of secondary school students in physics. *Chemistry: Bulgarian Journal of Science Education*, 23(3), 353–373.
- Hasan, S., Tumbel, F. M., & Duran Corebima, A. (2013). Empowering critical thinking skills in indonesia archipelago: Study on elementary school students in Ternate. *Journal of Modern Education Review*, 3(11), 2155–7993.
- Hastuti, K. P., Aristin, N. F., & Fani, A. I. M. (2022). Improvement of six competency skills through the development of flipped-case project in era of education 4.0. *Education Quarterly Reviews*, 5(4), 125–135. <https://doi.org/10.31014/aior.1993.05.04.579>
- Hehakaya, W., Matdoan, M. N., & Rumahlatu, D. (2022). Integrating STEAM with PjBL and PBL on biology education: Improving students' cognitive learning results, creative thinking, and digital literacy. *Biosfer: Jurnal Pendidikan Biologi*, 15(1), 76–84. <https://doi.org/10.21009/biosferjpb.24468>
- Husamah, H. & Pantiwati, Y. (2014). Cooperative learning STAD-PjBL: motivation, thinking skills, and learning outcomes of Biology Department students. *International Journal of Education Learning and Development*, 2(1), 77–94. <http://www.eajournals.org/wp-content/uploads/Cooperative-Learning-Stad-Pjbl-Motivation-Thinking-Skills-And-Learning-Outcomes-of-Biology-Department-Students.pdf>
- Istiqomah, N., Hujjatusnaini, N., Septiana, N., & Amin, A. M. (2022). Implementasi model pembelajaran project based learning terintegrasi praktikum studi antagonisme *Escherichia coli* dan *Candida albicans* terhadap keterampilan berpikir kritis mahasiswa. *Jurnal Pendidikan Sains Indonesia*, 10(4), 892–904. <https://doi.org/10.24815/jpsi.v10i4.26264>
- Kumar, A., & Singh, D. A. P. (2016). Effect of Student Teams Achievement Divisions (STAD) method on problem solving in relation to critical thinking. *International Journal of Advanced Research and Development*, 1(7), 26–30.
- Lestari, T., Supardi, Z. A., & Jatmiko, B. (2021). Virtual classroom critical thinking as an alternative teaching model to improve students' critical thinking skills in pandemic coronavirus disease era. *European Journal of Educational Research*, 10(4), 2003–2015. <https://doi.org/10.12973/eu-er.10.4.2003>
- Markula, A., & Aksela, M. (2022). The key characteristics of project-based learning: how teachers implement projects in K-12 science education. *Disciplinary and Interdisciplinary Science Education Research*, 4(2), 1–17. <https://doi.org/10.1186/s43031-021-00042-x>.
- Marsiti, C. I. R., Santyasa, I. W., Sudatha, I. G. W., & Sudarma, I. K. (2023). The effect of project-based blended learning and students' creativity on eleventh-grade students' learning achievement. *International Journal of Instruction*, 16(4), 805–826. http://www.e-iji.net/dosyalar/iji_2023_4_45.pdf
- McKenney, S., Kali, Y., Markauskaite, L., & Voogt, J. (2015). Teacher design knowledge for technology enhanced learning: an ecological framework for investigating assets and needs. *Instructional Science*, 43, 181–202. <https://doi.org/10.1007/s11251-014-9337-2>
- Meihami, H. (2019). Identity-oriented english language teachers' education programs as the arena of becoming a glocal english language teacher. *Pedagogika*, 135(3), 71–84. <https://doi.org/10.15823/p.2019.135.4>
- Mentz, E., & van Zyl, S. (2016). Introducing cooperative learning: students' attitudes towards learning and the implications for self-directed learning. *Journal of Education*, 64, 79–100.

- <https://doi.org/10.17159/i64a04>
Nguyen, N. N., Le, T. T. T., Thi Nguyen, B. P., & Nguyen, A. (2024). Examining effects of students' innovative behaviour and problem-solving skills on crisis management self-efficacy: policy implications for higher education. *Policy Futures in Education*, 22(1), 1–20.
<https://doi.org/10.1177/14782103221133892>
- Nurhidayah, I. J., Wibowo, F. C., & astra, I. M. (2021). Project Based Learning (PjBL) learning model in science learning: Literature Review. *Journal of Physics: Confrence Series*, 012043.
<https://doi.org/10.1088/1742-6596/2019/1/012043>
- Nurlaela, E., Sumantri, M., & Sarkadi. (2021). Development of mind mapping based e-book in steam for skills of grade VI elementary school students. *International Journal of Multicultural and Multireligious Understanding*, 8(6), 390–399.
- Nurmala, R. S., & Priantari, I. (2017). Meningkatkan keterampilan komunikasi dan hasil belajar kognitif melalui penerapan discovery learning. *Jurnal Biologi Dan Pembelajaran Biologi*, 2(1), 1–10.
<https://doi.org/10.32528/bioma.v2i1.586>
- Pramasdyahsari, A. S., Setyawati, R. D., Aini, S. N., Nusuki, U., Arum, J. P., Astutik, L. D., Widodo, W., Zuliah, N., & Salmah, U. (2023). Fostering students' mathematical critical thinking skills on number patterns through digital book STEM PjBL. *Eurasia Journal of Mathematics, Science and Technology Education*, 19(7), em2297. <https://doi.org/10.29333/ejmste/13342>
- Rochim, R. A., Prabowo, P., Budiyanto, M., Hariyono, E., & Prahani, B. K. (2022). The use of STEM-integrated project-based learning models to improve learning outcomes of junior high school students. *Proceedings of the Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*, 627, 211–218.
<https://doi.org/10.2991/assehr.k.211229.034>
- Saad, A., Elbashir, A., Abdou, R., Alkhair, S., Ali, R., Parangusan, H., Ahmad, Z., & Al-thani, N. J. (2024). Exploring of the gender variations in 4Cs skills among primary students. *Thinking Skills and Creativity*, 52(101510). <https://doi.org/10.1016/j.tsc.2024.101510>
- Shukor, F., Mah, B. Y., & Ul-saufie, A. Z. (2023). Assessing perceptions on the effectiveness of online community projects encompassing 4C of 21st-century skills. *Journal of Administrative Science*, 20(2), 158–178.
- Sigit, D. V., Ristanto, R. H., & Mufida, S. N. (2022). Integration of project-based e-learning with STEAM: An innovative solution to learn ecological concept. *International Journal of Instruction*, 15(3), 23–40. <https://doi.org/10.29333/iji.2022.1532a>
- Singh, Y. K. (2006). *Fundamental of research methodology and statistics*. New Age International Limited Publisher.
- Sugiharto, S., Lubis, D. P., Lukitoyo, P. S., & Halim, J. (2024). Analysis of cultural geography learning concept design based on case method and team-based project. *The 3rd International Conference on Humanities Education Law and Social Sciences, KnE Social Sciences*, 1059–1069. <https://doi.org/10.18502/kss.v9i2.14922>
- Supena, I., Darmuki, A., & Hariyadi, A. (2021). The influence of 4C (Constructive, Critical, Creativity, Collaborative) learning model on students' learning outcomes. *International Journal of Instruction*, 14(3), 873–892. <https://doi.org/10.29333/iji.2021.14351a>
- Suryandari, K. C., Rohmaniyah, & Wahyudi. (2021). The effect of scientific reading based project model in empowering creative thinking skills of preservice teacher in elementary school. *European Journal of Educational Research*, 10(3), 1329–1340. <https://doi.org/10.12973/eu-er.10.3.1329>
- Tian, P., Sun, D., Han, R., & Fan, Y. (2023). Integrating micro projectbased learning to improve conceptual understanding and crucial learning skills in chemistry. *Journal of Baltic Science Education*, 22(1), 130–152. <https://doi.org/10.33225/jbse/23.22.130>
- Tran, V. D. (2014). The effects of cooperative learning on the academic achievement and knowledge retention. *International Journal of Higher Education*, 3(2), 131–140.
<https://doi.org/10.5430/ijhe.v3n2p131>
- Widarti, H. R., Rokhim, D. A., & Syafruddin, A. B. (2020). The development of electrolysis cell teaching material based on STEM-PJBL approach assisted by learning video: A need analysis. *Jurnal Pendidikan IPA Indonesia*, 9(3), 309–318. <https://doi.org/10.15294/jpii.v9i3.25199>
- Zunaidah, F. N., Sulistiyowati, T. I., Mahanal, S., Zubaidah, S., & Rahmawati, I. (2024). Need analysis of ecology course teaching materials based on student needs. *International Conference On Mathematics And Science Education, KnE Social Sciences*, 1145–1150.
<https://doi.org/10.18502/kss.v9i13.16054>