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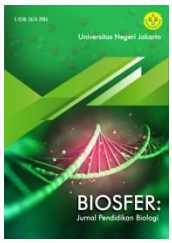

Effectiveness of the SrVER learning model assisted by augmented and virtual reality media in biology learning

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ABSTRACT

This study aims to analyze the effectiveness of the SrVER learning model assisted by Augmented Reality (AR) and Virtual Reality (VR) media in Biology Learning. The study employed a quasi-experimental method with a pretest–posttest nonequivalent control group design. The population comprised high school students in Mataram City, and samples were selected using purposive sampling. Data were collected through a validated multiple-choice test (25 items, $\alpha = 0.82$). Data analysis used Quade's Rank Analysis of Covariance followed by the Least Significant Difference (LSD) test. The findings revealed a significant difference ($p < 0.001$) in students' learning outcomes between the conventional, AR-assisted SrVER, and VR-assisted SrVER classes. The AR-assisted SrVER group achieved the highest improvement (52.31%), showing that AR effectively enhances visual understanding in biological concepts. Therefore, integrating AR in visual-based learning is recommended to improve student engagement and learning outcomes in Biology Learning.

INTRODUCTION

Education plays a vital role in developing students' potential through formal and informal learning (Johnson & Mejwska, 2022; Pristiwanti et al., 2022). Teachers must apply suitable learning strategies to accommodate students' diverse characteristics, including learning style (Hidayanti, 2023; Pozas et al., 2020). By understanding students' differences, teachers can help improve learning outcomes and self-competence (Putra et al., 2020; Tomaszewski et al., 2022).

Learning style describes individual preferences in acquiring, processing, and organizing information (Budi et al., 2021). Each learner has a different learning style, so the way they absorb, process, and organize the information they obtain also differs. Although learners' learning styles vary, they share the same goal, which is to achieve learning objectives and attain the academic achievements expected by the learners (Djara et al., 2023). Understanding learning styles helps teachers design more effective instructional strategies that improve learning outcomes (Gilakjani & Lahijan, 2012).

According to Waryani (2021), there are three types of learning styles, namely visual learning style, auditory learning style, and kinesthetic learning style. Visual learners learn through what they see, auditory learners learn by listening, and kinesthetic learners learn through movement, work, and touch (Bire et al., 2014). Visual learners benefit from materials presented in writing, pictures, charts, and graphs. Students with an auditory learning style prefer audio materials such as teacher explanations or discussion (Ahmadi & Supriyono, 2013). Meanwhile, kinesthetic learners learn best through direct involvement, such as handling and experimenting (Sari et al., 2022). Although all learners possess these learning styles, one typically dominates (Magdalena & Affifah, 2021).

Knowledge about students' learning styles is essential. Teachers who understand students' learning styles can more effectively create supportive environments and help students maximize information absorption (Widayanti, 2013). They can also apply appropriate learning techniques and strategies (Putri et al., 2020), and enhance student learning achievement by implementing suitable learning models (Sugiarto & Pratiwi, 2023). This is supported by the findings of Ariesta (2025), which show that elementary students who receive differentiated instruction tailored to their learning styles achieve significantly higher learning outcomes than those who do not.

The SrVER model (Screening, Visualization, Elaboration, and Reflection) accommodates visual learners by promoting active, creative, and reflective learning (Handayani et al., 2025). It emphasizes visualization and reflection to strengthen conceptual understanding, making it a promising model for biology instruction. According to Handayani et al. (2025) the SrVER model is feasible, practical, and easy to implement in classroom learning. It encourages active, creative, and collaborative learning while making the process engaging and enjoyable. However, the application of the learning model will be more effective if it is done with the help of learning media.

Learning media are essential tools to convey instructional materials from teachers to students effectively (Karo-Karo S & Rohani, 2018). Teachers can increase the effectiveness of the learning process, stimulate student interest, and support the development of creative and analytical thinking skills, as well as collaboration skills, by developing innovative and diverse learning media. Educators can create learning experiences that are more engaging, in-depth, and relevant to the current context by utilizing the latest technologies, such as Augmented Reality (AR), Virtual Reality (VR), online learning platforms, and mobile applications. Education can become more dynamic, inspire students to be active in the learning process, and help them achieve optimal learning outcomes using appropriate learning media.

Recent advances in educational technology particularly Augmented Reality (AR) and Virtual Reality (VR), offer immersive experiences that enhance visual learning (Azmi et al., 2024; Mustaqim, 2016). However, limited studies have compared the combined effect of AR and VR within the same instructional framework in biology learning. Previous reviews (Cheng & Tsai, 2020; Garzón et al., 2020) emphasized AR and VR's potential to improve science learning outcomes but did not address model integration. Therefore, this study analyzes the effectiveness of the SrVER model integrated with AR and VR media to enhance students' learning outcomes in biology learning.

AR and VR media that emphasize visual or viewing abilities can help students who have a tendency toward visual and audio-visual learning styles. Chania et al. (2016) explain that students who tend to have a visual learning style are more likely to remember what they see more easily. They also find it easier to understand material when it is presented in the form of images or models. In addition, they often take detailed notes and summaries as a strategy for obtaining information. The application

of the SrVER model, which accommodates students' visual learning styles and is integrated with AR and VR media that also support students' learning styles, will further support students' understanding of learning materials. This study aims to analyze the effectiveness of the SrVER model integrated with AR and VR media, which is expected to improve student learning outcomes.

METHODS

Research Design

This study employed a quasi-experimental design using a pretest-posttest nonequivalent control group design (Creswell, 2009). The research involved three groups: a control class using conventional learning, an experimental class using the SrVER model with AR, and another using the SrVER model with VR. All groups underwent pretest and posttest to evaluate treatment effects. The research design can be seen in Table 1.

Table 1.
Research Design

Group	Pretest	Treatment	Posttest
Control	O_1	X_0	O_2
Experimental 1	O_3	X_1	O_4
Experimental 2	O_5	X_2	O_6

Note:
O_1 : Initial test of the control group
O_2 : Final test of the control group
X_0 : Conventional Learning
O_3 : Initial test on the SrVER + AR group (pretest)
O_4 : Final test for the SrVER + AR group (posttest)
X_1 : Learning using the SrVER + AR model
O_5 : Initial test for the SrVER + VR group (pretest)
O_6 : Final test for the SrVER + VR group (posttest)
X_2 : Learning using the SrVER + VR model

Population and Samples

The population in this study was all tenth-grade high school students in Mataram City, Indonesia. The sample used in this study was tenth-grade students from two schools in Mataram City, Indonesia. Sampling was conducted using purposive sampling techniques, considering the equivalent abilities of the students.

Instrument

The instrument used in this study was a test instrument in the form of a learning outcome test consisting of 25 multiple-choice questions that had been validated by experts (Cronbach $\alpha = 0.82$).

Procedure

Before the study was conducted, students were given a pretest to determine their initial abilities before being given treatment. Next, students will be taught using different learning models and media in each class. Conventional models and media will be taught in the control class. The AR-assisted SrVER model will be taught in experiment class 1, and the VR-assisted SrVER model will be taught in experiment class 2. There will be 4 meetings. At the end of the learning process, students will be given a posttest to assess their learning outcomes after receiving the treatment.

Data Analysis Techniques

Student learning data was analyzed using the Ancova test with the help of the SPSS 27.0 program. Before analysis, prerequisite tests were carried out, namely homogeneity, normality, and linearity tests. If all prerequisite tests were met, the Ancova test could be continued. The decision criterion for the Ancova test is that if the significance value is < 0.05, H0 is rejected, which means that there is a significant difference between classes taught using the conventional model, the VR-assisted SrVER model, and the AR-assisted SrVER model. If the prerequisite tests are not met, data analysis can be performed with a nonparametric test equivalent to the Ancova test, namely Quade's Rank Analysis of Covariance test. If the test results are significant, it will be followed by an LSD or Smallest Significant Difference test.

RESULTS AND DISCUSSION

The learning outcomes of students using the conventional learning model, the AR-assisted SrVER model, and the VR-assisted SrVER model showed differences in learning outcomes. The learning

outcomes of students are shown in Figure 1.

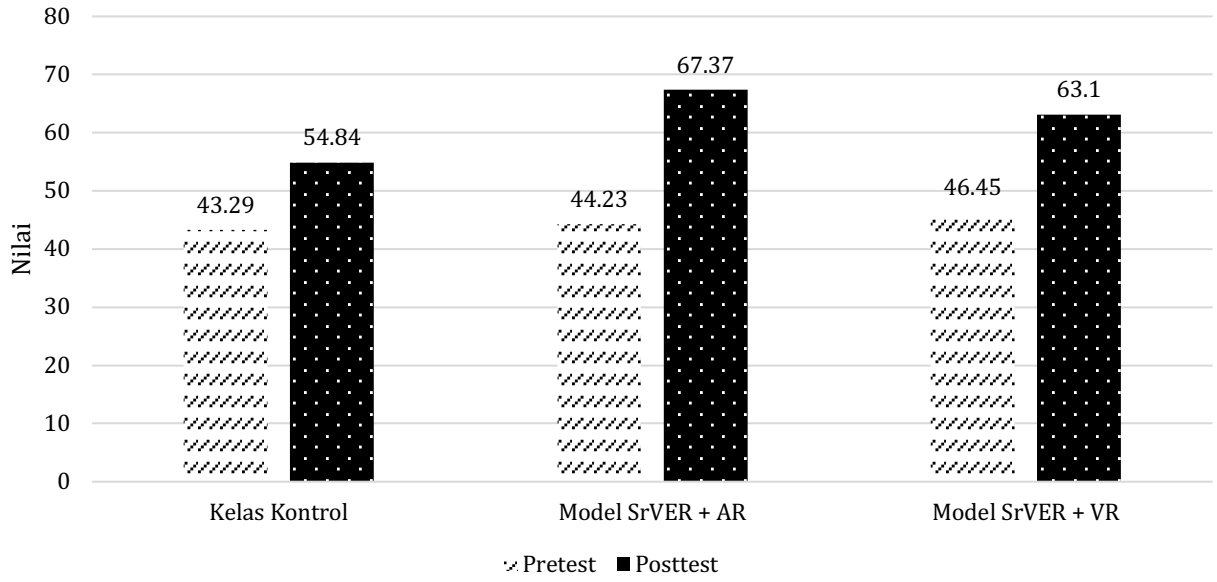

Figure 1. Student Learning Outcomes Under the Conventional Learning Model, the SrVER with AR Model, and the SrVER with VR Model

Figure 1 shows that there was an increase in the average score in the control class and the experimental class. After receiving treatment, the experimental class achieved a higher increase than the control class. The average learning outcome score of the control class before receiving treatment was 43.29, and after receiving treatment, it was 54.84. The experimental class that used the AR-assisted SrVER model achieved an average score before receiving treatment of 44.23 and after receiving treatment of 67.37. The experimental class that used the AR-assisted SrVER model obtained an average score of 46.45 before the treatment and 63.1 after the treatment. The class that was taught using the AR-assisted SrVER model experienced the highest increase compared to the control class and the class that was taught using the VR-assisted SrVER model.

Before the pretest and posttest data were analyzed using Ancova, a prerequisite test was conducted. Based on the results of the normality test using the Kolmogorov-Smirnov test, a Sig value of 0.003 (Sig. < 0.05) was obtained, indicating that the data were not normally distributed. Based on the homogeneity test using Levene's Test, a Sig value of < 0.001 (Sig. < 0.05) was obtained, indicating that the data variance was not homogeneous. Based on the linearity test, it was found that the class using the VR-assisted SrVER learning model had a distribution that was in line with the linear line, so it was concluded that the data was linear. However, the control class and the class using the AR-assisted SrVER learning model did not have a distribution that was in line with the linear line, so it was concluded that the data was not linear. Based on several tests that have been conducted, the data do not meet the requirements for parametric testing, so the data were tested using non-parametric testing, namely Quade's Rank Analysis of Covariance, as shown in Table 2.

Table 2.
Results of Quade's Rank Analysis of Covariance

Result		Conclusion
df1	2	There is a significant difference
df2	238	
F	14,611	
Sig.	<0,001	

The results of Quade's Rank Analysis of Covariance show a Sig. or p value of <0.001, which is <0.05. These results indicate a significant difference in student learning outcomes between those using the conventional model, the AR-assisted SrVER model, and the VR-assisted SrVER model, controlling for students' initial learning outcomes. Because the data show a significant difference, a follow-up test using

the LSD test was conducted. The results of the LSD test are presented in Table 3.

Tabel 3.
LSD Test Result

Result		Conclusion
Sig.	0,026	Truly Different

The LSD test results show that the Sig. value is 0.026 ($p < 0.05$), indicating that the data obtained are significantly different. Furthermore, the LSD test was continued by observing the corrected mean table to determine the differences between the control class, the AR-assisted SrVER class, and the VR-assisted SrVER class. The corrected means are presented in Table 4.

Table 4.
Corrected Means

Class	Pretest		Posttest		Difference	Improvement	Corrected Mean	Notation
	M	(SD)	M	(SD)				
Conventional	43.29	9,144	54,85	13,39	11,56	26,70%	55,28	a
SrVER + VR	46,20	14,56	63,05	12,87	16,85	36,47%	62,52	b
SrVER + AR	44,23	14,91	67,37	20,06	23,14	52,31%	64,14	c

Table 4 shows that classes using the SrVER learning model assisted by AR and VR had higher improvements and corrected averages compared to classes using conventional learning models. The use of the SrVER model in learning can improve student learning outcomes. These results are consistent with the research conducted by Maryam et al. (2025) and Muliani et al. (2025). By applying the SrVER learning model, learning proceeds in a structured manner through the stages of screening, visualization, elaboration, and reflection, thereby helping students understand the material more deeply and improving their learning outcomes.

The screening stage is an assessment or activity to diagnose students' initial abilities with the aim of providing the right amount of learning so that there is no gap between prior knowledge and new knowledge (Handayani et al., 2025). Students' initial abilities can facilitate and optimize the acquisition, organization, and recall of new knowledge (learning outcomes) (Nika et al., 2019). This stage is carried out by asking various questions related to the material to be taught. The SrVER learning model emphasizes constructivist learning theory, in which students are expected to construct their own knowledge. Thus, students' prior knowledge is important because constructing knowledge requires prior information to be able to check, change, or correct previous information if it is no longer appropriate (Bada & Olusegun, 2015). This is reinforced by Phillips (1995) those who state that prior knowledge will influence the new knowledge that students will build from their learning experiences. By knowing the students' initial abilities, teachers will find it easier to provide appropriate treatment to facilitate students' understanding of the material to be taught.

The visualization stage is an activity that aims to make it easier for students to understand lesson material by displaying visual images so that they appear more realistic (Handayani et al., 2025). Visualization helps students improve their understanding because it connects their current knowledge, technology, and the knowledge provided through visualization (Ricketts et al., 2018). This is supported by research conducted by Kumar (2016), which states that visualization can help students understand more concepts, both for students who can learn without the help of a tutor and for students who need a tutor. Hsiao et al. (2017) In their research also stated that visualization can help students identify the strategies they use in mastering the material. In the SrVER learning model, visualization is carried out by displaying 3D images using augmented reality (AR) media and displaying videos using virtual reality (VR) media. The use of media helps students understand the material more clearly by seeing images more realistically, even though they are limited to the classroom space. Research conducted by Agustira & Rahmi (2022) shows that the use of learning media affects student learning outcomes because it can create more interesting learning, making it easier for students to understand the material.

The next stage is elaboration, which aims to train students' collaboration and communication skills (Handayani et al., 2025). Elaboration can occur when students take notes, answer questions, discuss, and even study independently (Pires et al., 2020). In the SrVER model, this activity is carried

out by providing students with worksheets that must be completed in groups. This activity trains students' collaboration skills because they are required to solve problems together. Students are then asked to explain the results of their discussions, which trains them to improve their communication skills. This process also makes students better understand the material being studied because when students can collaborate well, they will gain more knowledge. This is in line with what Mandasari (2018) was stated, that elaboration is a process of obtaining additional knowledge based on what is already known, so that the information becomes more meaningful. Through collaboration and communication, synergy and harmony are created to achieve improved student learning achievement (Prastawati & Mulyono, 2023)

Reflection is the final stage in the SrVER learning model. This stage aims to measure students' understanding of the material studied while also training their reflective abilities so that they are aware of what they have learned and want to learn. Reflection activities are important because they encourage students to recall the material they have learned as a basis for improving and deepening their learning, increasing their motivation to learn, and making learning more meaningful (Wowor et al., 2022). Based on the results of research conducted, Noviana (2020) reflection activities not only help students acquire knowledge but also help develop their thinking and acting abilities. Research conducted by Listiyani (2018), where reflection activities were combined with the inquiry learning model, resulted in good learning outcomes for students and received positive responses from them. Thus, reflection activities, which are one of the stages in the SrVER model, greatly help students to be aware of the extent of their understanding of the material they have learned and encourage their ability to remember and think.

The effectiveness of a learning model greatly depends on the media used as a learning aid. Each learning model integrated with different learning media will have a different impact, which greatly depends on the characteristics of the model and the media. In the SrVER learning model, the media used to support learning are augmented reality (AR) and virtual reality (VR), which are used in the visualization stage. AR media has been widely integrated with various learning models and has successfully improved students' conceptual understanding (Alisa et al., 2024; Ismail & Amalia, 2021), critical thinking skills (Nofyanti & Andrijati, 2024), learning independence (Ekayogi, 2023), learning outcomes, and science process skills (Parung et al., 2024). Similarly, VR media integrated with various learning models can improve students' science literacy (Nurhidayah, 2024), teacher activity, student activity, learning motivation, and student learning outcomes (Sugiarto & Pratiwi, 2023).

The use of AR and VR media in this study contributed to an increase in student learning outcomes. However, there were differences between the learning outcomes of students who used AR and VR media as learning media. The increase in student learning outcomes was higher in classes taught using AR media. This may be because AR media can help students learn complex subjects in detail and realistically, making it easier for students to understand the material. Ganguly (2010) explains that the use of AR in learning has a positive impact on memory retention. Therefore, AR media can serve as a stimulus for students to have stronger memories (Radu, 2014). Students with strong memories will find it easier to repeat the material they have learned, which can lead to improved learning outcomes. Research conducted by (Fuchsova & Korenova, 2019) also shows that 93.4% of students stated that they liked the use of AR media in biology learning, and 98.4% of students stated that biology learning became more enjoyable when using AR.

Higher learning outcomes in classes that use AR media may also be achieved since AR media with 3D displays can make students more focused, allowing them to concentrate more easily on their studies. AR media allows students to see certain objects more clearly and in greater depth. Students can rotate images as they wish. This activity allows students to concentrate more on the objects being studied. Meanwhile, in VR media, the images seem more exploratory, and in one image or video, there are several objects that can make students less concentrated or less focused on the objects to be studied. Nasriruddin & Idris (2022) Their research showed that there is a significant influence between learning concentration and student learning outcomes, where learning concentration contributes 34% to student learning outcomes. Students who are able to concentrate during the learning process will be ready to grasp the material being taught. One way to improve student concentration is to limit the choice of objects to be observed or worked on by students (Nuryana & Purwanto, 2010).

CONCLUSION

Based on the results of research and discussion, the application of the SrVER-based learning model integrated with AR is more effective in improving student learning outcomes compared to the application of the SrVER learning model integrated with VR. AR media makes students more focused and concentrated in learning because it can display certain objects that can be seen more realistically and deeply. Meanwhile, VR media displays more objects because it visualizes the environment (many objects) in digital form to make it look more realistic. However, VR can still be implemented in learning, especially for learning objectives that emphasize learning experiences that require a comprehensive exploration of the environment.

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REFERENCES

Agustira, S., & Rahmi, R. (2022). Penggunaan Media Pembelajaran untuk Meningkatkan Hasil Belajar Siswa Pada Tingkat SD. *MUBTADI: Jurnal Pendidikan Ibtidaiyah*, *4*(1), 72–80. https://doi.org/10.19105/mubtadi.v4i1.6267

Ahmadi, & Supriyono. (2013). *Psikologi Belajar*.

Alisa, Suwangsih, E., & Solihah, P. (2024). Pengaruh Model Problem Based Learning Berbantuan Augmented Reality (AR) Terhadap Peningkatan Kemampuan Pemahaman Matematika Siswa Kelas V Sekolah Dasar. *Jurnal Ilmiah Wahana Pendidikan*, *10*(2), 89–102. https://doi.org/10.5281/zenodo.10472526

Ariesta, F. W. (2025). Optimizing Elementary Student Learning Outcomes through Differentiated Instruction Based on Learning Styles. *Jurnal Ilmiah Sekolah Dasar*, *9*(2), 356–364. https://doi.org/10.23887/jisd.v9i2.94754

Azmi, M. N., Mansur, H., & Utama, A. H. (2024). Potensi Pemanfaatan Virtual Reality Sebagai Media Pembelajaran di Era Digital. *Jurnal Dimensi Pendidikan Dan Pembelajaran*, *12*(1), 211–226. https://doi.org/10.24269/dpp.v12i1.9746

Bada, & Olusegun, S. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning. *IOSR Journal of Research & Method in Education*, *5*(6), 66–70. https://doi.org/10.9790/7388-05616670

Bire, A. L., Geradus, U., & Bire, J. (2014). Pengaruh Gaya Belajar Visual, Auditorial, Dan Kinestetik Terhadap Prestasi Belajar Siswa. *Jurnal Kependidikan*, *44*(2), 168–174. https://doi.org/10.31004/jrpp.v2i2.486

Budi, S. S., Suhaili, N., & Irdamurni, I. (2021). Konsep Gaya Belajar dan Implementasinya pada Proses Pembelajaran. *Journal of Educational and Learning Studies*, *4*(2), 232–236. https://doi.org/10.32698/01992

Chania, Y., Haviz, M., & Sasmita, D. (2016). Hubungan Gaya Belajar dengan Hasil Belajar Siswa pada Pembelajaran Biologi Kelas X SMAN 2 Sungai Tarab Kabupaten Tanah Datar. *Sainstek: Jurnal Sains Dan Teknologi*, *8*(1), 77–84. https://doi.org/10.31958/js.v8i1.443

Cheng, K. H., & Tsai, C. C. (2020). Students' Motivational Beliefs and Strategies, Perceived Immersion and Attitudes Towards Science Learning with Immersive Virtual Reality: A Partial Least Squares Analysis. *British Journal of Educational Technology*, *0*(0), 2139–2158. https://doi.org/10.1111/bjet.12956

Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches (3rd ed.).* Thousand Oaks, CA: SAGE Publications, Inc. https://doi.org/10.7748/nr.12.1.82

Djara, J. I., Imaniar, M., Sae, E., & Anin, S. (2023). Pengaruh Gaya Belajar Terhadap Hasil Belajar Siswa. *Jurnal Pendidikan Dan Kebudayaan*, *3*(2), 226–233. https://doi.org/10.55606/jurdikbud.v3i2.1907

Ekayogi, I. W. (2023). Penerapan Problem Based Learning Berbantuan Media Augmented Reality untuk Meningkatkan Hasil dan Kemandirian Belajar. *Jurnal Didaktika Pendidikan Dasar*, *7*(1), 181–196. https://doi.org/10.26811/didaktika.v7i1.1126

Fuchsova, M., & Korenova, L. (2019). Visualisation in Basic Science and Engineering Education of Future Primary School Teachers in Human Biology Education Using Augmented Reality. *European Journal of Contemporary Education*, *8*(1), 92–102. https://doi.org/10.13187/ejced.2019.1.92

Ganguly, P. K. (2010). Teaching and Learning of Anatomy in the 21st Century: Direction and the Strategies. *The Open Medical Education Journal*, *3*(1), 5–10. https://benthamopen.com/contents/pdf/TOMEDEDUJ/TOMEDEDUJ-3-5.pdf

Garzón, J., Kinshuk, Baldiris, S., Gutiérrez, J., & Pavón, J. (2020). How Do Pedagogical Approaches Affect the Impact of Augmented Reality on Education? A Meta-Analysis and Research Synthesis. *Educational Research Review*, *31*, 1–55. https://doi.org/10.1016/j.edurev.2020.100334

Gilakjani, A. P., & Lahijan. (2012). Visual, Auditory, Kinaesthetic Learning Styles and Their Impacts on English Language Teaching. *Journal of Studies in Education*, *2*(1), 104. https://doi.org/10.5296/jse.v2i1.1007

Handayani, B. S., Lestari, T. A., Suyantri, E., & Sukma, I. M. (2025). Development of visual learning style-based learning model biology subject. *Biosfer: Jurnal Pendidikan Biologi*, *18*(1), 115–125. https://doi.org/10.21009/biosferjpb.49270

Hidayanti, N. (2023). Implikasi Self Efficacy Albert Bandura dalam Pendidikan Agama Islam. *Risalah: Jurnal Pendidikan Dan Studi Islam*, *9*(4), 1626–1636. https://doi.org/10.31943/jurnal_risalah.v9i4.618

Hsiao, I. Y. T., Lan, Y.-J., Kao, C.-L., & Li, P. (2017). Visualization Analytics for Second Language Vocabulary Learning in Virtual Worlds. *Journal of Educational Technology & Society*, *20*(2), 161–175. https://blclab.org/wp-content/uploads/2013/02/Visualization-analytics-for-second-language-vocabulary-learning-in-virtual-worlds.pdf

Ismail, A., & Amalia, I. F. (2021). Penerapan Model Pembelajaran Problem Solving Berbantuan Augmented Reality Untuk Meningkatkan Pemahaman Konsep Mahasiswa Pada Mata Kuliah Fisika Umum. *Jurnal PETIK*, *7*(2), 87–92. https://doi.org/10.31980/jpetik.v7i2.1017

Johnson, M., & Mejwska, D. (2022). *Formal, Non-formal, and Informal Learning: What are They, and How Can We Research Them?* (Issue September).

Karo-Karo S, I. R., & Rohani. (2018). Manfaat Media dalam Pembelajaran. *Axiom: Jurnal Pendidikan Dan Matematika*, *7*(1), 91–96. http://dx.doi.org/10.30821/axiom.v7i1.1778

Kumar, A. N. (2016). The Effectiveness of Visualization for Learning Expression Evaluation: A Reproducibility Study. *Annual Conference on Innovation and Technology in Computer Science Education, ITiCSE*, *11-13-July*, 192–197. https://doi.org/10.1145/2899415.2899427

Listiyani, L. R. (2018). Implementasi Model Pembelajaran Inkuiri Berbasis Refleksi Kelompok pada Materi Reaksi Redoks. *JIPVA (Jurnal Pendidikan IPA Veteran*, *2*(1), 58–65. https://doi.org/10.31331/jipva.v2i1.576

Magdalena, I., & Affifah, A. N. (2021). Identifikasi Gaya Belajar Siswa (Visual, Auditorial, Kinestetik). *PENSA: Jurnal Pendidikan Dan Ilmu Sosial*, *2*(1), 1–8. https://doi.org/10.36088/pensa.v2i1.599

Mandasari, N. (2018). Elaborasi Kognitif Dalam Proses Abstraksi Konsep Matematika. *Prosiding Seminar Nasional 21 Universitas PGRI Palembang 05 Mei 2018*, 399–405. https://jurnal.univpgri-palembang.ac.id/index.php/Prosidingpps/article/view/1905

Maryam, N. O., Handayani, B. S., Lestari, T. A., & Setiadi, D. (2025). Pengaruh Model SrVER Berbantuan Media Virtual Reality (VR) terhadap Hasil Belajar Biologi Peserta Didik Kelas X SMAN 3 Mataram. *Journal of Classroom Action Research*, *7*(SpecialIssue), 381–387. http://jppipa.unram.ac.id/index.php/jcar/index

Muliani, M., Handayani, B. S., Lestari, T. A., & Setiadi, D. (2025). The Effect of the SrVER Learning Model Assisted by Augmented Reality Media on Biology Learning Outcomes. *Jurnal Pijar Mipa*, *20*(2), 291–296. https://doi.org/10.29303/jpm.v20i2.8629

Mustaqim, I. (2016). Pemanfaatan Augmented Reality sebagai Media Pembelajaran. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *13*(2), 174–183. https://doi.org/10.1109/SIBIRCON.2010.5555154

Nasriruddin, M. A., & Idris, H. (2022). Pengaruh Konsentrasi Belajar terhadap Hasil Belajar Siswa pada SMK Negeri 1 Sinjai. *Journal of Social Science and Character Education*, *1*(1), 1–6. https://ojs.unm.ac.id/Ecoculture/article/view/30322/15655

Nika, K., Wiryokusumo, I., & Karyono, H. (2019). Pengaruh Penggunaan Model Kooperatif Tipe Numbered Head Together Dan Direct Instruction Terhadap Hasil Belajar Matematika Pokok Bahasan Aritmatika Sosial Ditinjau dari Kemampuan Awal. *Jurnal Education and Development*, *7*(3),

43–48. https://media.neliti.com/media/publications/561427-pengaruh-penggunaan-model-kooperatif-tip-fe759518.pdf
Nofyanti, N., & Andrijati, N. (2024). Efektifitas Model Pembelajaran Berbasis Proyek Berbantuan Media Augmented Realiti terhadap Kemampuan Berpikir Kritis Matematis Siswa Sekolah Dasar. *Jurnal Ilmiah Pendidikan Dasar*, *09*(03), 321–335. https://doi.org/10.23969/jp.v10i01.23451
Noviana, M. (2020). Persepsi Mahasiswa STKIP Widya Yuwana Tentang Manfaat Kegiatan Refleksi dalam Pendidikan Katekis [Sekolah Tinggi Keguruan dan Ilmu Pendidikan Widya Yuwana]. In *Block Caving – A Viable Alternative?* https://www.golder.com/insights/block-caving-a-viable-alternative/
Nurhidayah, A. (2024). *Pengaruh Virtual Reality (Vr) Berbantuan Model Problem Based Learning (Pbl) Untuk Meningkatkan Kemampuan Literasi Sains Siswa*. Universitas Islam Negeri Syarif Hidayatullah.
Nuryana, A., & Purwanto, S. (2010). Efektivitas Brain Gym dalam Meningkatkan Konsentrasi Belajar pada Anak. *IIndigenous, Lmiah Berkala Psikologi*, *12*(1), 88–99. https://journals.ums.ac.id/indigenous/article/view/1558
Parung, Y., Herliani, H., Maasawet, E. T., & Rambitan, V. M. M. (2024). Pengaruh Model Pembelajaran Case Based Learning Berbantuan Ar terhadap Hasil Belajar dan Keterampilan Proses Sains Siswa. *PENDIPA Journal of Science Education*, *8*(2), 284–291. https://doi.org/10.33369/pendipa.8.2.284-291
Phillips, D. C. (1995). The Good, the Bad, and the Ugly: the Many Faces of Opioids. *Educational Research*, *24*(7), 5–12. https://doi.org/10.1016/j.bja.2019.04.003
Pires, E. M. S. G., Daniel-Filho, D. A., de Nooijer, J., & Dolmans, D. H. J. M. (2020). Collaborative learning: Elements encouraging and hindering deep approach to learning and use of elaboration strategies. *Medical Teacher*, *42*(11), 1261-1269. https://doi.org/10.1080/0142159X.2020.1801996
Pozas, M., Letzel, V., & Schneider, C. (2020). Teachers and Differentiated Instruction: Exploring Differentiation Practices to Address Student Diversity. *Journal of Research in Special Educational Needs*, *20*(3), 217–230. https://doi.org/10.1111/1471-3802.12481
Prastawati, T. T., & Mulyono, R. (2023). Peran Manajemen Pembelajaran dalam Meningkatkan Prestasi Belajar Siswa Melalui Penggunaan Alat Peraga Sederhana. *Didaktik : Jurnal Ilmiah PGSD FKIP Universitas Mandiri*, *09*(01), 378–392. https://doi.org/10.36989/didaktik.v9i1.709
Pristiwanti, D., Badariah, B., Hidayat, S., & Dewi, R. S. (2022). Pengertian Pendidikan. *Jurnal Pendidikan Dan Konseling*, *4*(6), 7911–7915.
Putra, R. R., Fitri, R., Hartanto, I., & Selaras, G. H. (2020). Multiple Intelligences of Students in SMAN 1 V Koto Kampung Dalam Padang Pariaman. *Jurnal Atrium Pendidikan Biologi*, *5*(3), 14. https://doi.org/10.24036/apb.v5i3.6430
Putri, R. A., Magdalena, I., Fauziah, A., & Azizah, N. F. (2020). Pengaruh Gaya Belajar terhadap Pembelajaran Siswa Sekolah Dasar. *Cerdika: Jurnal Ilmiah Indonesia*, *1*(2), 157–163. https://doi.org/10.59141/cerdika.v1i2.26
Radu, I. (2014). Augmented Reality in Education: A Meta-Review and Cross-Media Analysis. *Personal and Ubiquitous Computing*, *18*(6), 1533–1543. https://doi.org/10.1007/s00779-013-0747-
Ricketts, H. K., Salsbury, A. M., Bevan, D. R., & Brown, A. M. (2018). Using Immersive Visualization Environments to Engage Students in Hands-On Learning. *Proceedings of the Practice and Experience on Advanced Research Computing: Seamless Creativity*, 1–5. https://doi.org/10.1145/3219104.3229274
Sari, U. P., BT, S., & Maryamah. (2022). Kompetensi Guru dalam Memahami Gaya belajar Siswa. *Jurnal Pendidikan Islam Al-Affan*, *2*(2), 180–185. https://doaj.org/article/1e8aebf063e94d09a7eb93f04cf4b8fd
Sugiarto, A. R., & Pratiwi, D. A. (2023). Implementasi Model Pemimpin Berbantuan Media Vr Box dan Aplikasi Kahoot untuk Meningkatkan Aktivitas dan Motivasi Belajar Siswa Kelas IV. *Jurnal Ilmiah Multi Disiplin Indonesia*, *2*(10), 2224–2237. https://journal.ikopin.ac.id/index.php/humantech/article/view/3549/2987
Tomaszewski, W., Xiang, N., Huang, Y., Western, M., McCourt, B., & McCarthy, I. (2022). The Impact of Effective Teaching Practices on Academic Achievement When Mediated by Student Engagement: Evidence from Australian High Schools. *Education Sciences*, *12*(5), 1–14. https://doi.org/10.3390/educsci12050358

Waryani. (2021). *Dinamika Kinerja Guru dan Gaya Belajar Konsep dan Implementasi terhadap Prestasi Belajar*.

Widayanti, F. D. (2013). The Importance of Knowing Student Learning Styles in Classroom Learning Activities. *Erudio Journal of Educational Innovation*, *2*(1), 7–20.

Wowor, E. C., Tumewu, W. A., & Mokalu, Y. B. (2022). Implementasi Repetitive Method Melalui Kegiatan Refleksi dalam Pembelajaran. *SOSCIED: Journal Social, Science and Education*, *5*(2), 272–279. https://doi.org/10.32531/jsoscied.v5i2.545