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Development Of Augmented Reality-Based Science Learning Media for Earthquake Mitigation Readiness at Qatrinnada Kindergarten in Padang City

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Abstract: This study was motivated by the low level of knowledge and skills among early childhood students in earthquake mitigation, partly due to uninteresting learning media and a low level of integration of the latest technology. The aim of this study was to develop augmented reality-based science learning media to improve earthquake mitigation preparedness among early childhood students. The research employs the R&D Gall, Gall, and Ball development model with nine stages, involving validation by three experts (content, media, and instruments) and a pilot test with participants from Group B of Qatrinnada Kindergarten in Padang City. Data were collected through observation, questionnaires, and documentation, then analyzed using validity, practicality, effectiveness, N-gain, and paired sample t-test analyses. Validation results showed high validity for the material (89.23%) and instruments (86%), and validity for the media (76%). The media was deemed highly practical (92.30%) and provided knowledge improvement with moderate N-gain values for the small class (0.69) and large class (0.58). The t-test revealed a significant difference between pretest and posttest scores (sig. 0.000 < 0.05). Therefore, the augmented reality-based science learning media developed is effective in enhancing earthquake mitigation readiness among young children.

Keywords: Augmented Reality; Earthquake Mitigation; Early Childhood; Science Learning Media

Introduction

Indonesia is located on the Pacific Ring of Fire, making it one of the countries with the highest risk of earthquakes in the world (Hamdi et al., 2022; Haoying et al., 2025; Roza,. 2024). These disasters can occur suddenly and have a major impact on the safety of lives, infrastructure, and the psychological well-being of the community (M. H. Hamdi, 2024; M. Hamdi, Yusra, et al., 2022; Rasimin & Hamdi, 2021). Young children are a highly vulnerable group to the impacts of earthquakes due to their limited cognitive abilities, motor skills, and experience in handling emergency situations (M. Hamdi et al., 2022; Meichika & Yaswinda, 2025; Natari et al., 2025). Previous research has shown that disaster preparedness education from an early age can significantly reduce the risk of loss of life and strengthen community resilience (Helena et al., 2024; Nafadhila & Mahyuddin, 2025; Pratiwi & Yaswinda, 2024).

However, the implementation of disaster mitigation education in early childhood education institutions still faces various challenges. The learning media used tend to be conventional, less interactive, and have not optimized the potential of modern learning technology (Jasmanedi et al., 2025; Prasetyo et al., 2024; Prasetyo et al., 2024; Rinaldi et al., 2025). The

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development of augmented reality (AR) technology offers new opportunities to create immersive, interactive learning experiences that are appropriate for children's developmental characteristics (Indika et al., 2023; Nyoman et al., 2024; Padli et al., 2024; Sari, Indika, et al., 2025). AR has been proven to enhance learning motivation, conceptual understanding, and practical skills across various educational levels; however, its application in the context of earthquake mitigation for young children remains limited (Hidayat et al., 2025; Ilham et al., 2024; Sari et al., 2023; Sari et al., 2023).

Although various studies have proven the effectiveness of augmented reality in improving engagement and understanding of learning concepts , most studies focus on elementary or secondary school students, with little attention paid to early childhood education (PAUD) (Helena et al., 2024; Meichika & Yaswinda, 2025; Natari et al., 2025; Pratiwi & Yaswinda, 2024). In addition, existing research generally only assesses the feasibility of the media without testing its practicality and effectiveness comprehensively, especially in the context of earthquake mitigation. In Indonesia, no studies have specifically integrated AR with earthquake mitigation content tailored to the cognitive, affective, and psychomotor developmental characteristics of early childhood, let alone those based on local contexts such as the city of Padang, which has a high vulnerability to disasters (Nafadhila & Mahyuddin, 2025; Salwa & Mahyuddin, 2025).

This study fills this gap by developing AR-based science learning media specifically designed to improve earthquake mitigation preparedness in early childhood. The uniqueness (novelty) of this study lies in the application of Gall, Gall, and Ball's Research and Development (R&D) model, which includes stages of expert validation of materials, media, and instruments, limited trials, and extensive trials. The developed media were not only evaluated for feasibility but also for practicality and effectiveness through N-gain analysis and paired sample t-tests, thereby generating comprehensive empirical evidence regarding the impact of AR use on enhancing disaster preparedness among young children in early childhood education settings.

Thus, the purpose of this study is to develop, validate, and test the effectiveness of augmented reality-based science learning media as an innovative strategy to improve earthquake mitigation preparedness in early childhood. This study is expected to contribute to the international literature in the field of technology-based disaster education, as well as offer practical solutions for educators and policymakers.

Method

Research Methods

This research is research and development (R&D). The focus of the development research is the creation of educational products that can be used to develop and validate educational products. The purpose of this research is to create augmented reality-based science learning media that can help early childhood education students at Qatrinnada Kindergarten in Padang City to be better prepared to deal with earthquakes.

Research Procedure

This study adapts the development model proposed by Gall and Borg (Az-Zahra et al., 2025), which consists of nine stages, namely: (1) Assess needs to identify goals or conduct a needs analysis to identify goals; (2) Conduct instructional analysis to analyze learning materials; (3) Analyze learners and context to analyze learner characteristics and the learning context; (4) Write performance objectives or formulate measurable learning objectives; (5) Develop assessment instruments to create assessment tools; (6) Develop instructional strategies or design learning strategies; (7) Develop and select instructional materials to develop and select learning media; (8) Design and conduct formative evaluation of instruction or carry out formative evaluation; and (9) Revise instruction to revise the product based on evaluation results. 10) Design and Conduct Summative Evaluation. Figure 1 provides a detailed explanation.

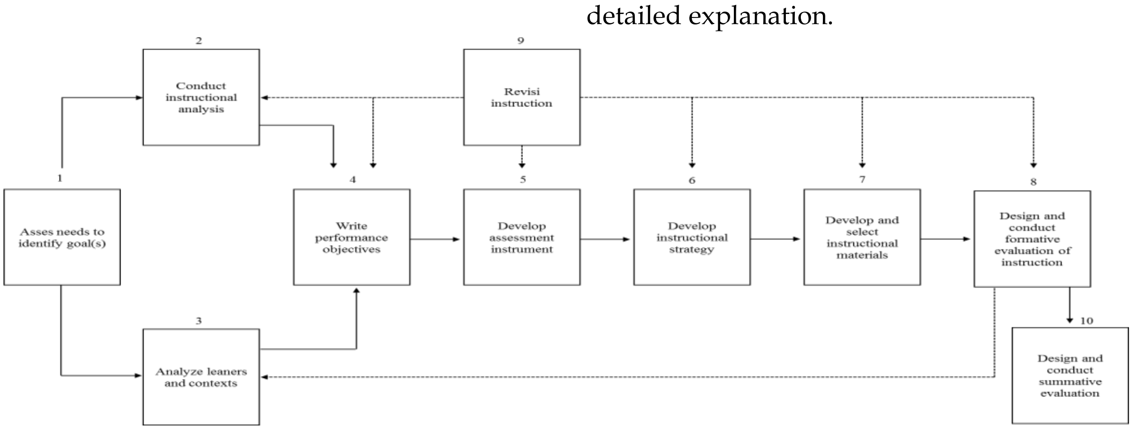

Figure 1. Gall, Gall, and Ball Development Model

Research Subject

The research subjects consisted of students in Group B at Qatrinnada Kindergarten in Padang City, involving three experts as validators, namely a subject matter expert, a media expert, and an instrument expert. The development process focused on creating augmented reality-based science learning media as a means of improving earthquake mitigation preparedness in early childhood.

Focus on Model Development

The material in augmented reality (AR)-based science learning media focuses on earthquake mitigation preparedness, covering basic concepts, causes, signs, mitigation instructions through interactive simulations, and reflective questions to reinforce children's understanding. This media is equipped with animations, images, and audio to attract interest in learning, so that it is expected to improve children's science skills. Based on Piaget's theory, children aged 5–6 years are in the concrete operational stage of cognitive development, so media that can overcome spatial and temporal limitations, align with developmental characteristics, and adhere to early childhood learning principles are necessary. The content is designed to provide contextual and enjoyable learning experiences while instilling earthquake preparedness skills (Ummayah et al., 2025).

Data Analysis

This study's data analysis covered teacher responses, student learning effectiveness, and validation of Augmented Reality (AR)-based science learning media. Teacher responses were collected using a five-point Likert scale questionnaire (Sari et al., 2025; Selviani et al., 2025) and analyzed descriptively by calculating feasibility percentages based on set criteria. Student learning effectiveness was evaluated through classroom observations using the same scale, with results expressed as percentages, categorized by success level, and tested for pretest–posttest differences using a paired *t*-test. Expert validation used a five-point Likert scale questionnaire and Aiken's V formula (Gong et al., 2024; Maulina & Suryana, 2023), with "Feasible" as the minimum requirement for use. All analyses, both descriptive and inferential, were performed using SPSS version 25 to ensure accurate calculations and clear result interpretation.

Result and Discussion

Media Validation

The data from the media expert's assessment of the media aspects is shown in Table 1 below.

Table 1. Data from Media Validator Assessment

Indicator	Score
Presentation	24
Display	14
Total	38
∑	50
Percentage	76%

From the table above, it can be seen that the validation results for the appearance aspect obtained a total of 28 data points with an average of 4, with 76% falling into the acceptable and valid category. After conducting product validation tests on the visual appearance, media experts provided several general comments and suggestions for improving the design of the media products being developed.

Large-Scale Trials

The large-scale trial is a continuation of the small-scale trial after improvements have been made.

Table 2. Pre-test and Post-test Scores

Pretest	Description	Posttest	Description
50,000	MB	96.4286	BSB

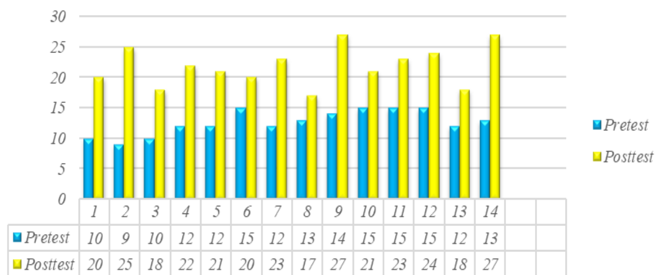

Figure 2. Comparison of Pre-test and Post-test Tests

Based on Table 2 and Figure 2 above, it can be seen that the results of the large-scale trial test show two different sets of data, namely the pretest and posttest scores. The average pretest score for 16 children was 48.62, categorized as "Beginning to Develop" (MB). Meanwhile, the average posttest score was 78.06, falling into the "Very Good Development" (BSB) category. This indicates that the augmented reality-based science learning media has a very high level of effectiveness.

The results of the N-Gain test are as follows:

$$N - gain = \frac{Mean\ posttest - mean\ pretest}{Max\ Skor - mean\ pretest} \quad (1)$$

$$N - gain = \frac{78.06 - (48.62}{100 - (48.62)}$$

N - $gain$ = 0.58

The N-Gain test results obtained an N-Gain score for earthquake mitigation readiness in children in large-scale trials of 0.58, indicating that the development of augmented reality-based science learning media for earthquake mitigation readiness at Qatrinnada Kindergarten in Padang City is in the moderate category.

Table 3. Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre	.164	14	.200*	.901	14	.116
Post	.106	14	.200*	.956	14	.655

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 4. Test of Homogeneity of Variances

Earthquake Mitigation			
Levene Statistic	df1	df2	Sig.
2.876	1	26	.102

Based on Table 3, the normality test value for the pretest is 0.116 > 0.05 and for the posttest is 0.655 > 0.05, so H0 is accepted. Therefore, it can be concluded that the data is normally distributed. Based on Table 4, the homogeneity test value = 0.102 > 0.05, so H0 is accepted. Therefore, it can be concluded that the data is homogeneous.

Table 5. Results of Paired Sample t-test

Paired Differences				t	df	Sig. (2-tailed)
Mean	Std. Deviation	95% CI Lower	95% CI Upper			
-9.214	3.468	-11.217	-7.212	-9.941	13	..000

Based on Table 5, the sig. (2-tailed) value is 0.000 < 0.05 with α = 0.05. Therefore, the decision is to reject H0, meaning that there is a difference in the mean values between the pre-test and post-test scores for children's earthquake mitigation readiness in the large-scale classroom trial. The results of this data analysis indicate that the development of science-based augmented reality learning media for earthquake mitigation readiness at Qatrinnada Kindergarten in Padang City is significant.

Validity of Science Learning Media Based on Augmented Reality

The validation results by subject matter experts and media experts indicate that the science learning media based on augmented reality (AR) for earthquake mitigation readiness falls into the highly valid category. This validity is attributed to the alignment of the material with the Early Childhood Education (ECE) curriculum, the integration of learning objectives, and the relevance to the developmental characteristics of young children in understanding natural disaster concepts.

In terms of design, the use of color composition, font size, layout, and color gradients improves readability and attractiveness, aligning with effective instructional design principles (Lever et al., 2025; Paes et al., 2024). The use of simple language, clear illustrations, and audio support further enhances children's comprehension, supporting Garg et al, (2025) findings on the effectiveness of visual-audio integration in increasing cognitive engagement.

Effectiveness in Small-Scale Trials

Large-scale trials have shown that augmented reality can improve earthquake mitigation preparedness among young children. This effectiveness is due to the attractive design of augmented reality, in terms of color selection, story development, and interactive elements such as accompanying audio. Children responded enthusiastically, showing high levels of interest and curiosity toward the augmented reality (Kheildar et al., 2025; Ying et al., 2025). The importance of developing AR media in earthquake mitigation learning lies in its ability to present complex information in a more interactive and easily understandable way for children (Qi et al., 2025).

Through AR, basic concepts such as the causes of earthquakes and the mitigation steps that need to be taken can be presented visually, dynamically, and enjoyably. Children can interact directly with virtual objects that depict earthquakes and how to deal with them safely. This is in line with research conducted by (Demiray et al., 2025). Learning media is a medium that facilitates and is a very important part of teaching and learning activities. Learning media in early childhood education must be attractive and able to stimulate all aspects of children's development. AR provides safe yet realistic simulations, consistent with experiential learning principles (Rekabi et al., 2025; Wahid et al., 2025) that emphasize learning through direct experience. The interactive visualizations made abstract concepts concrete, facilitating understanding and retention (M. Hamdi, 2016; Suryana & Kurnia, 2025; Suryana et al., 2024).

The findings of this study are in line with several studies that confirm that AR is an effective learning medium for improving the quality of learning in early childhood education. Furthermore, the results of this study support the view that learning media should have attractive, interactive characteristics and be able to stimulate all aspects of child development. Thus, this study contributes to the literature on early childhood education technology, particularly in the context of disaster education, and opens up opportunities for the development of technology-based media that are adaptive to the needs and developments of the times.

The development of augmented reality

The development of augmented reality-based science learning media that has been developed will be presented in Figure 3 below.

Figure 3. Final Media Product

The results of this study have important implications for the development of learning media at the Early Childhood Education (PAUD) level, particularly in disaster mitigation education. The use of augmented reality (AR) has proven effective in presenting complex information, such as the causes and mitigation measures for earthquakes, in a simpler, more engaging, and interactive manner (Nafadhila & Mahyuddin, 2025). With this approach, children can gain learning experiences that resemble real-life situations without facing risks, thereby developing preparedness skills from an early age. Integrating AR into the PAUD curriculum can serve as an innovative strategy to foster sustainable disaster awareness and contribute to the development of a generation better equipped to handle future disaster risks.

Although showing positive results, this study has several limitations. First, the sample size is relatively small, so the findings of this study cannot be generalized widely. Second, the use of technological devices such as projectors, loudspeakers, and gadgets is an important factor in the successful implementation of media, so schools with limited facilities may face obstacles in its application. Third, the developed media focuses on a single type of disaster, namely earthquakes, so its effectiveness for other types of disasters still needs to be tested through further research. These limitations present an opportunity for future research that can test the effectiveness of similar media with a broader scope of disasters and involving a larger number of participants.

Conclusion

This study produced a highly valid and usable augmented reality (AR)-based science learning medium to improve earthquake mitigation preparedness among early childhood students at Qatrinnada Kindergarten in Padang City. Validation by subject matter experts and media experts showed that the content, learning objectives, and graphic design were appropriate and supported children's engagement in the learning process (Gong et al., 2024). Trials in small and large classes proved that the use of AR media can improve children's knowledge, skills, and awareness in dealing with earthquakes through engaging, interactive learning experiences that are appropriate for the cognitive development of young children. These findings confirm that the integration of AR technology in disaster mitigation education in early childhood education can be an effective innovative strategy in building preparedness from an early age. Although this study has limitations, such as a small sample size and reliance on technological devices, the results open opportunities for the development of similar media for other types of disasters and their application in various educational contexts. Thus, AR-based learning media are not only theoretically relevant but also have high practical potential to support disaster education in Indonesia.

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Conflicts of Interest
The authors declare no conflict of interest

References

Az-Zahra, R. T., Suryana, D., & Eliza, D. (2025). Development of Smart Box Media Based on QR Code Technology to Improve Early Childhood Numerical Literacy Skills. *Jurnal Penelitian Pendidikan IPA*, *11*(3), 80–86.

Demiray, B. Z., Sermet, Y., Yildirim, E., & Demir, I. (2025). FloodGame: An interactive 3D serious game on flood mitigation for disaster awareness and education. *Environmental Modelling & Software*, *188*, 106418. https://doi.org/https://doi.org/10.1016/j.envsoft.2025.106418

Garg, V., Vinod, G., Singh, S., & Kant, V. (2025). Human reliability analysis for internal fire event with virtual reality – Conceptualization and challenges. *Nuclear Engineering and Design*, *444*, 114379. https://doi.org/https://doi.org/10.1016/j.nucengdes.2025.114379

Gong, P., Lu, Y., Lovreglio, R., Lv, X., & Chi, Z. (2024). Applications and effectiveness of augmented reality in safety training: A systematic literature review and meta-analysis. *Safety Science*, *178*, 106624. https://doi.org/https://doi.org/10.1016/j.ssci.2024.106624

Hamdi, M. (2016). Teori kepribadian sebuah pengantar. *Bandung: Alfabeta*.

Hamdi, M. H. (2024). How Work Environment, Job Characteristics, and Motivation Predict Employee Performance: A Study in Muaro Jambi Regency, Indonesia. *International Conference on Learning Community*, *1*(1), 386–400.

Hamdi, M., Sultoni, S., & Sukma, A. (2022). The role of family, school, and society in moral development and character building elementry school age children. *Jurnal Prajaiswara*, *3*(2), 156–169.

Hamdi, M., Yusra, A., & Sarman, F. (2022). Konseling Kelompok Solution Focused Brief Counseling (SFBC) untuk Meningkatkan Pemahaman Tupoksi Terhadap Perubahan Regulasi Kepegawaian di Institusi Pemerintah Daerah. *Bulletin of Counseling and Psychotherapy*, *4*(3), 618–627.

Haoying, Z., Jingjing, P., Han, Q., Yun, L., Demartino, C., Quinci, G., & Paolacci, F. (2025). A methodological framework for assessing economic loss in urban seismic disaster. *Computers & Industrial Engineering*, *207*, 111273. https://doi.org/https://doi.org/10.1016/j.ijdrr.2025.105508

Helena, H., Yaswinda, Y., Rahmi, A., Rahmalia, D., Intan, N., & Zeky, S. (2024). Science Learning Model Based on Multisensory-Ecologi of Cognitive and Social Development in Early Chilhood. *International Journal of Islamic Studies Higher Education*, *3*(2), 96–107.

Hidayat, R., Bahtra, R., Putra, A. N., & Kurniawan, R. (2025). The Influence of Speed , Flexibility and Agility on the Dribbling Ability of Futsal Players Vamos Academy Padang. *Jurnal Penelitian Pendidikan IPA*, *11*(3), 87–93. https://doi.org/10.29303/jppipa.v11i3.10537

Ilham, I., Agus, A., Tomoliyus, T., Sugiyanto, F. X., Tirtawirya, D., Lumintuarso, R., … Jean-Berchmans, B. (2024). Comparative Analysis of Adaptations Progress in VO2max , Leg Power , and Agility among Male and Female Sports Science Students Análisis Comparativo del Progreso de las Adaptaciones en VO2max , Potencia de Piernas y Agilidad entre Estudiantes Masculinos y. *Retos*, *57*, 245–257. https://doi.org/10.47197/retos.v57.107053

Indika, P. M., Kurniawan, R., Bahtra, R., & Yuniarti, E. (2023). The Effect of Administration of Honey on Maximal Physical Activity in Malondialdehyd (Mda) Levels of Male Mice (Mus musculus L.). *Proceedings of the 3rd International Conference on Biology, Science and Education (IcoBioSE 2021)*, 171–180. Atlantis Press. https://doi.org/10.2991/978-94-6463-166-1_25

Jasmanedi, R., Barlian, E., & Kurniawan, R. (2025). Analysis of Physical Fitness of Elementary School Learners in the Beachside , Plain , and Mountain Areas of Padang City. *Jurnal Penelitian Pendidikan IPA*, *11*(3), 19–25. https://doi.org/10.29303/jppipa.v11i3.10374

Kheildar, F., Samouei, P., & Mansoorizadeh, M. (2025). Reinforcement learning-dijkstra-genetic algorithm for debris removal problem under different scenarios: An earthquake case study. *Engineering Applications of Artificial Intelligence*, *151*, 110693. https://doi.org/https://doi.org/10.1016/j.engappai.2025.110693

Lever, J., Cheng, S., Quilodrán Casas, C., Liu, C., Fan, H., Platt, R., … Arcucci, R. (2025). Facing & mitigating common challenges when working with real-world data: The Data Learning Paradigm. *Journal of Computational Science*, *85*, 102523. https://doi.org/https://doi.org/10.1016/j.jocs.2024.102523

Maulina, N., & Suryana, D. (2023). Implementasi Gerakan Literasi Sekolah Melalui Sudut Baca Anak Usia 5-6 Tahun Di Taman Kanak-Kanak Yari School Padang. *Jurnal Mutiara Pendidikan*, *3*(3), 102–109.

Meichika, D., & Yaswinda, Y. (2025). Pengaruh Media Augmented Reality Terhadap Kemampuan Sains Anak Usia Dini. *IJIGAEd: Indonesian Journal of Islamic Golden Age Education*, *6*(1), 46–57.

Nafadhila, A., & Mahyuddin, N. (2025). Efektivitas Media Compact Disc Interaktif Terhadap Kesantunan Berbahasa Lisan Anak Di Taman Kanak-Kanak Negeri Pembina Pasaman. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, *11*(02), 212–223.

Natari, R., Rakimahwati, R., Mayar, F., & Yaswinda, Y. (2025). Implemetation of Project Based Learning to Increase Creativity And Critical Thinking Abilities of Early Childhood. *JETL (Journal of Education, Teaching and Learning)*, *10*(1).

Nyoman, A. A., Kurniawan, R., Sari, A. P., & ... (2024). Pengaruh Latihan Renang Terhadap Pengembangan Keterampilan Motorik Anak: Systematic Literature Review. *… Pendidikan*, *8*(2), 114–122. https://doi.org/https://doi.org/10.17509/jpp.v20i1.24557

Padli, P., Prasetyo, T., Kurniawan, R., Putra, R. A., & Candra, O. (2024). The influence of environment and social interaction on the formation of athlete character: a descriptive study. *Revista Iberoamericana de Psicología Del Ejercicio y El Deporte*, *19*(4), 430–434.

Paes, D., Feng, Z., King, M., Khorrami Shad, H., Sasikumar, P., Pujoni, D., & Lovreglio, R. (2024). Optical see-through augmented reality fire safety training for building occupants. *Automation in Construction*, *162*, 105371. https://doi.org/https://doi.org/10.1016/j.autcon.2024.105371

Prasetyo, T., Kurniawan, R., Putra, R. A., & Candra, O. (2024). The Role of Sports in Preventing and Overcoming Problems During the Transition Period Case Study of Adolescents in Indonesia: Descriptive Study. *Social Science and Humanities Journal (SSHJ)*, *8*(07), 4477–4489. https://doi.org/https://doi.org/10.18535/sshj.v8i07.1213

Prasetyo, T., Kurniawan, R., Putra, R. A., & Sipayung, A. Y. (2024). The Role Of Multimedia In The Process Physical Education Learning: Study Literature. *Journal Sport Science Indonesia*, *3*(3), 493–504. https://doi.org/https://doi.org/10.31258/jassi.3.3.493-504

Pratiwi, V., & Yaswinda, Y. (2024). Pengaruh Eksperimen Pelangi Terhadap Kemampuan Sains

Anak Di Taman Kanak-kanak Nur Ilaahi Lubuk Buaya Kota Padang. *JCE (Journal of Childhood Education)*, *8*(2), 126–135.

Qi, H., Zhou, J., Peng, K., & Khandelwal, M. (2025). Knowledge structure and research progress in earthquake-induced liquefaction assessment from 2000 to 2023: A scientometric analysis incorporating domain knowledge. *Soil Dynamics and Earthquake Engineering*, *188*, 109075. https://doi.org/https://doi.org/10.1016/j.soildyn.2024.109075

Rasimin, M. P., & Hamdi, M. (2021). *Bimbingan dan Konseling Kelompok*. Bumi Aksara.

Rekabi, S., Sazvar, Z., & Tavakkoli-Moghaddam, R. (2025). A data-driven approach to optimize a blood supply chain within the Industry 5.0 framework: A stochastic optimization model. *Expert Systems with Applications*, *289*, 127960. https://doi.org/https://doi.org/10.1016/j.eswa.2025.127960

Rinaldi, R., Argantos, A., Syahrastani, S., Zulbahri, Z., & Kurniawan, R. (2025). Evaluation of the Achievement Development Program of Swimming Athletes of the Indonesian Aquatic Federation (IAF) Solok City. *Jurnal Penelitian Pendidikan IPA*, *11*(3), 26–33. https://doi.org/10.29303/jppipa.v11i3.10373

Roza, D. (2024). Urgensi profesionalisme guru pendidikan anak usia dini dalam penyelenggaraan perlindungan anak. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *4*(1), 277.

Salwa, C., & Mahyuddin, N. (2025). Pengaruh Kegiatan Eksperimen Hidroponik Terhadap Kemampuan Proses Sains Anak Usia Dini Di Taman Kanak-Kanak Kemala Bhayangkari 03 Alai. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *10*(02), 243–250.

Sari, A. P., Bafirman, Rifki, M. S., Syafrianto, D., & Kurniawan, R. (2023). The impact of maumere gymnastics on blood pressure reduction in hypertensive patients: A promising non-pharmacological intervention. *Journal Sport Area*, *8*(3), 328–339. https://doi.org/10.25299/sportarea.2023.vol8(3).11727

Sari, A. P., Indika, P. M., Arnando, M., Welis, W., Umar, Bahtra, R., … Kurniawan, R. (2025). Creative Gymnastics: An Innovative Approach to Blood Pressure Management in Hypertensive Patients. *Annals of Applied Sport Science*, *13*(Special-Issue), 57–62. https://doi.org/10.61186/aassjournal.1485.ABSTRACT

Sari, A. P., Kurniawan, R., Indika, P. M., Wulan, T. S., Syafrianto, D., & Sari, D. N. (2023). Exploring the impact of aerobic gymnastics on reducing blood: with hypertension medications vs without hypertension medications. *Journal of Physical Education and Sport*, *23*(12), 3253–3263. https://doi.org/10.7752/jpes.2023.12372

Sari, A. P., Rahmadhanti, R., Car, B., Pavlović, R., Ndayisenga, J., Prasetyo, T., & Kurniawan, R. (2025). Royal Jelly Potentially Reduces Oxidative Stress and Inflammation after Physical Activity : A Systematic Literarure Review. *South Eastern European Journal of Public Health*, *XXVI*, 1939–1954.

Selviani, I., Sari, A. P., Gustina, T., Maliza, R. P., Yusriana, A., Qori, A. M., … Kurniawan, R. (2025). Effectiveness of Kegel Exercise as an Intervention to Reduce Pain in Parturients. *Annals of Applied Sport Science*, *13*(Special-Issue), 83–86. https://doi.org/10.61186/aassjournal.1485.ABSTRACT

Suryana, D., & Kurnia, R. (2025). Introducing Local Culture through Local Content Curriculum to Young Children. *International Journal of Interdisciplinary Educational Studies*, *20*(1).

Suryana, D., Lina, L., & Sari, N. E. (2024). E-Module to Assist Early Childhood Learning. *The International Journal of Early Childhood Learning*, *31*(2), 55.

Ummayah, Y. A., Nurhafizah, N., Mayar, F., & Mahyuddin, N. (2025). The Impact of Using Immersive Virtual Reality Technology on Children's Communication Skills in Kindergartens in Padang City. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *13*(1), 112–121.

Wahid, J. A., Xu, M., Ayoub, M., Jiang, X., Lei, S., Gao, Y., … Yang, Y. (2025). AI-driven social media text analysis during crisis: A review for natural disasters and pandemics. *Applied Soft Computing*, *171*, 112774. https://doi.org/https://doi.org/10.1016/j.asoc.2025.112774

Ying, Z., Congcong, W., Sornette, D., & Chengxiang, Z. (2025). Integrating artifical intelligence and geophysical insights for earthquake forecasting: A cross-disciplinary review. *Earth-Science Reviews*, 105232. https://doi.org/https://doi.org/10.1016/j.earscirev.2025.105232