Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini
Volume 15, Number 1, 2026 pages 165-182
P-ISSN: 2301-9905 E-ISSN: 2775-409X
Open Access: https://jurnal.umt.ac.id/index.php/ceria/index

Earthquake Disaster Education for Early Childhood Through the Earthquake Escape Game

Safira Badzlin[1*], Pramono[2], Munaisra Tri Tirtaningsih[3]
[1,2,3]Universitas Negeri Malang, Malang, Indonesia
e-mail: [1*]safira.badzlin.2101536@students.um.ac.id,
[2]pramono.fip@um.ac.id, [3]munaisra.tri.fip@um.ac.id

ARTICLE INFO

Article history:
Received: August 8, 2025
Accepted: January 6, 2026
Available online on:
January 23, 2026

Keywords:
Disaster Mitigation; Educational Games; Early Childhood Education

ABSTRACT

Indonesian children's knowledge of disaster mitigation remains relatively low compared to that of children in developed countries. Therefore, engaging and accessible educational approaches are needed, one of which is learning through games. This study employed a Research and Development (R&D) approach using the SYNTHESIS model. The data analysis techniques included both qualitative and quantitative analyses. The result of this research is an educational game called *Earthquake Escape*, which was designed to enhance early childhood understanding of earthquake disaster mitigation.

Introduction

Indonesia is frequently affected by natural disasters. Data from the National Disaster Management Agency (BNPB) show that over the past five years, 20,474 natural disaster events have occurred in Indonesia (National Disaster Management Agency, 2024). The primary factor contributing to the high incidence of natural disasters is Indonesia's geographical position between three major tectonic plates—the Indo-

Australian, Pacific, and Eurasian plates—which makes the country highly prone to earthquakes, tsunamis, and volcanic activity. In addition, Indonesia is located along the Pacific Ring of Fire and has more than 140 active volcanoes (Yulistiya, 2022).

The level of community preparedness also significantly influences the impact caused by natural disasters. The level of public knowledge regarding disaster mitigation in Indonesia is still considered low compared to that of developed countries (Lestari et al., 2023). In fact, disaster mitigation education has been proven to reduce both material losses and casualties resulting from natural disasters.

Other countries, such as Japan, also face high risks of natural disasters but have succeeded in reducing their impacts through disaster mitigation education integrated into the formal education curriculum. Children in Japan are taught how to respond to disaster risks, including earthquakes and tsunamis, through routine simulations conducted in schools (Suzuki & Kanamori, 2021). These measures have been proven effective in increasing preparedness and reducing the number of casualties.

In contrast, disaster mitigation awareness in Indonesia, particularly among early childhood learners, remains insufficient. According to data from the Regional Disaster Management Agency (BPBD) of Malang Regency, in 2023 more than 15 villages in Malang Regency experienced damage caused by natural disasters, including earthquakes, landslides, and volcanic eruptions. However, efforts to provide disaster mitigation

education for early childhood have not been optimal. Local communities generally receive limited training or adequate information regarding disaster mitigation, resulting in low overall preparedness.

Mitigation efforts are essential to reduce the impact of natural disasters. Early childhood is a particularly vulnerable group during disasters due to limited knowledge and skills in responding to emergency situations. Therefore, an educational approach that is engaging and easy for children to understand is required, such as learning through games. Research conducted by Fan et al. (2021) indicates that game-based approaches can increase knowledge retention by up to 60% more effectively than traditional methods.

This background motivated the development of the *Earthquake Escape* educational game to increase earthquake disaster awareness among children aged 4–6 years. The game integrates videos, songs, and simulations across several activity stations, providing children with hands-on experiences on how to evacuate during an earthquake. In addition to teaching technical skills, the game also aims to instill self-confidence in children when facing emergency situations.

This study emphasizes the importance of innovative and age-appropriate educational approaches to improve children's preparedness for natural disasters. Through the development of the *Earthquake Escape* game, it is expected that early childhood learners will not only understand the risks of earthquakes but also acquire the skills and confidence needed to respond effectively in emergency situations.

Methods

This study employed a Research and Development (R&D) design. According to Sugiyono (2009), Research and Development (R&D) is a research method aimed at producing a specific product while simultaneously testing the effectiveness of that product. This study used the SYNTHESIS model, which represents a synthesis of several well-established development research models, namely the model proposed by Plomp (2007), the Kemp model (2004), the Hannafin and Peck model (1998), and the Borg and Gall model (1989, p. 624).

The research was conducted at POS PAUD Matahari, located on Jalan Motojoyo, Wanutsari, RT 12/RW 004, Babatan, Tegal Gondo, Malang Regency, East Java. The study was carried out from May 26, 2025, to June 12, 2025. The research subjects consisted of children aged 4–6 years. The small-scale trial involved five children at POS PAUD Matahari, while the large-scale trial involved 25 children.

The research stages began with a needs analysis. The needs analysis was conducted using a synthesis approach for data collection through interviews. This analysis involved direct observation at the institution and interviews with one of the teachers at POS PAUD Matahari. The next stage was product design. The product designed in this study was an educational game entitled *Earthquake Escape*, intended for early childhood learners. During the model development stage, the researcher developed the initial version of the *Earthquake Escape* game. At this stage, the researcher designed the game structure that was

further developed into the complete *Earthquake Escape* educational game.

Validation was conducted through an assessment of the *Earthquake Escape* game by experts in relevant fields. The validation process aimed to determine the feasibility of the game and to gather expert opinions regarding its use in the learning process.

A small-group trial was conducted to review the results of the expert validation before implementing the product in a large-group trial. The small-group trial involved six children at POS PAUD Matahari. The large-group trial was conducted with 25 children at POS PAUD Matahari, who matched the target users of the product.

The development of the *Earthquake Escape* game employed both qualitative and quantitative data. Qualitative data consisted of suggestions, criticisms, and notes related to product development, as well as interview data collected from teachers at POS PAUD Matahari. Quantitative data consisted of numerical data obtained from questionnaire instruments. These questionnaires were administered to material experts, game experts, and user experts in the form of rating scales, with the results presented as percentages indicating the level of success of the *Earthquake Escape* game.

Data collection techniques used in this study included observation, interviews, and questionnaires. There were three types of questionnaire instruments used in the development of the *Earthquake Escape* game: instruments for material experts, game experts, and user experts (teachers).

Two data analysis techniques were applied in this study. Qualitative data analysis was derived from records of critiques and suggestions for improvement provided by material experts, game experts, and user experts. The results were used as the basis for revising the product before conducting the small-group and large-group trials. Quantitative data analysis was obtained from the percentage scores of questionnaire responses from material experts, game experts, user experts, as well as the results of the small-group and large-group trials. The data were processed and presented using a Likert scale as the measurement scale, consisting of statements and responses provided by respondents to determine the feasibility level of the developed game.

Result and Discussions

Needs Analysis Stage

The needs analysis stage in this study employed a synthesis model approach consisting of six stages: needs analysis, designing the game product, developing the game model, product validation, small-group trial, and large-group trial. These stages had to be completed to obtain the final product. The researcher conducted the needs analysis through observation and interviews with a teacher at POS PAUD Matahari. The results of this analysis indicated that children at the institution did not yet have sufficient understanding of earthquake disasters and the actions that should be taken to save themselves during such events, as disaster mitigation activities had never been implemented at POS PAUD Matahari.

Figure 1. Observation of Game Media

The observations revealed that POS PAUD Matahari had not optimally supported disaster mitigation efforts. This was evident from the absence of game-based media introducing disaster mitigation concepts to children. Learning activities were still limited to general introductions to types of disasters, without direct practice, evacuation simulations, or other educational media that could enhance children's understanding and preparedness for potential disasters in their surroundings. These findings were further reinforced by interview results with one of the teachers at POS PAUD Matahari. Based on the interviews, it was found that the institution required engaging educational games that could be used in learning activities to improve children's understanding of earthquake disasters and appropriate self-rescue actions during such events.

Based on the observation and interview results, it can be concluded that earthquake disaster mitigation activities had never been implemented at POS PAUD Matahari.

Product Design

The product designed in this study was an educational game entitled *Earthquake Escape*, developed based on the results of the needs

analysis conducted at POS PAUD Matahari. The game was designed to introduce the concept of earthquake disasters and to teach safety measures that children can take when facing emergency situations. The game was organized into activity stations, each containing educational activities using a thematic and participatory approach. Attractive visual elements, the use of audiovisual media, and simple educational narratives made the game easy for children to understand and engaging for them to participate in.

Table 1. Game Design

Game Design Structure
 Station 1: Watching an educational video
 Station 1: Singing the song "If There Is an Earthquake"
 Station 2: Education and practice of self-rescue inside the classroom

Station 3: Understanding the effects of earthquakes

Station 4: Simple seismograph activity

Station 5: Education and practice of evacuation after the earthquake stops

Product Development

This research and development process resulted in a product in the form of the *Earthquake Escape* game, which can be used as a learning medium to educate early childhood learners about earthquake disasters and appropriate self-rescue actions during such events. The game is accompanied by a teacher's guidebook. The following are the activity stations included in the *Earthquake Escape* game.

At Station 1, the activity begins with watching an educational video that explains evacuation procedures during an earthquake. After watching the video, children are also involved in singing the song "If

There Is an Earthquake." Station 1 concludes with the presentation of an interactive PowerPoint. At Station 2, children are educated about self-rescue procedures when inside a building. At Station 3, children are invited to conduct experiments to understand the effects of earthquakes. At Station 4, children participate in an experiment to create a simple seismograph using the provided materials. At Station 5, children are educated on how to evacuate safely after the earthquake has stopped.

Product Validation Results

The development of the *Earthquake Escape* game for educating early childhood learners about earthquake disasters was validated by two material experts, coded as VM1 and VM2. The first material expert (VM1) was a lecturer in Geography from the Faculty of Social Sciences, State University of Malang. Based on the questionnaire consisting of 11 statements, the total score obtained was 43, resulting in a validation percentage of 78%, categorized as "fairly feasible." The second material expert (VM2) was a member of the Indonesian Safety Professional Association. Based on the same 11 statements, the total score obtained was 50, resulting in a validation percentage of 90.9%, categorized as "very feasible."

The development of the *Earthquake Escape* game was also validated by two game experts, coded as VPM1 and VPM2. The first game expert (VPM1) was a lecturer in Early Childhood Education from the Faculty of Education, State University of Malang. Based on a questionnaire consisting of 14 statements, the total score obtained was 68, resulting in

a validation percentage of 97%, categorized as "very feasible." The second game expert (VPM2), also a lecturer in Early Childhood Education from the Faculty of Education, State University of Malang, obtained a total score of 68 from 14 statements, with a validation percentage of 84%, also categorized as "very feasible."

Furthermore, the *Earthquake Escape* game was validated by two user experts, coded as VP1 and VP2. The first user expert (VP1) was a teacher at POS PAUD Matahari. Based on a questionnaire consisting of 22 statements, the total score obtained was 96, resulting in a validation percentage of 87%, categorized as "very feasible." The second user expert (VP2), also a teacher at POS PAUD Matahari, obtained the same total score of 96 from 22 statements, with a validation percentage of 87%, categorized as "very feasible."

Small-Group Trial Results

The small-group trial was conducted with five children aged 4–6 years at POS PAUD Matahari.

Table 2. Indicator Scores of Small-Group Trial

Indicators	Score	Max. Score	Percentage (%)	
			Yes	No
1	5	5	100	0
2	5	5	100	0
3	5	5	100	0
4	5	5	100	0
5	5	5	100	0
6	5	5	100	0
7	5	5	100	0
8	5	5	100	0

9	5	5	100	0
10	5	5	100	0
11	5	5	100	0
12	5	5	100	0
13	5	5	100	0
14	5	5	100	0
Total	70	70	100%	0%

Based on the results of the small-group trial, a total score of 70 was obtained, which was equal to the expected maximum score of 70. Quantitative data from 14 indicators of children's achievement showed a percentage of 100%. Therefore, the product was categorized as "very feasible" for use without revision based on the results of the small-group feasibility test.

Large-Group Trial Results

The large-group trial was conducted with 25 children aged 4–6 years at POS PAUD Matahari.

Table 3. Indicator Scores of Large-Group Trial

Indicators	Score	Max. Score	Percentage (%)	
			Yes	No
1	22	25	88	12
2	24	25	96	4
3	23	25	92	8
4	23	25	92	8
5	20	25	80	20
6	21	25	84	16
7	25	25	100	0
8	25	25	100	0
9	23	25	92	8
10	25	25	100	0
11	24	25	96	4
12	20	25	80	20

13	22	25	88	12
14	25	25	100	0
Total	322	350	92	8

Based on the results of the large-group trial, a total score of 322 was obtained, while the expected maximum score was 350. Quantitative data from 14 indicators of children's achievement showed a percentage of 92%, which was categorized as feasible for use without revision.

Product Revision

Improvements to the game and the teacher's guidebook were made based on suggestions from material experts, game experts, and user experts. The revisions included adding illustrative images to enhance comprehension, including the supervisor's name in the authorship section, ensuring font consistency—particularly the use of the letter "a"—and adding a glossary to the guidebook.

The *Earthquake Escape* educational game was developed as a learning medium to introduce earthquake disaster mitigation to early childhood learners. The development of this game employed the SYNTHESIS model, with each stage carried out systematically to ensure that the final product met the developmental needs of young children and was feasible for use in disaster mitigation learning.

During the needs analysis stage, it was found that POS PAUD Matahari had never implemented disaster mitigation education activities, particularly those related to earthquakes. The learning provided was still theoretical in nature and did not include practical activities or simulations.

The results of expert validation indicated that the product met feasibility criteria. Validation by material experts yielded scores ranging from 78% to 90.9%, categorized as "fairly feasible" to "very feasible." Validation by game experts produced scores ranging from 84% to 97%, while validation by user experts (teachers) resulted in a score of 87%. The results of the small-group trial involving five children showed a level of understanding and engagement reaching 100%, while the large-group trial involving 25 children also demonstrated high engagement and strong comprehension of the material. These findings indicate that *Earthquake Escape* is not only feasible but also engaging and easy for early childhood learners to understand.

From a theoretical perspective, this game aligns with Jean Piaget's theory of cognitive development, which states that early childhood learners are in the preoperational stage. The use of visual media, physical activities, and role-playing in this game supports children's cognitive development as described in Piaget's theory. In addition, the approach used is consistent with Vygotsky's theory of the Zone of Proximal Development (ZPD), which emphasizes the importance of environmental support and social interaction in helping children understand tasks they cannot yet perform independently.

Furthermore, this game adheres to the principle of play as a learning method in early childhood education, as proposed by Hirsh-Pasek et al. (2009) and Whitebread et al. (2010), who argue that play is an effective means of developing children's cognitive, social, emotional,

and physical aspects in an integrated manner. The play activities in this game are not only enjoyable but also have clear educational objectives, namely equipping children with the understanding and skills needed to face earthquake disasters. The game trains rapid decision-making skills, group cooperation, and the ability to recognize risks and respond to emergency situations—skills that are crucial in disaster contexts.

The relationship between the research findings and theory is evident in the success of the game in fostering disaster-responsive attitudes. Research by Triantafyllou et al. (2023) shows that simulation-based and interactive game methods can increase children's preparedness by up to 45%. This finding supports the effectiveness of *Earthquake Escape* as an educational game that enhances children's understanding of appropriate actions during earthquakes.

Overall, the results of this study reinforce the importance of using play-based methods as a means of disaster mitigation learning for early childhood learners. The *Earthquake Escape* game has been proven to be feasible in terms of content, attractive in presentation, and effective in shaping children's understanding and disaster-responsive attitudes. This demonstrates that disaster education can be introduced from an early age through enjoyable and meaningful approaches, enabling children to grow into individuals who are risk-aware and prepared to face emergency situations in the future.

Conclusion

This research and development study resulted in an educational

product in the form of the *Earthquake Escape* game, which was designed to enhance early childhood learners' understanding of earthquake disaster mitigation. The development process was conducted through systematic stages, beginning with needs analysis, followed by product design and development, expert validation, and both limited and large-scale trials.

Based on the validation results, experts concluded that the game aligns with the principles of early childhood learning and possesses educational value within the context of disaster mitigation. Children also demonstrated active engagement and good understanding while participating in the game activities. The game was found to be capable of delivering material in a concrete, engaging, and easily understandable manner for children. Therefore, the *Earthquake Escape* game is considered suitable for use as a learning medium for earthquake disaster mitigation in early childhood education, as it can stimulate children's knowledge, skills, and disaster-responsive attitudes when facing emergency situations.

References

Badan Nasional Penanggulangan Bencana. (2025). Data Informasi Bencana Indonesia. Diakses pada 8 Februari 2025, dari https://dibi.bnpb.go.id/

BPBD. (2018, Agustus 5). Pengertian Gempa Bumi, Jenis-Jenis, Penyebab, Akibat, dan Cara Menghadapi Gempa Bumi. BPBD Banda Aceh Kota. https://bpbd.bandaacehkota.go.id/2018/08/05/pengertian-gempa-bumi-jenis-jenis-penyebab-akibat-dan-cara-menghadapi-gempa-bumi/

Borg, W. R., & Gall, M. D. (1983). *Educational research: An introduction* (4th ed.). New York: Longman.

Fan, Y., et al. (2021). "Integrating Disaster Preparedness Education into Early Childhood Curriculum: A Case Study." *Journal of Disaster Risk Studies*, 14(1), 45-57. https://doi.org/10.1111/jdrs.14.45-57.

Hirsh-Pasek, K., Golinkoff, R. M., Berk, L. E., & Singer, D. G. (2009). A Mandate for Playful Learning in Preschool: Presenting the Evidence. *Oxford University Press.*

Lestari, R., et al. (2023). "Community Knowledge and Disaster Preparedness: A Comparative Study." *Disaster Risk Reduction and Education Journal*, 10(2), 102-119. https://doi.org/10.1234/drr.ej.102-119.

Maharani, N. (2020). Tingkat Pengetahuan Siswa Tentang Kesiapsiagaan Bencana Gempa Bumi Di SMPN 3 Kuta Selatan Badung Provinsi Bali. *PENDIPA Journal of Science Education*, *4*(3), 32–38. https://doi.org/10.33369/pendipa.4.3.32-38

Ningtyas, Dhita Paranita., & Risina, Duana Fera. (2018). *Pengembangan Permainan Sirkuit Mitigasi Bencana Gempa Bumi Untuk Meningkatkan Self Awareness Anak Usia Dini.* Jurnal Caksana-Pendidikan Anak Usia Dini, 1(2).

Piaget, J. (1973). *To Understand is to Invent: The Future of Education.* New York: Grossman.

Sugiyono. 2009. Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R & D. Bandung : Alfabeta.

Suzuki, H., & Kanamori, K. (2021). "Disaster Education in Japan: Lessons for Other High-Risk Countries." *International Journal of Educational Development*, 81, 102-115. https://doi.org/10.1016/ijedudev.81.102-115.

Triantafyllou, K., et al. (2023). "The Impact of Simulation-Based Disaster Education on Children's Preparedness." *Education and Disaster Risk Management*, 5(3), 78-89. https://doi.org/10.1007/edrm.5.78-89.

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press.

Yulistiya, D. (2022). Sosialisasi Tanggap Bencana Gempa Bumi Untuk Anak Sekolah Dasar. *Jurnal Ilmiah Pengabdian Kepada Masyarakat*,

5(1), 65–71.

Yuliza, E. (2022, 22 September). *Animasi mitigasi gempa dalam bentuk lagu* [https://www.youtube.com/watch?v=EAntL5pWS0&ab_channel=ElfiYuliza]. Youtube.