EVALUATION OF THE EFFECTIVENESS AND USER EXPERIENCE OF THE SALI EDUCATION APPLICATION USING UEQ

Oky Irnawati[1*], Kusmayanti Solecha[2], Yoseph Tajul Arifin[1], Sutan Arlie Johan[2]

Department of Electrical Engineering[1]
Department of Information Technology[2]
Universitas Bina Sarana Informatika, Jakarta, Indonesia [1,2]
https://www.bsi.ac.id[1,2]
oky.okt@bsi.ac.id*, kusmayanti.ksc@bsi.ac.id, yoseph.ypa@bsi.ac.id, sutanarliejohan@gmail.com

(*) Corresponding Author
(Responsible for the Quality of Paper Content)

Abstract— *CSA (Child Sexual Abuse) poses serious risks to preschool-aged children, yet culturally sensitive and developmentally appropriate learning tools remain scarce in Indonesia. This study evaluates the effectiveness and user experience of SALI, a gamified mobile application designed to foster early childhood body safety awareness. SALI integrates interactive storytelling, animated scenarios, and digital quizzes to help children recognize safe and unsafe touches in an engaging way. A pre–posttest design was applied with 46 children aged 4–6 years selected through purposive sampling. Children's knowledge was measured using an in-app digital quiz, while parents assessed the app's usability through the User Experience Questionnaire (UEQ), a standardized and validated instrument. Results showed that mean scores increased from 70.00 (SD = 31.55) in the pre-test to 94.98 (SD = 8.69) in the post-test. The Wilcoxon Signed Rank Test confirmed a significant improvement (Z = –5.382, p < 0.001), with an average N-Gain of 0.86 categorized as high. UEQ outcomes indicated positive ratings across all six dimensions, with attractiveness (M = 2.66) and efficiency (M = 2.61) scoring highest, while perspicuity (M = 2.18) scored lowest but remained within a positive range. These findings suggest that SALI not only improves children's understanding of protective behaviors but also provides a satisfactory user experience for parents. The study contributes to both theory and practice by demonstrating how gamified mobile learning can serve as a foundation for developing adaptive and engaging CSA prevention curricula in early childhood education.*

Keywords: *Body Safety Awareness, Early Childhood Education, Gamification, Mobile Application, User Experience Questionnaire (UEQ).*

Intisari— *CSA (Child Sexual Abuse) menimbulkan risiko serius bagi anak usia prasekolah, namun alat pembelajaran yang peka budaya dan sesuai perkembangan masih langka di Indonesia. Studi ini mengevaluasi efektivitas dan pengalaman pengguna SALI, sebuah aplikasi seluler gamifikasi yang dirancang untuk menumbuhkan kesadaran keselamatan tubuh anak usia dini. Desain pra-pasca-tes diterapkan dengan 46 anak berusia 4-6 tahun dari lembaga anak usia dini di Jakarta. Pengetahuan anak-anak diukur menggunakan kuis digital dalam aplikasi, sementara orang tua menilai kegunaan aplikasi melalui Kuesioner Pengalaman Pengguna (UEQ). Hasil menunjukkan bahwa skor rata-rata meningkat dari 70,00 (SD = 31,55) dalam pra-tes menjadi 94,98 (SD = 8,69) dalam pasca-tes. Uji Peringkat Bertanda Wilcoxon mengkonfirmasi peningkatan yang signifikan (Z = -5,382, p < 0,001), dengan rata-rata N-Gain 0,86 dikategorikan tinggi. Hasil UEQ menunjukkan peringkat positif di keenam dimensi, dengan daya tarik (M = 2,66) dan efisiensi (M = 2,61) memperoleh skor tertinggi, sementara kejelasan (M = 2,18) memperoleh skor terendah tetapi tetap dalam rentang positif. Temuan ini menunjukkan bahwa SALI tidak hanya meningkatkan pemahaman anak tentang perilaku protektif tetapi juga memberikan pengalaman pengguna yang memuaskan bagi orang tua. Studi ini*

menyoroti potensi pembelajaran seluler gamifikasi sebagai alat yang layak untuk pencegahan CSA dalam pendidikan anak usia dini.

INTRODUCTION

The rapid development of mobile technology has created significant opportunities to support interactive learning, particularly in early childhood education [1][2]. One of the approaches that has gained wide adoption is gamification, which integrates game elements such as points, levels, and rewards to improve motivation, engagement, and user learning experiences [3][4][5]. Several studies have demonstrated that gamification is effective in enhancing learning outcomes in various educational contexts, including literacy and numeracy skills [6][7]. At the same time, child protection against sexual abuse has become a critical issue that requires early educational interventions [8][9][10][11]. International and national organizations emphasize the importance of equipping children with knowledge and self-protection skills to recognize and resist inappropriate touches [12]. Although some interactive media based on gamification have been developed for educational purposes, systematic evaluations focusing on children's understanding and user experience (UX) from parents' perspectives remain limited [13].

The SALI (Sadar dan Lindungi) application was previously developed through a government research grant in 2025 to support early childhood body safety education. SALI was designed as a gamified mobile learning tool featuring visual illustrations, interactive audio, and game-based elements tailored to children's learning characteristics. With the support of this research funding, SALI has completed the design, development, and initial trials. However, a comprehensive evaluation regarding its effectiveness in improving children's understanding and the user experience from the parents' perspective has not yet been conducted. Previous studies have highlighted the role of systematic evaluation methods in assessing digital applications and games [14][15]. For example, Sari et al. evaluated the usability of an academic information system using the User Experience Questionnaire (UEQ) combined with heuristic walkthrough, and the study revealed that UX-based evaluation provided deeper insights into system interaction and user satisfaction [16]. Similarly, Saurik et al. conducted an evaluation of player experience in a 2D East Java horror game and demonstrated how user-centered evaluation could be applied to measure engagement and emotional responses in game-based applications [17]. Another study by Yulianto et al. evaluated an interactive book based on augmented reality using SUS and UEQ, showing that digital educational tools can achieve positive usability and user experience outcomes when systematically assessed.

In addition, recent advancements in digital health education for children have introduced gamified mobile applications as innovative tools for delivering safety education. For instance, the iBsafe app was found to significantly enhance knowledge and skills related to physical safety among children aged 5–6 years [18]. Similarly, Safe City and KiddieSafe applications employed game-based strategies to raise awareness among primary school students, though their focus was on general health and physical safety rather than child sexual abuse (CSA)–specific education [19]. Other interventions such as Make Safe Happen® targeted parents by promoting safer home practices through mobile technology, while video game platforms like VirtualSafeHome explored early childhood injury prevention using digital approaches [20]. These studies demonstrate the potential of gamified and mobile-based interventions in promoting safety awareness, yet highlight the lack of targeted applications addressing CSA prevention in early childhood contexts.

These findings highlight the importance of conducting further evaluation of SALI in terms of learning effectiveness and user experience [21]. Based on these gaps, this study aims to evaluate the SALI application with two main objectives: (1) to measure the effectiveness of the application in improving children's understanding of body safety concepts through a pre–post test, and (2) to assess the user experience using the UEQ from the parents' perspective. This research does not discuss the technical development aspects of the application but focuses on an empirical evaluation of its implementation. Unlike previous studies that mainly evaluated general information systems, games, or augmented reality media, this study specifically addresses the underexplored domain of gamified mobile applications for early childhood body safety education [22][23][24][25]. The novelty of this research lies in combining a pre–post

test of children's comprehension with a parent-based User Experience Questionnaire (UEQ) evaluation. This dual perspective provides a more holistic understanding of both learning effectiveness and usability. Beyond its educational focus, this study also contributes to the field of applied computer science by presenting a replicable evaluation framework that integrates quantitative learning outcomes with user experience analysis. This methodological contribution supports the development of more comprehensive evaluation models for gamified learning systems in future research.

MATERIALS AND METHODS

Figure 1 presents the methodological framework of this study. The diagram outlines the stages of the research, beginning with the research design, followed by participant selection, the instruments used, data collection, and finally, data analysis.

Source : (Research Results, 2025)
Figure 1. Methodological Framework

Research Design

This study employed a quantitative pre- and post-test design with a complementary user experience evaluation to assess the effectiveness and usability of a gamified mobile health application aimed at improving early childhood body safety awareness. A quantitative approach was chosen because it enables objective measurement of learning gains and standardized evaluation of user experience metrics, providing reliable data for assessing both effectiveness and usability [26]. Each SALI module—storytelling, educational songs, and interactive quizzes—was intentionally developed to support body safety learning by reinforcing cognitive, emotional, and behavioral understanding through play-based interaction [23]. The core of the study involved comparing children's understanding before and after interacting with the app's educational modules [27][28][29]. Additionally, the User Experience Questionnaire was administered to the children's parents to evaluate the app's usability, appeal, and functionality from the caregiver's perspective [30].

Participants

A total of 46 children aged 4 to 6 years were recruited from PAUD (Early Childhood Education Institutions) in Jakarta, Indonesia. Participants were selected based on informed consent provided by both parents and school administrators. Inclusion criteria included age range, ability to participate in a classroom setting, and no prior formal education on body safety topics. Children with developmental disorders or those previously exposed to CSA-focused programs were excluded to ensure baseline uniformity. Parents were involved in the user experience evaluation component.

Instruments

1) Pre- and Post-Test Quiz
The children's knowledge was assessed using an in-app digital quiz embedded in the mobile application. The instrument comprised 8 items (multiple-choice and true/false) designed to measure understanding of appropriate and inappropriate touches, personal boundaries, and recognizing trusted adults. The same quiz was used as both the pre-test and post-test, with randomization of question order in the post-test to minimize recall bias.

2) UEQ (User Experience Questionnaire)
The user experience of the application was evaluated using the standardized UEQ, which measures six dimensions: Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty. The UEQ was administered to the parents of participating children after observing their child's interaction with the app. Out of the 46 children who participated in the intervention, only 34 parents completed the UEQ. The Indonesian-translated version of UEQ was used to ensure clarity and consistency in responses.

Data Collection

Children first completed the pre-test quiz independently using a tablet or smartphone device. They then interacted with three core educational modules within the app: Storytelling–Animated narrative scenarios introducing concepts of body autonomy, safe vs unsafe touch, and the importance of speaking to trusted adults. This visualization is shown in Figure 2:

Source : (Research Results, 2025)
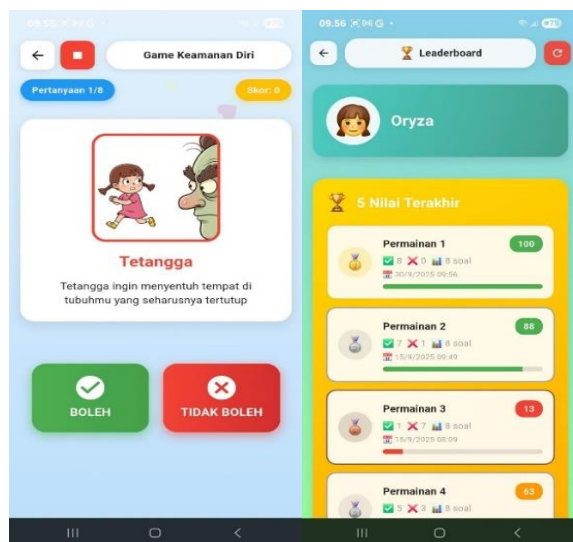Figure 2. Storytelling Menu

Educational Songs – Engaging music videos reinforcing personal safety messages. This visualization is shown in Figure 3:

Source : (Research Results, 2025)
Figure 3. Songs Menu

Interactive Quiz Game – A gamified true/false game format aligned with the learning objectives, also functioning as a post-test. Figure 4, which illustrates the quiz module and score board.

Source : (Research Results, 2025)
Figure 4. Interactive Quiz Game and Score Board

The intervention was carried out in a classroom setting under teacher supervision using a smart TV. Children collectively watched the animated storytelling module and listened to the educational song together in class, guided by their teacher. This group-based activity ensured equal exposure to the learning content in an engaging and interactive manner. Following the classroom session, parents were provided with a GForm (Google Form) link to complete the UEQ (User Experience Questionnaire), allowing them to evaluate the app's usability and overall user experience from their perspective as primary caregivers.

Data Analysis

Quantitative data from the pre- and post-test quiz scores were exported from the application and analyzed using IBM SPSS Statistics version 26. Descriptive statistics (mean, median, and standard deviation) were calculated for both sets of scores. A paired-sample t-test was performed to determine whether the difference in scores was statistically significant, with the significance level set at $p < 0.05$.

UEQ responses were analyzed using the official UEQ analysis tool, which calculates means and confidence intervals for each of the six dimensions, benchmarked against existing user experience data from other interactive systems. The results were interpreted to assess the overall user satisfaction and usability of the app from the parents' perspective.

RESULTS AND DISCUSSION

Effectiveness of the Gamified Mobile App on Children's Understanding

Table 1 presents the descriptive statistics of children's pre-test and post-test scores obtained from the in-app quiz. The results show a clear improvement in mean scores after the intervention.

Table 1. Descriptive Statistics of Pre-test and Post-test Scores.

| Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
pre-test	46	70.00	31.549	0	100
post-test	46	94.98	8.688	70	100

Source : (Research Results, 2025)

The evaluation of children's comprehension through pre-test and post-test demonstrated a substantial improvement after using the SALI application. The mean pre-test score was 70.00 (SD = 31.55), while the post-test mean increased to 94.98 (SD = 8.69). This represents a gain of 24.98 points, accompanied by a reduction in score variability, suggesting more homogeneous learning outcomes among participants.

Table 2. Test of Normality.

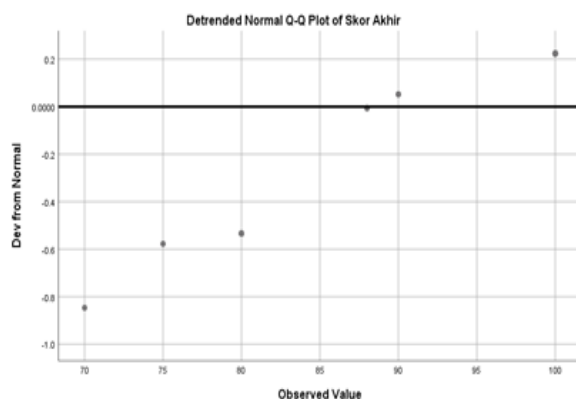| **Tests of Normality** | | | | | |
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
pre-test	.237	46	.000	.784	46	.000
post-test	.436	46	.000	.625	46	.000
a. Lilliefors Significance Correction						

Source : (Research Results, 2025)
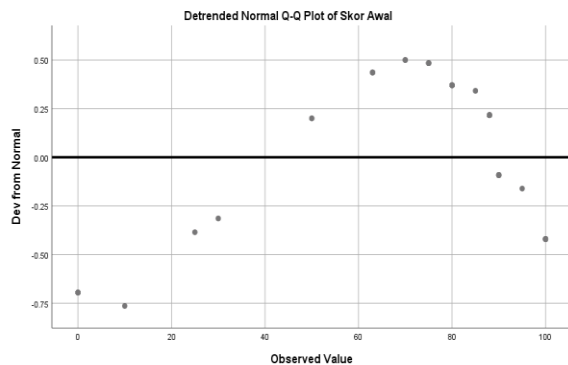
Source : (Research Results, 2025)
Figure 5. The Q–Q Plot Pre-Test

Source : (Research Results, 2025)
Figure 6. The Q–Q Plot Post-Test

The normality test using both the Kolmogorov–Smirnov and Shapiro–Wilk methods indicated that the distribution of pre-test and post-test scores did not meet the normality assumption (p < 0.05). This result was further confirmed through the Q–Q plot, which showed deviations from the diagonal line, indicating that the data were not normally distributed. Consequently, a non-parametric test was applied to examine the difference between pre-test and post-test scores. Because the normality test results indicated that the data were not normally distributed (p < 0.05), the analysis was continued with the Wilcoxon Signed Rank Test. This test is used to determine the difference between pre-test and post-test scores in two paired samples when the normality assumption is not met.

Table 3. Wilcoxon Signed Rank Test Statistics (Rank).

Ranks				
		N	Mean Rank	Sum of Ranks
post-test - pre-test	Negative Ranks	0[a]	.00	.00
	Positive Ranks	38[b]	19.50	741.00
	Ties	8[c]		
	Total	46		

Source : (Research Results, 2025)

Table 4. Wilcoxon Signed Rank Test Statistics (Test Statistics).

Test Statistics[a]	
	Skor Akhir - Skor Awal
Z	-5.382[b]
Asymp. Sig. (2-tailed)	.000
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Source : (Research Results, 2025)

The analysis revealed no negative ranks, with 38 participants showing score improvements and 8 maintaining the same scores. The test yielded Z = -5.382, p = 0.000, confirming a statistically significant increase in children's understanding following the intervention. Suggesting that the gamified mobile application effectively improved children's understanding of body safety concepts.

Measuring how effective the increase in student understanding is can be done using N-Gain with the following formula:

$$N - Gain = \frac{Final\ Score - Initial\ Score}{Maximum\ Score - Initial\ Score} \quad (1)$$

This is then averaged and categorized as follows:
g < 0.3 = low
0.3 ≤ g < 0.7 = moderate
g ≥ 0.7 = high

The N-Gain analysis further substantiated the practical significance of this improvement, yielding an average score of 0.86, categorized as "high." This indicates that the SALI application was not only statistically effective but also practically impactful in enhancing children's comprehension of body safety concepts.

User Experience Evaluation by Parents
In addition to effectiveness testing, parental perceptions of the application's usability and quality were assessed using the User Experience Questionnaire (UEQ). Results indicated consistently positive evaluations across all six dimensions, with

mean scores above +2, which is categorized as "good to very good" according to UEQ benchmarks.

Table 5. UEQ Results Based on Parent Responses.

UEQ Scale	Mean	Variance
Attractiveness	2.662 ↑	0,27
Perspicuity	2.176 ↑	0,53
Efficiency	2.610 ↑	0,24
Dependability	2.522 ↑	0,46
Stimulation	2.500 ↑	0,63
Novelty	2.529 ↑	0,35

Source : (Research Results, 2025)

Interpretation: Poor (< -0.8), Below Average (-0.8 – 0.0), Above Average (0.0 – 0.8), Good (0.8 – 1.5), Excellent (> 1.5).
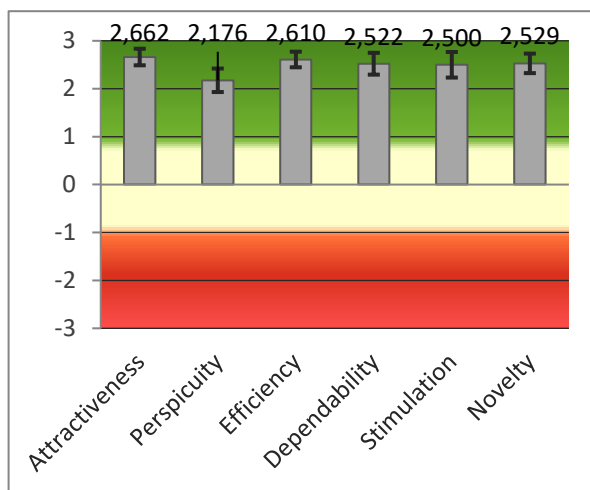
Source : (Research Results, 2025)
Figure 7. UEQ Results in Graphic Form

Attractiveness achieved the highest score (M = 2.662, var = 0.27), indicating that the application was perceived as appealing, enjoyable, and well-received. Efficiency (M = 2.610) and Dependability (M = 2.522) also scored highly, suggesting that parents found the navigation intuitive and the app's features reliable for supporting children's learning. Stimulation (M = 2.500) and Novelty (M = 2.529) highlighted the engaging and innovative aspects of the app, particularly its use of gamification, storytelling, and educational songs. However, Perspicuity scored relatively lower (M = 2.176), suggesting that some parents perceived a need for clearer instructions or more consistent navigation.

These findings align with previous studies reporting the effectiveness of gamified and interactive digital interventions in improving health-related knowledge among young learners. For example, prior applications such as iBsafe and Safe City demonstrated measurable learning gains in children when game-based elements were incorporated into safety education. However, unlike these general safety-focused interventions, the present study specifically targeted body safety and CSA prevention for preschool-aged children within the Indonesian context.

The significant improvement observed after the intervention underscores the importance of culturally sensitive, developmentally appropriate, and gamified approaches in early childhood education. It also highlights the feasibility of using mobile applications as a complementary educational tool in PAUD institutions, especially considering the limited body safety curriculum in formal settings. Moreover, the integration of storytelling, music, and interactive quizzes into the application likely contributed to engagement and retention among children, consistent with theories of play-based learning and multimedia pedagogy. The results support the integration of such digital tools into broader child protection initiatives and provide empirical evidence for policymakers to consider mobile-based interventions as part of early childhood education strategies in Indonesia.

CONCLUSION

This study demonstrated that the SALI (Sadar dan Lindungi) gamified mobile application significantly improved early childhood body safety awareness. The results of the pre- and post-test analysis using the Wilcoxon Signed Rank Test indicated a statistically significant increase in children's understanding, with an N-Gain score categorized as high (0.86). This finding confirms that SALI is not only effective in enhancing knowledge but also ensures more equitable learning outcomes among preschool children. Furthermore, the UEQ (User Experience Questionnaire) evaluation by parents revealed consistently positive responses across all six dimensions, with the highest scores achieved in attractiveness, efficiency, and novelty. These results indicate that the application was perceived as engaging, motivating, and user-friendly. However, the relatively lower score in clarity suggests that further refinement is needed to simplify instructions and enhance navigation consistency.
This study is limited by its relatively small sample size and single-location implementation, which may affect the generalizability of the results. Future research could involve cross-cultural validation to explore how the SALI application performs in different socio-cultural contexts. Moreover, the integration of adaptive learning mechanisms powered by artificial intelligence (AI) is recommended to personalize learning experiences and improve long-term user engagement.

Overall, the findings provide strong evidence that gamification, storytelling, and music can be effectively integrated into mobile learning applications to support early childhood education on sensitive topics such as body safety. Future development should focus on improving clarity of instructions and expanding the application's reach to broader early childhood education settings. This research highlights the potential of mobile-based interventions as a complementary tool for child protection education in Indonesia.

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REFERENCE

[1]   J. Arfi, A. S. Wahyuri, Gusril, W. Rasyid, and Y. Ockta, "Developing Engaging Audio-Visual Learning Media For Basic Locomotor Patterns Through Play-Based Activities For Early Learners," *J. Educ. Teaching, Learn.*, vol. 9, no. 1, pp. 40–46, 2024.

[2]   S. Lee-Cultura, K. Sharma, and M. Giannakos, "Children's play and problem-solving in motion-based learning technologies using a multi-modal mixed methods approach," *Int. J. Child-Computer Interact.*, vol. 31, p. 100355, 2022, doi: 10.1016/j.ijcci.2021.100355.

[3]   M. A. Bright, D. Ortega, D. Finkelhor, and K. Walsh, "Moving school-based CSA prevention education online: Advantages and challenges of the 'new normal,'" *Child Abus. Negl.*, vol. 132, no. July, p. 105807, 2022, doi: 10.1016/j.chiabu.2022.105807.

[4]   M. Lu, J. Barlow, F. Meinck, and Y. Wu, "'Prevention Alone Is Not Enough:' Stakeholders' Perspectives About School-based Child Sexual Abuse (CSA) Prevention Programs and CSA Research in China," *J. Interpers. Violence*, vol. 37, no. 7–8, pp. NP5116–NP5142, 2022, doi: 10.1177/0886260520959630.

[5]   S. Trew, D. Russell, D. Higgins, and K. Walsh, *Effective delivery methods and teaching strategies for child sexual abuse prevention: A rapid evidence check*. 2021.

[6]   X. Jin, E. Kim, K. chul Kim, and S. Chen, "Innovative Knowledge Generation: Exploring Trends in the Use of Early Childhood Education Apps in Chinese Families," *J. Knowl. Econ.*, vol. 15, no. 3, pp. 12253–12292, Nov. 2023, doi: 10.1007/s13132-023-01585-2.

[7]   D. Laranjeiro, "Development of game-based m-learning apps for preschoolers," *Educ. Sci.*, vol. 11, no. 5, 2021, doi: 10.3390/educsci11050229.

[8]   R. Kızıltepe, D. Eslek, T. Y. Irmak, and D. Güngör, "'I am Learning to Protect Myself with Mika:' A Teacher-based Child Sexual Abuse Prevention Program in Turkey," *J. Interpers. Violence*, vol. 37, no. 11–12, pp. NP10220–NP10244, Jun. 2022, doi: 10.1177/0886260520986272.

[9]   T. Solehati and M. Yusuf, "Determinants of parental communication practices to prevent child sexual abuse : A cross-sectional study in Indonesia," *Res. Sq.*, pp. 1–17, 2025, doi: https://doi.org/10.21203/rs.3.rs-6614468/v1 License:

[10]   "Data Perlindungan Anak," *Kpai*, pp. 2–3, 2025. [Online]. Available: https://bankdata.kpai.go.id/tabulasi-data-perlindungan-anak

[11]   KPAI, "Data Kasus Perlindungan Anak dari Pengaduan ke KPAI tahun 2023," *Pusdatin Kpai*, pp. 1–4, 2023. [Online]. Available: https://bankdata.kpai.go.id/tabulasi-data/data-kasus-perlindungan-anak-dari-pengaduan-ke-kpai-tahun-2023

[12]   A. Patterson, L. Ryckman, and C. Guerra, "A Systematic Review of the Education and Awareness Interventions to Prevent Online Child Sexual Abuse," *J. Child Adolesc. Trauma*, vol. 15, no. 3, pp. 857–867, Sep. 2022, doi: 10.1007/S40653-022-00440-X/METRICS.

[13]   A. Bagas and E. Supraptono, "The Development of an Android-Based 'LaporKPS' Application to Support the Service Center for Reports of Sexual Violence and Harassment Cases," *Data Sci. J. Comput. Appl. Informatics*, vol. 6, no. 2, pp. 111–124, Jul. 2022, doi: 10.32734/jocai.v6.i2-9092.

[14]   A. S. Wisnumurti, C. Mahendra, Suyudi, and R. Yani, "Penerapan Gamifikasi Pada

Pembelajaran Huruf Dan Angka Untuk Anak Usia Dini Berbasis Android," *J. Tek. Mesin, Ind. Elektro Dan Inform.*, vol. 1, no. 2, pp. 20–30, 2023, doi: 10.59061/repit.v1i2.179.

[15] M. F. Rizki, R. A. Sukamto, and Y. A. Hambali, "Pengembangan Aplikasi Mobile Pengenalan Permainan Tradisional Menggunakan Metode User-Experience Design Thinking Dan Teknik Visualisasi Untuk Mengedukasi Anak Usia Sekolah Dasar Studi Kasus: Sdn Pasirtanjung 01 Kabupaten Bekasi," *J. Sci. Res. Dev.*, vol. 6, no. 1, pp. 1126–1139, 2024, [Online]. Available: https://idm.or.id/JSCR/index.php/JSCR/article/view/14

[16] Y. Sari, M. Arafah, and Novitasari, "Evaluasi Usability Sistem Informasi Akademik Dosen Menggunakan User Experience Questionnaire dan Heuristic Walkthrough," *J. RESTI*, vol. 5, no. 2, pp. 247–253, 2021, doi: 10.29207/resti.v5i2.3022.

[17] H. T. T. Saurik, H. A. Rosyid, A. P. Wibawa, and E. I. Setiawan, "Evaluating Player Experience for Fear Modeling of 2D East Java Horror Game Alas Tilas," *J. RESTI*, vol. 7, no. 4, pp. 858–864, 2023, doi: 10.29207/resti.v7i4.5043.

[18] R. S. Wong *et al.*, "Effect of a Mobile Game–Based Intervention to Enhance Child Safety: Randomized Controlled Trial," *J. Med. Internet Res.*, vol. 26, no. 1, pp. 1–13, 2024, doi: 10.2196/51908.

[19] P. N. M. Aris, N. S. A. M. Nor, and A. Othman, "Kiddiesafe: Enhancing Safety And Cleanliness Awareness In Primary School Students Through Game-Based Learning," *J. Creat. Ind. Sustain. Cult.*, vol. 3, pp. 27–47, 2024, doi: https://doi.org/10.32890/jcisc2024.3.3.

[20] A. D. Woolf, J. Jacobson, S. Flanagan, and P. Weinstock, "Education on Preventing Early Childhood Injuries Using a Video Game: The VirtualSafeHome Platform," *Clin. Pediatr. (Phila).*, vol. 63, no. 2, pp. 257–262, Feb. 2024, doi: 10.1177/00099228231169262.

[21] A. Y. Lee and J. T. Hancock, "Developing digital resilience: An educational intervention improves elementary students' response to digital challenges," *Comput. Educ. Open*, vol. 5, no. June, p. 100144, 2023, doi: 10.1016/j.caeo.2023.100144.

[22] K. Xu, J. Fu, and J. Yang, "Enhancing Child Sexual Abuse Prevention Knowledge With an Educational Toolkit -Evaluation of the Chinese Doll Program," *Int. J. Public Health*, vol. 69, no. January, pp. 1–9, 2024, doi: 10.3389/ijph.2024.1606641.

[23] A. Şakir, "Influences on early childhood educators' adoption of gamified mobile learning tools: a multitheoretical analysis," *Interact. Learn. Environ.*, May 2025, doi: 10.1080/10494820.2025.2494157.

[24] D. Rahayu, I. Indryani, and B. A. Wulandari, "Pengembangan Media Sex Kids Education (Skidu) Berbasis Board Game Untuk Anak Usia Dini," *J. Muara Pendidik.*, vol. 8, no. 1, pp. 83–95, 2023, doi: 10.52060/mp.v8i1.1179.

[25] T. N. Siregar, "Implementasi Metode Design Thinking Pada Perancangan Aplikasi Game Edukasi Pencegahan Kekerasan Seksual Anak Berbasis Multimedia," *J. Teknol. Inf. Dan Komun.*, vol. 15, no. 1, pp. 155–167, 2024, doi: 10.51903/jtikp.v15i1.841.

[26] I. F. Liu, "Gamified mobile learning: effects on English learning in technical college students," *Comput. Assist. Lang. Learn.*, vol. 37, no. 5–6, pp. 1397–1420, 2024, doi: 10.1080/09588221.2022.2080717.

[27] R. F. Lisondra, X. N. G. Jumawan, J. P. E. Anito, G. R. B. Abugan, R. J. T. Mira, and U. B. Patayon, "eMATH: A Gamified Approach to Arithmetic Lessons," in *2023 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies, 3ICT 2023*, Institute of Electrical and Electronics Engineers Inc., 2023, pp. 440–444. doi: 10.1109/3ICT60104.2023.10391559.

[28] M. Zolfaghari, M. Shirmohammadi, H. Shahhosseini, M. Mokhtaran, and S. Z. Mohebbi, "Development and evaluation of a gamified smart phone mobile health application for oral health promotion in early childhood: a randomized controlled trial," *BMC Oral Health*, vol. 21, no. 1, pp. 1–9, 2021, doi: 10.1186/s12903-020-01374-2.

[29] S. Bantun, P. Setyosari, S. Ulfa, H. Praherdhiono, and J. Y. Sari, "Pengembangan Aplikasi Mobile dengan Pendekatan Gamifikasi dalam Pembelajaran Matematika di Sekolah Dasar," *INFORMAL Informatics J.*, vol. 8, no. 3, p. 234, 2024, doi: 10.19184/isj.v8i3.43856.

[30] H. Mehdizadeh, F. Asadi, E. Nazemi, A. Mehrvar, A. Yazdanian, and H. Emami, "A Mobile Self-Management App (CanSelfMan) for Children With Cancer and Their Caregivers: Usability and Compatibility Study," *JMIR Pediatr. Parent.*, vol. 6, pp. 1–10, 2023, doi: 10.2196/43867.