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Improving Early Childhood Emotional Regulation through Colored Light Games: A Play-Based Intervention Approach

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ABSTRACT

Emotion regulation in early childhood (ages 4–6) is still developing and often manifests in emotional outbursts and difficulty following classroom instructions. This study investigates the effectiveness of the *Lampu Warna* (Colored Lights) game, a structured play-based learning strategy, in improving children's emotion regulation. A pretest–posttest control-group design was employed with 32 kindergarten children in Pariaman Regency, West Sumatra, randomly assigned to an experimental group (n = 16) and a control group (n = 16). The intervention consisted of eight sessions (15–20 minutes each), conducted twice weekly over four weeks during circle time. Emotion regulation was measured using the teacher-rated Emotion Regulation Checklist (ERC). Data were analyzed using Wilcoxon signed-rank and Mann–Whitney U tests in JASP (version 19). The experimental group showed a substantial improvement in emotion regulation, with mean scores increasing from 47.88 to 71.06 ($W = 0.00$; $z = -3.516$; $p < 0.001$; $r = 0.88$). The control group exhibited no significant change. Between-group analysis confirmed significantly higher outcomes in the experimental group ($U = 256.0$; $p < 0.001$; Cliff's $\delta = 1.00$). The findings indicate that the Colored Light game effectively enhances emotion regulation by engaging children in structured, interactive play that supports emotional awareness and control. The Colored Light game is an effective play-based intervention for improving emotion regulation in early childhood and offers practical implications for classroom-based socio-emotional learning strategies.

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1. INTRODUCTION

The focus on early childhood education (PAUD) is no longer limited to strengthening cognitive aspects and early literacy skills, but also includes socio-emotional, moral, and spiritual development from the first years of life (Meirani et al., 2023; Oskar et al., 2025; Ministry of Education, Culture, Research, and Technology, 2022). According to Puspita et al. (2025), PAUD is currently tasked with preparing children to face academic activities in elementary school and attitudes in later life. Within this framework, learning

activities should be structured through fun and meaningful play experiences so that children's curiosity, independence, and ability to interact can grow in a balanced manner (Angkur et al., 2025; Ester & Situmeang, 2025; Natsir et al., 2025). One crucial socio-emotional component is emotional regulation, which is a child's ability to recognize, understand, and manage emotions so they can respond to situations in a more controlled manner and in accordance with environmental expectations (Chintya & Sit, 2024; Malti et al., 2016). In child development, this ability is closely related to executive functions, particularly inhibitory control, such as restraining the urge to act spontaneously; attentional shifting, such as maintaining focus on relevant cues; and cognitive flexibility, such as adjusting responses when rules change (Halse et al., 2024; Hong et al., 2025). Therefore, play activities that provide "stop–go" signals and gradually change rules can serve as direct practice for inhibiting impulses, shifting focus, and adjusting actions (Cankaya et al., 2023). In addition to training rule compliance, brief reflection after play also helps children recognize the emotions that arise and choose simple self-calming strategies, such as taking deep breaths or engaging in positive self-talk (Cankaya et al., 2023; Lambert et al., 2025; McClelland et al., 2019). Various studies have shown that mature and positive emotional regulation is closely related to school adjustment, maintaining friendships, and long-term learning readiness (Adynski et al., 2024; Lu et al., 2024). However, empirical findings in Indonesia indicate that many preschool children already exhibit emotional and behavioral problems.

Previous literature studies have shown that the level of emotional regulation in early childhood in Indonesia varies. While some children are able to control emotional outbursts and cooperate with friends, others still cry easily, become angry, or withdraw when faced with stressful or unexpected situations (Auriza et al., 2025; Randiawan & Muthmainah, 2025). A study in East Denpasar using the Strengths and Difficulties Questionnaire (SDQ) on children aged 3–6 years reported that the proportion of abnormal scores for emotional problems, hyperactivity, and peer relations in the 6-year-old age group was very prominent (Sari & Iga, 2015). According to early childhood education (PAUD) teachers, emotional dysregulation is still common in children aged 4-6 years, where they often get carried away by emotions, cry for long periods, scream, throw objects, and have difficulty waiting their turn when faced with disappointment or defeat in play (Leo & Hendriati, 2022; Muthmainah, 2022; Putri & Primana, 2018). Various findings in early childhood education institutions in West Sumatra indicate that early childhood emotional regulation skills are still relatively low. Children show a lack of emotional regulation skills which is a risk factor for the emergence of aggressive behavior in children, such as children fighting over toys and arguing, some speaking in a raised tone, shouting at friends, and not being able to patiently wait their turn (Febriani & Yulsyofriend, 2022; Nurhafifah et al., 2024).

Emotional regulation problems in children can be caused by several underlying factors. Parenting styles influence how children respond to their emotions (Leo & Hendriati, 2022). Children growing up in environments lacking attention and affection will impact their ability to regulate their emotions effectively (Aninditha & Boediman, 2021; Rohman et al., 2024). Furthermore, research findings in West Sumatra suggest that one contributing factor to children's low emotional regulation abilities is an imbalance of attention in early childhood education (PAUD) practices, where the focus is still predominantly on academic achievement and less on structured social-emotional learning (Annisa et al., 2024; Siti & Hafizah, 2023). This suggests that the role of teachers in West Sumatra in teaching children emotional regulation is suboptimal, necessitating training support and a curriculum that is more responsive to children's emotional needs (Annisa et al., 2024).

Theoretically, developmental psychology literature positions the preschool period as a critical period for the development of emotional regulation (Harrington et al., 2020). Children aged 4–6, who are still in the preoperational stage, tend to be egocentric, so they naturally tend to focus their perspective on themselves and are easily involved in social conflict if not guided (Marwaha, 2017; Sidiq et al., 2025). The emotional socialization framework emphasizes the importance of co-regulation through sensitive and responsive adult figures such as parents and teachers, who help children name feelings, recognize triggers, and practice strategies such as taking a breath, counting, or taking a moment to step away from situations that trigger anger (Kostøl, 2025; Silkenbeumer et al., 2024). On the other hand, cross-cultural studies show

that in the Indonesian context, children are often taught to "hide" negative emotions to maintain harmony (Riany et al., 2022; Wandansari, 2020). This is also supported by various studies in Indonesia showing that parents and teachers still often prioritize authoritarian parenting through short commands such as "be quiet," "don't be angry," or "don't cry," without providing consistent emotional regulation practice, which negatively impacts children's emotional development (Boediman & Desnawati, 2019; Hafshah & Pratiwi, 2021). This contradiction between theoretical recommendations and practical practice has the potential to make children appear obedient, but lack the skills to truly manage their emotions healthily (Boediman & Desnawati, 2019).

If emotional regulation difficulties at an early age are not addressed appropriately, the impact can extend into elementary school and beyond. Several longitudinal studies have shown that poor emotional regulation is associated with increased aggressive behavior, discipline problems, difficulties with school adjustment, and a higher risk of anxiety and depression in adolescence (Kuzucu, 2016; Ningrum, 2023). Research in West Sumatra, for example, shows that the combination of parenting styles demanding high levels of obedience and strict control at home leads to relatively high rates of aggressive and violent behavior in the school environment (Rahayuningrum et al., 2024; Suryana & Sakti, 2022). These findings confirm that strengthening emotional regulation at home and in early childhood education is not only a short-term necessity for classroom management but also a strategic investment in the quality of future human resources.

Emotional regulation intervention efforts in Indonesia have so far utilized a variety of media. In addition to picture books and interactive storybooks, there are three-in-one storytelling programs for kindergarten children aged 4–6 (Nurhafifah et al., 2024), snakes and ladders games (Hikmah et al., 2024), and the use of traditional games such as hide-and-seek (Khadijah et al., 2023). However, such approaches generally emphasize emotion identification and broader socio-emotional responses, and they typically involve relatively brief intervention procedures. Furthermore, research on circle time activities in the classroom has generally focused on recognizing emotions or general emotional intelligence, without utilizing a structured, gradual self-regulation game protocol. Internationally, the Red Light, Purple Light (RLPL) program developed by McClelland and Tominey has demonstrated effectiveness in improving self-regulation in preschoolers through a series of music and movement games during circle time sessions, with gradually changing color signals and rules to challenge children's ability to remember, distract, and inhibit automatic responses (McClelland et al., 2019). Within the early childhood Social and Emotional Learning (SEL) literature, games that involve stop–go practice, rule changes, and teacher support are viewed as aligned with self-regulation learning grounded in experience and social interaction (Arda & Tugce, 2025; Kloo & Sodian, 2017). To date, researchers have not found any research reports that specifically adapt RLPL or similar games into the context of Indonesian PAUD.

Accordingly, the research gap lies in the limited empirical evidence in Indonesia regarding movement-based, game-based emotion regulation interventions that explicitly target inhibitory control and cognitive flexibility through structured rule switching, such as RLPL. The novelty of this study is the development and evaluation of the Colored Light game as an adaptation of RLPL principles, integrating stop–go cues, gradual rule changes, and brief emotion reflection to help children practice coping strategies within the context of early childhood education circle time. Based on this gap, this study developed the "Colored Lights" game as a local adaptation of the RLPL principle to improve emotional regulation in children aged 4–6 years in early childhood education (PAUD). In this game, children respond to colored cards (such as green, yellow, and purple) with specific movement patterns. As the program progresses, the meanings of the colors are changed or combined, challenging children to remember new rules, shift focus, resist the urge to act spontaneously, and practice calming strategies when making mistakes or experiencing disappointment.

Operationally, emotion regulation in this study was measured using the teacher-rated Emotion Regulation Checklist (ERC), in which higher scores reflect more adaptive emotion regulation. In addition, emotion regulation was also observed through behavioral indicators during the game, including the ability to stop movement in response to signals, inhibit impulses prior to instructions, wait for one's turn,

accept mistakes without tantrums, use self-calming strategies, and return to play calmly. Theoretically, this study is expected to add empirical evidence regarding movement-based emotional regulation interventions in the Indonesian cultural context. Practically, the results are expected to provide a model for circle time activities that are simple, engaging, and easy for teachers to replicate as part of a systematic effort to strengthen emotional regulation in PAUD institutions. Based on this rationale, the study tested the following hypotheses: H1: the experimental group's post-test ERC scores will be higher than those of the control group; H2: the experimental group will show an increase in ERC scores from pre-test to post-test, whereas the control group will not show a statistically meaningful increase.

2. METHODS

This study employed a quantitative approach using a pretest–posttest experimental design with a control group. The study sample consisted of children aged 4–6 years enrolled in a kindergarten in Pariaman Regency, West Sumatra. The children were then randomly assigned, with 16 selected for the experimental group and another 16 selected for the control group, resulting in a total sample of 32 children. Sample characteristics were reported in terms of age distribution (4 years = 10, 5 years = 9, 6 years = 13) and sex distribution (boys = 15, girls = 17). Included children were active students and had obtained written informed consent from their parents/guardians. The inclusion criteria were: (1) active enrolment; (2) aged 4–6 years; (3) completion of both the pre-test and post-test; and (4) written parental/guardian consent.

The intervention in the experimental group involved the circle time game "Colored Lights," an adaptation of the Red Light, Purple Light game for the Indonesian Early Childhood Education (PAUD) context. The activity was conducted twice a week for four weeks (eight sessions total), each lasting approximately 15–20 minutes at the beginning of regular learning. The teacher stood at the front of the class holding green, yellow, and purple colored cards. In the first and second weeks, only two colors were used: green indicated that children could move freely, such as walking, dancing, or jumping to the music. Purple meant that children should stop immediately when the music stopped, stand still like a statue, hug themselves, and take three deep breaths. In the third and fourth weeks, yellow cards were added, symbolizing specific movements such as walking slowly as if tired or jumping slowly. Children were asked to immediately match their movements to the color the teacher held up. In one of the final sessions, the color rules were deliberately changed (green = stop, purple = walk slowly, yellow = jump), requiring children to suppress their previous habitual responses, remember the new rules, and manage any feelings of confusion or disappointment when they made mistakes. Each session concluded with a brief reflection by the teacher, asking the children, "Were you upset when you had to stop?" and modeled positive self-talk such as "It's okay to make a mistake, I'll try again, take a breath." The control group followed routine learning activities without the addition of the Color Lights game. To enhance procedural replicability, each session was conducted in a consistent sequence: an opening/rule reminder, the core game delivered across several rounds, a brief cool-down, and emotion reflection.

Emotional regulation ability was measured using the Emotional Regulation Checklist (ERC) scale developed by Shields and Cicchetti (1997), and adapted into Indonesian by Putri and Primana (2017). This scale was completed by the class teacher for all research subjects during the pretest (before intervention) and posttest (after four weeks). The ERC score provides a general overview of the child's ability to manage negative emotions and express emotions adaptively. In addition, in several game sessions in the experimental group, structured observations were conducted using an observation sheet containing the following indicators: (1) ability to stop movement immediately after a stop signal appears; (2) ability to restrain oneself from moving before instructions; (3) ability to wait one's turn; (4) accepting mistakes without tantrums; (5) use of self-calming strategies (e.g., taking a breath, hugging oneself); and (6) returning to play calmly after making a mistake. Each indicator was assessed using a graded scale which was then processed into an average score for behavioral emotional regulation during the game. Each indicator was rated using an ordinal scale ranging from "behavior not yet observed" to "behavior consistently displayed" (1–4), which was then aggregated into a mean score

representing behavioral emotion regulation during the game. A rubric for the ordinal rating scale was used to maintain consistency in scoring across sessions.

Quantitative data from ERC measurements and observations were analyzed descriptively and inferentially. Given the relatively small sample size and the non-normal distribution of part of the data, inferential analyses were conducted using nonparametric tests. Differences in pretest–posttest scores in each group were tested using the Wilcoxon Signed Rank Test. Differences in emotional regulation scores between the experimental and control groups were analyzed using the Mann–Whitney test. The significance level was set at $\alpha = 0.05$, and data processing was performed using the JASP Version 19 statistical program.

This research was conducted after obtaining official permission from the PAUD institution and ethical approval from the authorities. Children's identities were encrypted to maintain confidentiality, participation was voluntary, and parents/guardians were given the right to discontinue their child's participation at any time without negative consequences. The Color Lights game was designed to be safe, in line with the developmental characteristics of early childhood, and aligned with the applicable PAUD curriculum. During the movement-based game, the classroom space was arranged and teacher supervision was provided to minimize the risk of tripping or collisions; the game was stopped if a child appeared uncomfortable or fatigued.

3. FINDINGS AND DISCUSSION

3.1 Findings

The "Colored Lights" game was implemented in the experimental group over eight sessions. Each session began with a brief opening activity, followed by a core game session using green, yellow, and purple cards with increasingly complex rules. The game concluded with a shared emotional reflection session. The control group continued to participate in routine early childhood education activities without the addition of a special emotional regulation game. During the intervention, teachers and researchers observed children's emotional regulation behavior and administered the ERC scale before (pretest) and after (posttest) the series of sessions.

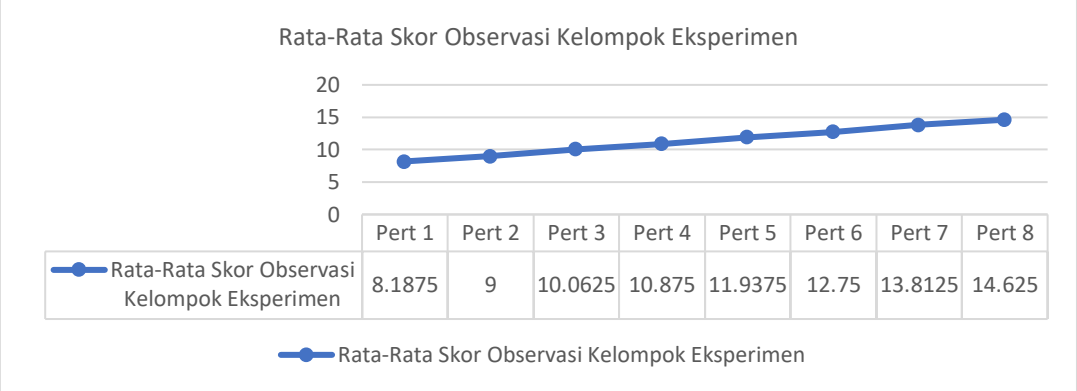

Figure 1. Plot of the increase in the experimental group's ability to follow directions at each meeting.

Figure 1 shows the development of the average observation score of the experimental group's emotion regulation during the eight sessions of the "Colored Lights" game. It can be seen that from the first to the eighth session, there was a consistent increase. At the first session, the average score was 8.19, then increased to 9.00 at the second session and 10.06 at the third session. At the fourth session, the average score rose again to 10.88, then successively 11.94 (session 5), 12.75 (session 6), 13.81 (session 7), until reaching 14.63 at the eighth session. This continuously increasing line pattern indicates that each session of the game was followed by improvements in the children's emotional regulation abilities, both in terms of stopping movements on signal, waiting for their turn, and using self-calming strategies when experiencing mistakes or disappointment.

Table 1. Descriptive statistical analysis of pretest and posttest data

	KE_*Pretest*	KE_*Posttest*	KK_*Pretest*	KK_*Posttest*
Valid	16	16	16	16
Mean	47.88	71.06	47.50	47.25
Mean	47.88	71.06	47.50	47.25
Std. Deviation	4.303	3.820	3.847	3.733
IQR	4.750	2.500	4.250	4.750
Shapiro-Wilk	0.929	0.870	0.948	0.962
P-value of Shapiro-Wilk	.235	.028	.454	.691
Minimum	42.00	66.00	40.00	40.00
Maximum	58.00	79.00	54.00	53.00

In general, the descriptive measurement results in Table 1 indicate a tendency for increased emotional regulation in the experimental group after participating in the "Colored Lights" game, while the control group experienced relatively no significant changes. A descriptive overview of the ERC scores can be seen in Table 1. The average ERC score of the experimental group increased from 47.88 (SD = 4.303; min = 42; max = 58) in the pretest to 71.06 (SD = 3.820; min = 66; max = 79) in the posttest. In contrast, the control group showed an average score of 47.50 (SD = 3.847; min = 40; max = 54) in the pretest and 47.25 (SD = 3.733; min = 40; max = 53) in the posttest. This means that the average increase in the experimental group's score reached approximately 23 points, while the control group's score tended to remain the same. A visual comparison of the average pretest and posttest scores of both groups is shown in Figure 2, which shows a sharp increase in the experimental group and a flat line in the control group. The Shapiro–Wilk normality test showed that most of the data were normally distributed ($p > 0.05$), except for the posttest score of the experimental group which had a p value = 0.028 (< 0.05), so the distribution was not completely normal. Based on this, the analysis of differences in pretest–posttest scores in each group was conducted using the Wilcoxon signed-rank test.

Table 2. Wilcoxon signed-rank and Mann-Whitney tests

			Wilcoxon signed-rank			Mann–Whitney	
Measure 1		**Measure 2**	**W**	**z**	**p**	**U**	**p**
KE_Pretest	-	KE_Posttest	0.000	-3.516	< .001		
KK_Pretest	-	KK_Posttest	38.500	1.121	.227		
KE_Posttest	-	KK_Posttest				256.0	< .001

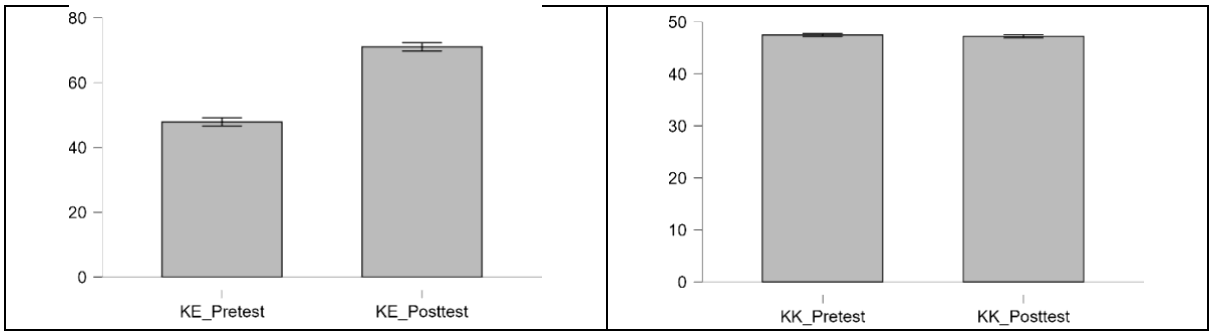

Figure 2. Wilcoxon Test Plot

The Wilcoxon test results (Table 2; Figure 2) in the experimental group (EG) show a p-value of < 0.001. A p-value far below 0.05 indicates that there is a significant difference between ERC scores before and after the intervention in the EG, so the null hypothesis is rejected and the working hypothesis stating that there is an improvement in emotion regulation after participating in the Colored Light game is accepted. In contrast, the Wilcoxon test results in the control group (CG) produced a p-value of 0.227 (> 0.05). This indicates that there is no significant difference between pre-test and post-test scores in the CG, so statistically, the group that did not receive the Colored Light game did not experience a meaningful change in emotion regulation. Likewise, the p-value of < 0.001 with a very large effect size (rank-biserial/Cliff's δ = 1.00; EG > CG) in the Mann–Whitney test indicates that there is a significant difference in outcomes between the experimental group's post-test results and the control group that was not given the treatment. Thus, the descriptive and inferential results consistently show that the EG experienced a meaningful improvement in emotion regulation, whereas the CG did not show a statistically significant change.

3.2 Discussion

This study aimed to test the effectiveness of the Colored Lights game in improving emotional regulation skills in early childhood. The results consistently showed that children participating in the Colored Lights game experienced significant improvements in emotional regulation, both observationally across eight intervention sessions and based on comparisons of pretest and posttest ERC scores. The Wilcoxon and Mann-Whitney tests further confirmed that the improvement in emotional regulation did not occur naturally but was influenced by the Color Lights game intervention. Therefore, the results of this study support the assumption that deliberate and structured stimulation is more effective than routine learning in developing emotional regulation in early childhood (TA, 2024).

Descriptively, the gradual increase in observed emotional regulation scores in the experimental group at each session indicates that emotional regulation is a skill that develops through repeated practice and direct experience (Madden & Reynolds, 2021; Martin & Ochsner, 2016; Nilfyr & Ewe, 2025). Specifically, the increase in scores from session to session can be understood as the impact of repeated practice on executive functions and the co-regulation framework, in which children become increasingly skilled at restraining the urge to move (inhibition) when the stop signal appears, increasingly able to maintain the rule that is currently in effect while the game is in progress (working memory), and increasingly flexible in switching responses when the rules are changed (cognitive flexibility) (Binns et al., 2019; Javier & Irene, 2025; Smit et al., 2025). At the same time, teacher-guided instructions and emotion reflection function as co-regulation scaffolding, which helps children label emotions, accept mistakes, choose self-calming strategies, and then return to play calmly (Blewitt et al., 2021). The consistent pattern of increasing scores indicates that the increasing complexity of the game rules from session to session plays a role in strengthening children's ability to control impulses, follow directions, delay responses, and calm down when faced with mistakes or disappointments. When viewed from the perspective of executive functions, these increasing game demands can be understood as progressive practice, in which the "stop–go" rules stimulate inhibitory control, the need to maintain the rule currently in effect relates to working memory, and rule changes (rule switching) require cognitive flexibility when children must replace a response that was previously correct with a new response (Hong et al., 2025; Javier & Irene, 2025). This is in line with the view of emotional development that positions emotional regulation as a plastic ability and is highly responsive to contextual and repeated learning experiences (English & Eldesouky, 2020; Preece et al., 2025; Pyle et al., 2022).

When integrated with existing theory, these findings align with a self-regulation framework that emphasizes the importance of attentional control, behavioral inhibition, and self-monitoring as key components of early childhood emotion regulation (Scoular et al., 2025). The Color Lights game works through mechanisms such as strengthening inhibitory control (stopping and moving on cue), managing attention (noticing color changes), and reflecting on emotions at the end of the session (McClelland et

al., 2019). When the rules are changed, children are not only expected to “comply,” but are also trained to inhibit their previous habitual responses and shift to responses aligned with the new rules, which is the core of cognitive flexibility. These three components are the foundation of emotion regulation in early childhood (Yurdakul et al., 2022). Furthermore, this approach is consistent with a sociocultural perspective that views social interactions and teacher scaffolding as crucial factors in the development of emotion regulation (Diebold et al., 2023). The teacher's presence as a facilitator during play and emotional reflection allows children to learn to recognize, name, and manage their emotions in a safe social context (Silkenbeumer et al., 2024). Furthermore, the findings of this study expand empirical evidence on the effectiveness of play-based interventions in early childhood education, particularly on emotional regulation. Unlike verbal and abstract instructional approaches, the Colored Lights game provides a concrete and enjoyable sensorimotor experience, thus aligning with the developmental characteristics of early childhood. These results reinforce the view that emotional regulation is more optimally developed through structured play activities than through direct teaching or instruction-based discipline alone (Sitorus et al., 2025).

From the perspective of emotion socialization theory, the Colored Lights game provides a strong environment for co-regulation. This occurs because it involves active interaction between children, peers, and teachers, in a situation that stimulates collaborative emotion management and regulation (McClelland et al., 2019). The teacher not only gives instructions to stop or go, but also models self-soothing techniques, such as asking them to "take a breath" or "give yourself a hug," and encourages the child to reflect on their feelings at the end of the game. When the child makes a mistake and feels upset, the teacher normalizes the emotion and guides the child in using the agreed-upon emotion regulation strategies. In this way, teacher support functions as scaffolding that bridges external regulation (supported by adults) toward internal regulation (independent), as children practice identifying emotions, selecting strategies, and resuming activities without prolonged emotional outbursts (Blewitt et al., 2021; Brinckman et al., 2025; Shetty & Padmakumari, 2025). This type of interaction aligns with the idea that children learn to regulate their emotions through relationships with responsive adults, not just through verbal advice (Grimmer, 2022; Saez et al., 2025). Morris et al. (2017) refer to this process as a bridge between the external regulation provided by adults and the internal regulation the child will eventually develop.

Based on the integration of empirical findings and theoretical frameworks, this study proposes a strengthened model of emotion regulation based on reflective structured play. This model modifies approaches to emotion regulation that generally emphasize individual emotion recognition and self-control by adding elements of gradual play and collective emotional reflection. In this model, emotion regulation is understood as the result of a dynamic interaction between game rules, cognitive stimulation, direct emotional experiences, and social support from the learning environment. Thus, children's emotion regulation develops not only as an intrapersonal skill but also as a social competence learned through collaborative play activities.

The findings of this study add to the diversity of interventions aimed at improving emotional regulation in early childhood in Indonesia. Previous research in Indonesia has used picture stories, interactive storybooks, and traditional games to help children understand and manage emotions (Hikmah et al., 2024; Khadijah et al., 2023; Nurhafifah et al., 2024). The results all demonstrate an increase in children's ability to express emotions more adaptively and a decrease in aggressive behavior. However, most of these interventions emphasize cognitive aspects such as recognizing emotion names and understanding situations that trigger anger or sadness, rather than directly training executive functions through body movement. The uniqueness of the "Colored Lights" game lies in its integration of physical exercise, changing rules, and emotional reflection, allowing children to practice connecting "what I feel," "what I should do," and "how I calm myself" within a single activity. However, the results of this study should be interpreted with several limitations in mind. The sample size is relatively small and comes from only one early childhood education institution, so generalizing the findings to a broader context should be done with caution.

Nevertheless, the findings of this study should be interpreted in light of several limitations. First, the sample size was relatively small and drawn from only one early childhood education institution, so generalization of the findings to broader contexts should be made with caution. Second, no follow-up (maintenance) test was conducted to assess the sustainability of the effects after the intervention ended. Future studies may consider a multi-site design with a larger number of clusters, as well as analyses that account for the clustered structure of the data.

Overall, the results of this study provide both theoretical and practical contributions. Theoretically, these findings strengthen and modify the concept of emotional regulation in early childhood by emphasizing the role of structured play and emotional reflection as primary learning mechanisms. Practically, the Colored Lights game can be recommended as an applicable and easily integrated intervention strategy in early childhood education activities to systematically and sustainably support the development of children's emotional regulation.

4. CONCLUSION

This study concluded that the Colored Lights game was effective in improving emotional regulation skills in early childhood. Children who participated in the game demonstrated improved emotional control, followed directions, delayed impulsive responses, and calmed themselves when faced with mistakes or disappointment compared to children in the control group. Statistically, the experimental group showed a significant improvement (Wilcoxon $p < 0.001$), whereas the control group did not ($p > 0.05$); the between-group difference was also significant (Mann–Whitney $p < 0.001$). These findings suggest that emotional regulation does not develop optimally through routine learning alone but requires planned stimulation tailored to the child's developmental characteristics. The results of this study confirm that structured, gradual play activities accompanied by emotional reflection can be an effective social-emotional learning strategy in early childhood education. The Color Lights game provides concrete and contextual learning experiences, thus supporting the development of children's emotional regulation through social interaction and adherence to game rules. Practically, stop/go games, rule changes, and brief reflection can be implemented in the classroom to train emotion regulation.

Early childhood educators are advised to integrate the Colored Lights game or similar structured games into daily learning activities to foster children's emotional regulation. Minimum dose of 8 sessions over 4 weeks (approximately 15–20 minutes per session). Teachers are expected to play an active role as facilitators by providing consistent guidance and helping children reflect on their emotional experiences during play. Early childhood institutions can utilize the results of this study as considerations in developing more planned and sustainable social-emotional learning programs. Further research is recommended to involve a wider sample size, use a long-term research design, and examine other factors such as the role of teachers and the sustainability of the impact of interventions on child development. Future research is recommended to involve a broader sample size, employ a long-term research design, and examine other factors such as the teacher's role and the sustainability of the intervention's impact on child development. Future studies are also recommended to include larger, multi-site samples using a cluster-based randomized controlled trial (cluster-RCT) design to enhance external validity, and to add follow-up measurements (e.g., 4–8 weeks after the intervention) to assess the durability of effects. In addition, subsequent studies could compare the Colored Light game with other comparable SEL games.

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