Journal of English Language and Education
ISSN 2597- 6850 (Online), 2502-4132 (Print)
Journal Homepage: https://jele.or.id/index.php/jele/index

OPEN ACCESS Article

Strengthening Early Childhood Social-Emotional Character through STEAM-Based Learning

https://doi.org/10.31004/jele.v11i3.2475

*Thea Yuliana Anjari, Tita Sapriyanti, Aisyah Oktavia Siregar, Arnita Fitri, Hera Dwi Kusuma Wardani[abcde]

[12345]Universitas Rokania, Indonesia

*Corresponding Author: Theayuliana2018@gmail.com

A B S T R A C T

This study aims to analyze the effect of STEAM-based learning on strengthening the social-emotional character of early childhood. Various studies have examined the application of STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning in early childhood education, but the majority still focus on the development of cognitive aspects, creativity, and critical thinking skills. Research that specifically integrates the STEAM approach with strengthening social-emotional character, especially on indicators of cooperation, empathy, emotional control, and social communication, is still very limited, and there is minimal empirical evidence based on experimental designs comparing its effectiveness with conventional learning. The study subjects were 30 children aged 5–6 years who were divided into an experimental class and a control class. Data were collected through observations using a Likert scale instrument based on four social-emotional indicators. The results showed that the experimental class experienced higher improvements than the control class, with a gain value of 1.35 in the experimental class and 0.70 in the control class. Statistical tests showed a significant difference between the two groups. These findings indicate that STEAM-based learning is effective in improving children's social-emotional character through interactive, collaborative, and experience-based activities. Thus, this study fills a research gap by providing empirical evidence that STEAM integration in learning not only contributes to cognitive aspects but also significantly strengthens the social-emotional character of early childhood.

Keywords: *STEAM Learning, Social-Emotional, Early Childhood, Character Education, Quasi-Experimental*

Article History:
Received 03rd May 2026
Accepted 25th May 2026
Published 29th May 2026

INTRODUCTION

Social-emotional development is a fundamental aspect of early childhood education, which plays an important role in shaping a child's personality, interaction skills, and self-control. At a golden age, children experience rapid development, so they need the right stimulation to manage their emotions, build social relationships, and exhibit prosocial behavior in daily life. Therefore, strengthening social-emotional character is an important part of the early childhood education process (Fuadia, 2022; Yulisetyaningrum, 2019).

However, the challenges faced by children's social-emotional development are increasingly complex as time goes by, especially in the digital era. Children tend to interact more with technological devices than with their social environment, potentially reducing their ability to interact directly with others. This can have an impact on children's ability to empathize, cooperate, and manage emotions effectively (Radliya et al., 2017). The role of educational institutions, especially early childhood education (PAUD), is very important in providing targeted stimulation for children's social-emotional development. Teachers are required to create learning that not only focuses on cognitive aspects but also integrates social and emotional aspects into learning activities. This can be achieved through various innovative and fun learning approaches for children (Hidayah & Khadijah, 2023).

In addition, the family environment and parenting style also greatly affect the social-emotional development of children. Inappropriate parenting styles, such as a lack of emotional involvement or ineffective communication, can affect a child's ability to control emotions and interact with others. Conversely, supportive parenting can help children develop optimal social-emotional skills (Dhiu & Fono, 2022; Ummah & Fitri, 2020).

Various innovative learning approaches have been developed to answer these challenges, one of which is the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach. This approach emphasizes integrative, contextual, and experiential learning that can develop children's critical thinking, creativity, and collaboration skills (Sousa & Pilecki, 2013; Yakman, 2008). Previous research has shown that STEAM is effective in improving children's cognitive skills and problem-solving abilities (Lubis, 2019).

However, there is a fairly clear research gap. Most research on STEAM still focuses on the development of cognitive aspects, creativity, and science literacy, while studies that specifically integrate STEAM in strengthening early childhood social-emotional character are still very limited. In addition, studies that empirically test the influence of STEAM on social-emotional indicators such as cooperation, empathy, emotional control, and social communication through experimental design are also rare. This suggests that the integration between STEAM learning and social-emotional development has not been explored in depth.

Based on these conditions, the urgency of this research has become stronger. Strengthening the social-emotional character of early childhood is an urgent need amid the challenges of the digital era that tends to reduce direct social interaction. A learning model is needed that is not only oriented to the cognitive aspect, but also able to develop children's character holistically. STEAM-based learning has the potential to answer these needs because it integrates collaborative, exploratory, and experiential activities that can stimulate children's social interaction and emotional engagement (Hidayah & Khadijah, 2023).

STEAM-based learning also provides opportunities for children to learn through hands-on experience (learning as they do), thereby increasing their emotional involvement in the learning process. Exploration, experimentation, and collaboration in STEAM allow children to express feelings, understand other people's perspectives, and build confidence. This forms an important foundation for strengthening the social-emotional character of early childhood (Lubis, 2019).

Social-emotional development is not only related to a child's ability to interact, but also reflects emotional maturity, self-regulation, and adaptive behavior in the social environment. According to Dewi et al. (2020), social-emotional behaviour in early childhood includes the ability to cooperate, show empathy, control emotions, and build positive relationships with peers. These aspects are essential as basic skills for the child's future social functioning.

Efforts to optimize social-emotional development must be made through stimulation and appropriate educational strategies. Mulyani (2014) emphasized that early intervention through structured learning activities can significantly improve children's social-emotional competence. In line with this, Fitriya et al. (2022) highlight that social-emotional development is formed through continuous interaction between children and their environment, both in the family and educational environment.

Family environment and parenting patterns also play an important role in shaping a child's social-emotional abilities. Dhiu & Fono (2022) explain that positive parenting characterized by warmth, communication, and responsiveness contributes significantly to the emotional stability of children. This is supported by Ummah and Fitri (2020), which found that a supportive family environment improves children's ability to regulate emotions and interact socially. In addition, the practice of co-parenting between parents can strengthen children's emotional security and social competence (Gymnastia et al., 2025).

In the context of early childhood education, teachers are required to design learning activities that actively stimulate social-emotional skills. Various approaches such as role-playing, traditional games, and the use of educational play tools have proven effective. (Gymnastia et al., 2025). found that role-playing methods significantly improved empathy and

social interaction among children. Similarly, traditional games can foster cooperation, discipline, and emotional control (Dini, 2023; Mukhlis & Mbelo, 2019).

In addition, the use of educational play tools (APE) also contributes to improving children's social-emotional development by providing an interactive and interesting learning experience (Rakhmawati, 2022). These findings suggest that play- and experiential-based learning approaches are particularly relevant in early childhood education.

Therefore, integrating these approaches into STEAM-based learning becomes particularly relevant. STEAM not only encourages cognitive development but also provides opportunities for children to engage in collaborative, creative, and experiential activities that support the holistic development of social-emotional skills.

However, the implementation of STEAM-based learning in the context of early childhood education is still not optimal, especially in relation to strengthening social-emotional aspects. Most previous research has focused more on cognitive development and thinking skills, while aspects of social-emotional character have not been studied in depth in this approach. This shows that there is a research gap that requires further investigation.

Based on this description, this study aims to examine how strengthening the social and emotional character of early childhood can be achieved through STEAM-based learning. This research is expected to contribute to the development of learning models that are not only cognitively oriented but also integrate the strengthening of social and emotional character holistically into early childhood education.

METHOD

This study uses a quantitative approach with a quasi-experimental design (pretest-posttest control group design). This design was chosen to determine the influence of STEAM-based learning on the reinforcement of early childhood social-emotional character through a comparison between an experimental class and a control class. The experimental class was given STEAM-based learning, while the control class used conventional learning.

Respondent

The subjects of this study were early childhood children in Group B with children aged 5–6 years in a preschool institution (PAUD). The sample size of 30 children was divided into two groups: 15 in the experimental class and 15 in the control class. The sampling technique used was purposive sampling, taking into account the similarity of age and background characteristics of the children.

Instruments

The research instrument used was a social-emotional development observation sheet developed based on the following indicators: (1) the ability to work together, (2) empathy, (3) emotional control, and (4) social communication. The scale used is the Likert scale with a range of 1–4 (Not Yet Developed to Highly Developed). The instrument has been tested for validity and reliability before being used in research. Based on this explanation, the following data results were obtained:

Table 1. Results Based on Social-Emotional Indicators

Indicator	Experiments (Posttest)	Control (Posttest)
Cooperation	3,60	2,80
Empathy	3,50	2,70
Emotional Control	3,40	2,75
Social Communication	3,30	2,75

Procedure

Data collection was carried out through direct observation during learning activities, both before and after treatment (pretest) and after treatment (posttest). The STEAM-based learning treatment was implemented over four weeks (eight meetings) with activities such as simple experiments, collaborative projects, and art-based exploration. Based on this explanation, the following data results were obtained:

Table 2. Pretest and Posttest Results

Groups	Average Initial Test	Posttest rate-rate	Obtaining
Eksperimen (STEAM)	2,10	3,45	1,35
Controls	2,05	2,75	0,70

Data Analysis

Data analysis was performed using descriptive and inferential statistical tests, including t-tests to determine significant differences between the experimental class and the control class. Furthermore, an improvement score analysis was performed to assess improvements in the child's social and emotional development after treatment.

The results of the t-test showed a calculated t-value of 3.85, while the table t-value was 2.05 at a significance level of 0.05. Since the calculated t-value is greater than the table t-value, it can be concluded that there is a significant difference between the experimental class and the control class. Thus, the research hypothesis that STEAM-based learning affects the reinforcement of early childhood social-emotional character is acceptable. These results confirm that the STEAM approach is effective in improving the quality of children's social-emotional development compared to conventional learning

FINDINGS AND DISCUSSIONS

The findings of this study are further supported by previous research that emphasizes the importance of active learning and experiential in developing children's social-emotional skills. Dewi et al., (2020) stated that children's social-emotional behavior develops optimally when they engage in interactive and collaborative activities. This is in line with the STEAM approach, which emphasizes hands-on experience and teamwork.

The significant improvement in cooperative skills found in this study is consistent with the findings of Mukhlis & Mbelo (2019), who report that collaborative play activities, such as traditional play, improve children's ability to work together and build social relationships. Similarly, Dini (2023) highlights that traditional games foster social values such as cooperation, empathy, and responsibility. In terms of empathy development, the results of this study are in line with research conducted by Maghfiroh et al. (2020) and Linda & Mayar (2022), which show that role-playing activities can effectively improve children's ability to understand the feelings and perspectives of others. STEAM-based learning, which often involves group projects and joint problem-solving, provides similar opportunities for children to develop empathy.

In addition, the improved emotional control observed in this study can be attributed to the findings of Mulyani (2014), who emphasized that structured and meaningful learning experiences help children regulate their emotions more effectively. The experimental and exploratory nature of STEAM activities encourages children to face challenges, manage frustrations, and develop resilience.

The role of family and environmental factors also supported the findings of this study. As highlighted by Dhiu & Fono (2022) and Gymnastia et al. (2025), supportive parenting and effective co-parenting make a significant contribution to children's emotional stability, which in turn increases their readiness to engage in social learning environments such as STEAM classes.

In addition, the use of interesting learning media and tools, such as educational play equipment (Rakhmawati, 2022), is in line with the STEAM approach in creating an interactive learning environment. This environment allows children to actively participate, communicate, and collaborate, thus strengthening their social and emotional competence.

Overall, the integration of STEAM-based learning with a game-based and interactive approach provides a comprehensive framework for improving early childhood social-emotional development. This confirms that holistic learning strategies that combine cognitive, social, and emotional aspects are more effective than conventional teacher-centered approaches.

The results show that STEAM-based learning significantly affects the development of early childhood social-emotional character. This can be seen from the difference in average values between the experimental class and the control class. The average pretest score of the experimental class of 2.10 increased to 3.45 on the posttest, with an increase of 1.35, while the value of the control class only increased from 2.05 to 2.75, with an increase of 0.70. This difference suggests that STEAM-based learning is more effective than conventional learning in improving children's social-emotional skills. This finding is in line with the statement of Fuadia (2022) that proper stimulation will accelerate the optimal social-emotional development of children.

The results of the statistical test showed a calculated t-value of 3.85, greater than the table t-value of 2.05 at a significance level of 0.05. This shows a significant difference between the two groups, thus supporting the research hypothesis. Thus, STEAM-based learning has been shown to have a significant impact on early childhood social-emotional development. These results strengthen the theory that active and contextual learning can increase children's emotional involvement in the learning process (Yulisetyaningrum, 2019).

In the analysis of indicators, the cooperation aspect obtained the highest score in the experimental class, which was 3.60, followed by empathy (3.50), emotional control (3.40), and social communication (3.30). High scores on the cooperation indicators indicate that project-based activities in STEAM can encourage social interaction between children. Children learn to share roles, discuss, and solve problems together. This is in line with the research of Lubis (2019), who states that collaborative activities in learning can significantly improve children's social skills.

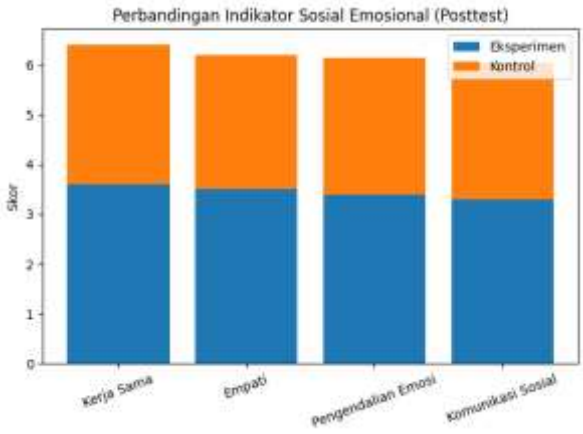

Figure 1. Comparison of experimental and control indicators

On the cooperation indicator, the experimental class obtained an average score of 3.60, compared to 2.80 in the control class. These results suggest that STEAM-based learning effectively improves collaboration skills among children. Through project-based and exploratory activities, children are encouraged to share roles, engage in discussions, and solve problems collectively. These findings support previous research showing that collaborative learning improves children's social skills.

For the empathy indicator, the experimental class obtained a score of 3.50, while the control class obtained a score of 2.70. These differences suggest that STEAM-based activities facilitate children's ability to understand and respond to the feelings of others. The interactive and experiential nature of STEAM learning provides opportunities for children to engage in perspective taking during social interactions.

In terms of emotion control, the experimental class achieved an average score of 3.40, compared to 2.75 in the control class. These findings suggest that children who engage in

STEAM learning are better able to regulate their emotions, especially when faced with challenges during experimental and group activities. The learning environment encourages constructive emotional expression and self-regulation.

Similarly, on the social communication indicator, the experimental class obtained a score of 3.30, higher than the control class's score of 2.75. This suggests that STEAM-based learning improves children's ability to communicate ideas and interact effectively with peers. The emphasis on discussion and teamwork provides more opportunities for active social engagement.

Furthermore, increased empathy suggests that children are better able to understand and respond to the feelings of their peers after participating in STEAM learning. Exploratory activities and experiences allow children to see a variety of perspectives in social interactions. These findings are supported by the research of Hidayah & Khadijah (2023), who stated that structured group learning can optimize the development of empathy and social interaction in early childhood.

In terms of emotional control and social communication, STEAM learning also shows positive results. Children are better able to manage their emotions when faced with challenges in experimental activities and group projects. Furthermore, children become more active in expressing ideas and communicating with peers. This is in contrast to the control class, which showed a lower improvement because learning tended to be teacher-centered. These findings are in line with the findings of Radliya et al. (2017), who stated that a lack of active interaction can hinder children's social and emotional development.

Overall, the results of this study show that STEAM-based learning makes a significant contribution to strengthening the social and emotional character of early childhood. An interactive, collaborative, and experiential-based learning environment can create conditions that support optimal social and emotional development. These findings are also in line with the research of Ummah & Fitri (2020), which emphasizes that a positive learning environment plays an important role in shaping children's social and emotional character. Therefore, STEAM-based learning can be used as an innovative strategy in early childhood education that focuses not only on the cognitive aspect but also on character development holistically.

CONCLUSIONS

Based on the results of research and discussion, it can be concluded that STEAM-based learning has a significant influence on strengthening the social-emotional character of early childhood. This was shown by a higher increase in average scores in the experimental class than in the control class, with a gain value of 1.35 in the experimental class and 0.70 in the control class. The results of the statistical test also showed that there was a significant difference between the two groups, so the research hypothesis was acceptable. The significance of the findings of this study shows that STEAM learning not only plays a role in developing cognitive aspects, but is also able to strengthen children's social-emotional character holistically. Activities that are collaborative, exploratory, and experience-based provide opportunities for children to develop empathy, cooperation, communication skills, and emotional control in real-life situations. Thus, STEAM is a relevant approach in answering the needs of child development in the modern era. The practical implications of this research are aimed at PAUD teachers, namely the importance of integrating STEAM-based learning in daily learning activities. Teachers are expected to be able to design activities that involve group work, simple experiments, and creative exploration that encourage children's social interaction. In addition, teachers need to play the role of facilitators who provide space for children to express emotions, communicate, and solve problems together, so that learning becomes more meaningful and oriented towards strengthening character. As for follow-up research recommendations, it is recommended to conduct research with a larger sample number and wider scope so that the results can be generalized more robustly. In addition, further research can extend the duration of the intervention to look at the long-term impact of STEAM learning on children's social-emotional development. The research can also examine

other variables such as the role of teachers, family environment, and the integration of technology in STEAM learning to gain a more comprehensive understanding.

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