Finger

Jurnal Ilmiah Teknologi Pendidikan
https://ejournal.1001tutorial.com/index.php/finger

Creative Cutouts: Integrating Kirigami as a Learning Media to Enhance Fine Motor Skills in Kindergarten Children

Istirokah [1*], Sulis Janu Hartati[2], Edy Widayat[3], Nuril Huda[4], Nensy Megawati Simanjuntak[5], Sarah Prather[6]

[1,2,3,4,5]Universitas Dr. Soetomo
Surabaya, Indonesia
[6]Madison Area Technical College
Madison, United States
✉ istirokah01@gmail.com*

Article Information:
Received June 17, 2025
Revised July 23, 2025
Accepted September 22, 2025

Keywords:
Early Childhood; Education; Fine Motor Skills; Kindergarten Kirigami; Learning Media

Abstract

Background: Fine motor skills are fundamental to a child's early development, influencing their ability to perform daily academic and self-care tasks. However, traditional methods for developing these skills in kindergartens often lack creative andengaging approaches. Kirigami, the Japanese art of cutting and folding paper, has the potential to serve as an interactive learning medium that promotes fine motor skill development through artistic expression and hand coordination.
Aims: This paper aims to examine the effectiveness of integrating kirigami as a learning medium to enhance fine motor skills in kindergarten children. The scope includes evaluating improvements in muscle control, hand-eye coordination, and paper manipulation abilities through structured kirigami activities.
Methods: The study employed a quasi-experimental design involving 30 children aged 4–6 years, divided equally into an experimental group and a control group. The experimental group received four weeks of kirigami-integrated sessions, while the control group followed conventional fine motor activities. Pre-test and post-test assessments were conducted using a standardized fine motor rubric. Data were analyzed using paired and independent t-tests.
Results: The results showed a statistically significant improvement in fine motor skills in the experimental group compared to the control group. Notable gains were observed in scissor control, grip strength, and spatial accuracy. Additionally, qualitative observations indicated increased engagement and enjoyment during kirigami activities.
Conclusion: Integrating kirigami into early childhood education serves as an effective, low-cost learning media to enhance fine motor development. It not only supports motor coordination but also fosters creativity and concentration. The study recommends adopting kirigami as a regular component of kindergarten curricula.

A. Introduction

The early stage of childhood is a vital time for nurturing key skills that contribute to long-term growth in both thinking and physical coordination (Likhar et al., 2022). One essential area of development is fine motor ability, which supports young children in handling everyday tasks such as using scissors, writing, fastening buttons, and managing small items (Bondi et al., 2022; Huang et al., 2025). Mastery of these

How to Cite : Istirokah, I., Hartati, S. J., Widayat, E., Huda, N., Simanjuntak, N. M., & Prather, S. (2025). Creative Cutouts: Integrating Kirigami as a Learning Media to Enhance Fine Motor Skills in Kindergarten Children. *FINGER: Jurnal Ilmiah Teknologi Pendidikan, 4*(3), 158–164. *https://doi.org/10.58723/finger.v4i3.453*
ISSN : 2830-6813
Published by : CV Media Inti Teknologi

small muscle movements, particularly those involving the hands and fingers, is strongly related to school preparedness, especially in foundational literacy and mathematics skills (Scott, 2024). As noted by Sutapa et al. (2021), activities like cutting, drawing, and writing are directly tied to fine motor control. Furthermore, fine motor development builds children's autonomy and contributes to their academic achievements later on (Vretudaki & Athanasopoulou, 2025). Despite this importance, many early education programs still lack stimulating and practical strategies to promote these crucial skills in young learners.

Recent trends in early childhood education highlight the importance of incorporating creative and hands-on learning media (Kurniawati et al., 2024; Vidal-Hall et al., 2020). Kirigami, an ancient Japanese art that combines paper folding and cutting, has emerged as a promising tool in this context (Jamil et al., 2020; Sun et al., 2021). Beyond its artistic appeal, kirigami stimulates both cognitive and motor processes, making it ideal for early childhood development (Faber et al., 2025). Activities that involve folding and cutting paper can enhance spatial awareness, hand-eye coordination, and precision all of which are key components of fine motor development (Nisa & Khotimah, 2025). However, traditional instructional approaches in many kindergartens often emphasize repetitive drills or pencil-based activities, which may not effectively engage children with diverse learning preferences (Rosalianisa et al., 2023). In recent years, educators and researchers have explored alternative learning media that incorporate arts and crafts as tools to enhance physical coordination while also stimulating creativity and imagination.

One such method is kirigami, a traditional Japanese art that involves folding and cutting paper into intricate designs (Asakawa & Sugimura, 2022; De Giorgi, 2024). Unlike origami, which focuses solely on folding, kirigami incorporates scissors and complex manipulations that can help children practice precise hand control, strengthen grip, and improve bilateral coordination (Park et al., 2023). Kirigami-based activities offer children an engaging, multisensory learning experience that not only develops their motor abilities but also fosters concentration and aesthetic awareness (Buzzatto et al., 2024; Lim, 2024). Studies have demonstrated that incorporating paper-based cutting activities like kirigami into early childhood education programs significantly improves fine motor development. Kahar & Khadavi (2025) found a notable increase in children's scissor-handling skills and hand eye coordination following a series of kirigami sessions. Similarly, Rahayu et al.(2023) reported that children participating in weekly kirigami workshops showed measurable gains in both precision and endurance compared to peers engaged in conventional activities.

In addition to its motor benefits, kirigami also encourages problem-solving, spatial reasoning, and pattern recognition, making it a holistic approach to child development (Harsismanto et al., 2021). This aligns with the growing emphasis on creative learning media in early childhood education, where art-based activities serve as effective pedagogical strategies (Travers et al., 2018). Despite its potential, kirigami remains underutilized in many kindergarten classrooms, particularly in developing countries, due to limited awareness or lack of curriculum integration. Therefore, this study seeks to explore the effectiveness of integrating kirigami as a learning medium to enhance fine motor skills in kindergarten children, with the goal of providing evidence-based recommendations for early childhood practitioners.

B. Research Methods

Research Design

This study employed a quasi-experimental design with a pre-test and post-test control group format to examine the effectiveness of kirigami as a learning medium for improving fine motor skills in kindergarten children. This design was chosen to allow comparison between children exposed to kirigami-based activities and those engaged in traditional fine motor exercises, such as coloring and tracing.

Participants

The participants consisted of 40 kindergarten children, aged between 4 and 5 years, enrolled in a private early childhood education center in Medan, Indonesia. The children were divided into two equal groups: the experimental group (n = 20) and the control group (n = 20). Selection was done using purposive sampling, based on the children’s age, developmental stage, and parental consent.

Instruments

To assess fine motor skills, the researchers used a modified version of the Fine Motor Observation Checklist adapted from Cameron et al. (2012), covering indicators such as hand strength, scissor handling, bilateral coordination, and accuracy of cuts. Each skill was rated on a 5-point Likert scale ranging from 1 (very poor) to 5 (excellent). Validity and reliability testing showed a Cronbach's alpha value of 0.88, indicating high internal consistency.

Intervention Procedure

The experimental group participated in a 4-week kirigami-based intervention, conducted three times a week. Each session lasted approximately 30–40 minutes, involving structured kirigami tasks such as symmetrical folding, line cutting, angle trimming, and assembling paper into artistic forms. Tasks progressed in complexity each week. Activities were designed to target hand control, eye-hand coordination, and fine grip strength, in accordance with early childhood development standards (Harsismanto et al., 2021). Meanwhile, the control group followed the standard curriculum, engaging in conventional motor skill activities including coloring worksheets, clay molding, and simple drawing.

Data Collection and Analysis

The data were collected through a fine motor skills checklist. This checklist included simple activities such as cutting, folding, and drawing, observed before and after the kirigami sessions. Each child was scored from 1 (needs improvement) to 5 (very good) for every activity. The researcher and a teacher observed the children during the tasks to make sure the scoring was accurate and fair. All children were tested before the intervention (pre-test) and after four weeks of activities (post-test). After collecting the scores, the results were entered into a computer program (SPSS 25) to compare the scores before and after the program. A paired t-test was used to see if each group improved and an independent t-test to compare the two groups. Result were considered statistically significant if the p-value less than 0.05. We also used Cohen's d to measure how big the effect size of the difference.

Ethical Considerations

Before the study commenced, informed consent was obtained from all parents or legal guardians. The research was approved by the Institutional Review Board of the university affiliated with the researchers. Children were allowed to withdraw at any time without penalty, and confidentiality was strictly maintained throughout the process.

C. Results and Discussion

1. Results

The results of this study reveal a notable enhancement in the fine motor skills of children who participated in kirigami-based learning activities. To evaluate the progress, the average scores from pre-tests and post-tests were compared for both the experimental and control groups.

Table 1. Descriptive Analysis

Group	Pre-Test Average	Post-Test Average	Score Increase
Experimental (Kirigami)	2.6	4.3	+1.7
Control (Traditional)	2.5	3.1	+0.6

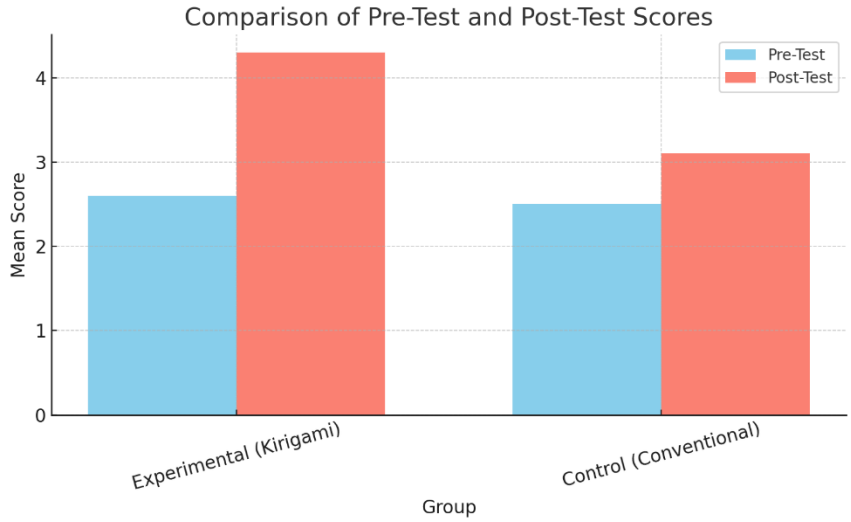
Children in the kirigami group demonstrated a 1.7-point improvement, while those in the control group only showed an increase of 0.6 points.

1.1. Statistical Testing

a. The **paired-sample t-test** indicated a statistically significant enhancement within the experimental group (**$p < 0.001$**).
b. The **independent-sample t-test** confirmed a statistically difference in post-test outcomes between the two groups (**$p < 0.01$**).
c. The **Cohen's d value** for the experimental group was **1.25**, suggesting a substantial effect size of the intervention.

1.2. Graphical Representation

As shown in the bar chart above, the experimental group's post-test performance was substantially higher than their pre-test score and also outperformed the control group's post-test score.



2. Discussion

The results demonstrate that kirigami-based activities effectively improve fine motor skills in early childhood. Children in the experimental group displayed enhanced hand–eye coordination, cutting accuracy, and grip control after consistent exposure to paper folding and cutting tasks. These findings align with the research of Mahdalena et al. (2020) and Maqother et al.(2024) who reported improved motor development following structured paper-cutting activities. Similar outcomes were also supported by Rakimahwati et al. (2018), suggesting that combining folding and trimming activates both cognitive planning and muscular control. The large effect size in this study reinforces the pedagogical value of integrating fine motor-focused art in preschool curricula. The creative process involved in kirigami demands not only precision but also sequencing, bilateral hand use, and visual-spatial awareness. This makes it a more engaging and holistic medium compared to passive coloring or tracing. Moreover, the sustained improvement in the experimental group illustrates how incorporating *culturally rich and aesthetically stimulating media* can lead to better developmental outcomes. Although the control group also improved slightly, the results suggest that traditional activities may not provide the same level of challenge or novelty, which are key in stimulating motor development at this stage. In conclusion, the data support the implementation of kirigami as an innovative and culturally embedded educational tool in early childhood classrooms to boost fine motor proficiency.

This study provides compelling evidence that kirigami, as a hands-on learning medium, can substantially enhance the fine motor skills of kindergarten children. The significant improvement observed in the experimental group compared to the control group underscores the pedagogical value of integrating creative arts into early childhood education.

2.1 Implications

The implications of this study are twofold. Firstly, educators and curriculum developers should consider incorporating kirigami and similar paper-based activities into their lesson plans to support motor development. Unlike passive tasks such as coloring or tracing, kirigami involves bimanual coordination, precision cutting, spatial planning, and creativity, all of which are essential components of motor skill enhancement. Secondly, the findings suggest that motor development can be enriched through culturally grounded methods, bridging art, heritage, and education. The use of kirigami not only improves hand function but also stimulates imagination and perseverance, which contribute to holistic child development.

2.2 Research Contribution

This study contributes to the growing body of literature on early childhood motor development and creative learning media. While previous research has focused on origami, clay modeling, and coloring (Harsismanto et al., 2021), few studies have explored kirigami as a structured educational intervention.

By demonstrating both quantitative improvements and practical classroom applications, this study fills a notable gap in the literature.

Moreover, the study offers a measurable framework for integrating traditional crafts into modern pedagogy, showcasing how culturally rooted activities can align with developmental objectives in early childhood programs.

2.3 Limitations

Despite promising results, the study has certain limitations. The sample size was relatively small and drawn from a single preschool, which may affect the generalizability of the findings. Additionally, the duration of the intervention (four weeks) may not fully capture long-term developmental effects. Other limitations include the subjectivity of the observational checklist and potential biases in scoring. Although inter-rater reliability was controlled, observational data may not fully reflect each child's daily motor capabilities across different contexts.

2.4 Suggestions

Future research should consider conducting longitudinal studies to assess the sustained impact of kirigami over an academic year. Expanding the sample to include diverse socioeconomic backgrounds and geographical locations would also enhance the generalizability of results. Additionally, integrating technology-enhanced kirigami, such as augmented reality cut-and-fold simulations or digital templates, could offer a hybrid model that appeals to digital-native learners while retaining the benefits of hands-on activity. Educators are encouraged to collaborate with local artisans or cultural practitioners to develop thematic kirigami lessons, thereby enriching the curriculum with contextual and cultural relevance while advancing motor and cognitive development.

D. Conclusion

This study demonstrates that integrating kirigami as a learning medium can significantly enhance the fine motor skills of kindergarten children. Through structured and progressive folding and cutting activities, children in the experimental group showed substantial improvements in their grip strength, cutting accuracy, bilateral coordination, and visual-motor integration. The data revealed a clear contrast between the progress of those exposed to kirigami and those who followed conventional motor skill practices. Kirigami, as both a cultural and educational tool, offers more than aesthetic value it promotes active engagement, concentration, and motor refinement. The creative and tactile nature of kirigami stimulates multiple developmental domains, making it a valuable addition to early childhood curricula. Its potential to bridge traditional art and modern pedagogy presents an opportunity for educators to foster creativity while addressing core developmental goals. While the study was limited by sample size and duration, the findings offer meaningful insights for practitioners, curriculum planners, and future researchers. Kirigami-based learning activities could be further adapted and scaled across different contexts, particularly in culturally rich and resource-conscious educational environments. In conclusion, kirigami serves as a simple yet powerful medium to support the development of fine motor skills in young learners. Its integration into early education not only benefits physical coordination but also cultivates patience, problem-solving, and creative thinking—traits essential for lifelong learning.

E. Acknowledgment

The authors would like to express their sincere gratitude to the children, teachers, and parents of the participating kindergarten for their enthusiastic involvement and cooperation throughout this study. Special thanks are also extended to the school principal and teaching staff for providing the time, space, and support necessary for the kirigami intervention sessions to take place smoothly. We also wish to thank the academic supervisors and colleagues who offered valuable feedback during the development of the research design and instrument validation process. Their insights significantly enriched the quality of this study. Finally, this study would not have been possible without the institutional support and ethical review approval granted by [Name of Institution], which ensured that all procedures were conducted with respect to child development standards and research ethics.

F. Author Contribution Statement

All authors contributed equally to the completion of this study. The contributions are outlined as follows: NMS conceptualized the study and designed the intervention activities. SJH assisted in literature review, developed research instruments, and supported manuscript drafting and editing. EW anssisted in literature review, developed research instruments, and supported manuscript drafting and editing. NH assisted the process for taking first author take magister degree. All authors reviewed and approved the final version of the manuscript and are accountable for all aspects of the work.

References

Asakawa, A., & Sugimura, S. (2022). Mediating process between fine motor skills, finger gnosis, and calculation abilities in preschool children. *Acta Psychologica*, *231*(October), 103771. https://doi.org/10.1016/j.actpsy.2022.103771

Bondi, D., Robazza, C., Lange-Küttner, C., & Pietrangelo, T. (2022). Fine motor skills and motor control networking in developmental age. *American Journal of Human Biology*, *34*(8), 1–15. https://doi.org/10.1002/ajhb.23758

Buzzatto, J., Jiang, H., Liang, J., Busby, B., Lynch, A., Godoy, R. V., Matsunaga, S., Haraguchi, R., Mariyama, T., MacDonald, B. A., & Liarokapis, M. (2024). Multi-Layer, Sensorized Kirigami Grippers for Delicate Yet Robust Robot Grasping and Single-Grasp Object Identification. *IEEE Access*, *12*(August), 115994–116012. https://doi.org/10.1109/ACCESS.2024.3446729

De Giorgi, M. (2024). Design of an Optical Device Based on Kirigami Approach. *Materials*, *17*(5), 1211. https://doi.org/10.3390/ma17051211

Faber, L., Hartman, E., Houwen, S., & Schoemaker, M. M. (2025). Sharp Skills or Snipping Struggles? Qualitative Paper-Cutting Performance in 5- to 10-Year-Old Children Using Hands-On! *Behavioral Sciences*, *15*(4), 1–18. https://doi.org/10.3390/bs15040489

Harsismanto, J., Fredrika, L., Wati, N., Padila, Suryani, D., & Yandrizal. (2021). Effectiveness of playing origami intervention on improvement of fine motor development pre school children. *Indian Journal of Forensic Medicine and Toxicology*, *15*(1), 1107–1112. https://doi.org/10.37506/ijfmt.v15i1.13565

Huang, C. Y., Yu, Y. T., Chen, K. L., Lien, J. J., Lin, G. H., & Hsieh, C. L. (2025). Predicting Age and Visual-Motor Integration Using Origami Photographs: Deep Learning Study. *JMIR Formative Research*, *9*, 1–8. https://doi.org/10.2196/58421

Jamil, S. E. S. A., Ibrahim, N. H., Samsuddin, I., Rahim, P. R. M., & Baharom, M. K. (2020). The Endless Possibilities of Paper Art: Designing The Perak Traditional Costume (Puteri Perak). *Jurnal of Critical Reviews*, *7*(8), 932–936. https://doi.org/10.31838/jcr.07.08.196

Kahar, M., & Khadavi, M. J. (2025). Strategy to improve motor abilities through origami paper folding activities in children of group "b" at RA MasyitohV Probolinggo. *Pijar Pelita: Jurnal Pendidikan Anak Usia Dini Dan Pendidikan Islam Anak Usia Dini*, *1*(2), 1–14. Google Scholar

Kurniawati, A., Nurhayati, S., & Rukanda, N. (2024). Enhancing Early Childhood Education Teachers' Creativity through Professional Development Training Program. *Aulad: Journal on Early Childhood*, *7*(1), 141–149. https://doi.org/10.31004/aulad.v7i1.537

Likhar, A., Baghel, P., & Patil, M. (2022). Early Childhood Development and Social Determinants. *Cureus*, *14*(9). https://doi.org/10.7759/cureus.29500

Lim, C. K. (2024). Enhancing Sensing Performance of Capacitive Sensors Using Kirigami Structures. *Sensors*, *24*(21). https://doi.org/10.3390/s24216930

Mahdalena, R., Sujarwanto, & Budayasa, I. K. (2020). The Effect of Cutting Occupational Therapy to Increase Soft Motoric of Children With Autism. *Proceedings of the International Joint Conference on Arts and Humanities (IJCAH 2020) The*, *491*, 325–330. https://doi.org/10.2991/assehr.k.201201.058

Maqother, N. A., Sukardi, Rachmayani, I., & Astini, B. N. (2024). The Effect of The Use of Educational Toys Made of Nature on Fine Motor Development in Early Childhood. *Islamc EduKids: Journal of Early Childhood Education*, *6*(2), 1–8. https://doi.org/10.20414/iek.v6i2.10961

Nisa, K., & Khotimah, H. (2025). Improving Children's Fine Motor Skills in Folding Activities with the Demonstration Method of Utilizing Folded Paper Media at RA Miftahul Huda Purwosari Pasuruan. *Journal of Indonesian Primary School*, *2*(1), 203–215. https://doi.org/10.62945/jips.v2i1.432

Park, C., Lee, Y., Jang, J., & Han, M. (2023). Origami and Kirigami Structure for Impact Energy Absorption: Its Application to Drone Guards. *Sensors*, *23*, 2150. https://doi.org/10.3390/s23042150

Rahayu, N. A., Tahir, M., Astini, B. N., & Astawa, I. M. S. (2023). Pengaruh Kegiatan Kirigami

Terhadap Kemampuan Motorik Halus dan Kreativitas Anak Kelompok B di TK Gugus 1 Kecamatan Selaparang Tahun 2023. *Jurnal Ilmiah Profesi Pendidikan*, *8*(4), 2036–2041. https://doi.org/10.29303/jipp.v8i4.1643

Rakimahwati, R., Lestari, N. A., & Hartati, S. (2018). Pengaruh Kirigami Terhadap Kemampuan Motorik Halus Anak di Taman Kanak-Kanak. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *2*(1), 102–110. https://doi.org/10.31004/obsesi.v2i1.13

Rosalianisa, R., Purwoko, B., & Nurchayati, N. (2023). Analysis of Early Childhood Fine Motor Skills Through the Application of Learning Media. *IJORER : International Journal of Recent Educational Research*, *4*(3), 309–328. https://doi.org/10.46245/ijorer.v4i3.307

Scott, J. (2024). *The relations between physical activity , fundamental movement skills , spatial abilities , and mathematics achievement among lower Key Stage 2 children* [Loughborough University]. https://doi.org/10.26174/thesis.lboro.27613359.v1

Sun, Y., Ye, W., Chen, Y., Fan, W., Feng, J., & Sareh, P. (2021). Geometric design classification of kirigami-inspired metastructures and metamaterials. *Elsevier*, *3*, 3633–3643. https://doi.org/10.1016/j.istruc.2021.06.072

Sutapa, P., Pratama, K. W., Rosly, M. M., Ali, S. K. S., & Karakauki, M. (2021). Improving motor skills in early childhood through goal-oriented play activity. *Children*, *8*(11), 1–11. https://doi.org/10.3390/children8110994

Travers, B. G., Kirkorian, H. L., Jiang, M. J., Choi, K., Rosengren, K. S., Pavalko, P., & Jobin, P. (2018). Knowing how to fold 'em: Paper folding across early childhood. *Journal of Motor Learning and Development*, *6*(1), 147–166. https://doi.org/10.1123/jmld.2016-0044

Vidal-Hall, C., Flewitt, R., & Wyse, D. (2020). Early childhood practitioner beliefs about digital media: integrating technology into a child-centred classroom environment. *European Early Childhood Education Research Journal*, *28*(2), 167–181. https://doi.org/10.1080/1350293X.2020.1735727

Vretudaki, H., & Athanasopoulou, A. (2025). Encouraging young children's autonomy by supporting their fine motor skills development. *Research on Preschool and Primary Education*, *3*(1), 52–60. https://doi.org/10.55976/rppe.32025132552-60