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Impact of paper folding on middle school children's concentration

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ABSTRACT

This study aimed to investigate the effects of origami activities on the concentration and imagination abilities of upper elementary school students. The research contributes to understanding how structured, creative activities can enhance cognitive skills in middle childhood. We employed a quasi-experimental design, utilizing origami as an innovative teaching tool to engage students in focused, hands-on learning. The sample consisted of 40 students from a school in Kanchanaburi Province, Thailand, who participated in 16 hours of structured origami activities over 8 weeks. Data were collected using an origami task achievement test and a behavioral observation form for assessing concentration, grounded in Bandura's social cognitive learning theory. Results revealed significant improvements in students' concentration scores and task completion rates, with the percentage of students meeting concentration criteria increasing from 20% to 95%. Qualitative observations indicated enhanced attentiveness, patience, and self-regulation among participants. These findings suggest that integrating origami activities into educational curricula can effectively promote concentration and imagination abilities in upper elementary school students. Future research could explore the long-term effects of origami practice on cognitive development and its potential applications for students with specific learning challenges.

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1. INTRODUCTION

Attention deficit and restless behavior in children are significant concerns in Thai society, with far-reaching implications for academic performance, social adjustment, and overall development. Research by Al-Khayat and Elbarbari [1] has highlighted that children with attention deficits often face a trifecta of challenges: behavioral problems, lower academic performance compared to peers, and difficulties in social adaptation. These findings underscore the urgency of addressing attention-related issues in educational settings. Building on this, research by Assis and Donovan [2] delved deeper into the root causes, identifying environmental factors, stress, and lack of self-control as key contributors to attention deficits. This multifaceted nature of the problem suggests that effective interventions must address both internal and external factors influencing a child's ability to concentrate.

The consequences of attention deficits are particularly pronounced during middle childhood, a critical period for cognitive and social development. This stage, typically encompassing children aged 9-11 years in upper elementary levels (grades 5-6), is characterized by significant advancements in cognitive

abilities and the foundation of skills crucial for future academic success [3], [4]. The inability to focus during this pivotal stage can have lasting impacts on a child's educational trajectory and social competencies.

In response to these challenges, educators and researchers have been exploring innovative approaches to enhance concentration and cognitive skills in children. Origami, the Japanese art of paper folding, has emerged as a promising tool in this regard. Its potential lies in its unique combination of visual, tactile, and cognitive engagement, which aligns well with multisensory learning theories. Previous research has begun to uncover the benefits of origami in educational contexts [5], [6]. For instance, studies focusing on 4th-grade elementary students have demonstrated significant improvements in concentration levels through origami activities [7], [8]. Similarly, research on kindergarten students observed increased attentiveness during tasks involving paper folding [9].

However, there is a notable gap in the literature regarding the effects of origami on middle school students, particularly in the Thai context. This research aims to address this gap by investigating the impact of origami activities on the concentration and creative abilities of upper elementary students in Thailand. By focusing on this age group, we seek to contribute to a more comprehensive understanding of how hands-on, creative activities can support cognitive development during a crucial period of childhood.

The theoretical foundation for this study draws from social cognitive learning theory, which emphasizes the importance of observational learning and self-regulation in cognitive development [10]. Origami activities, with their step-by-step processes and tangible outcomes, provide an excellent platform for children to engage in both observational learning (following instructions) and self-regulation (maintaining focus to complete the task). This alignment between theory and practice offers a strong rationale for exploring origami as an educational tool. Therefore, this study aims to: i) examine the concentration behavior of middle childhood children before and after participating in creative art activities involving paper folding and ii) develop concentration and enhance the imagination of middle childhood children through structured origami activities.

We hypothesize that creative art activities using paper folding will have a positive effect on both the concentration and imagination of middle childhood children. This hypothesis is grounded in the growing body of research on the cognitive benefits of hands-on learning [11] and the specific advantages of origami in promoting spatial reasoning and attention to detail [12]–[14].

The potential implications of this research extend beyond the immediate scope of the study. By exploring the relationship between origami activities and cognitive skills, we aim to contribute to the development of innovative teaching methods that can be readily implemented in diverse educational settings. This is particularly relevant in the Thai context, where resources for high-tech interventions may be limited, and cost-effective, engaging learning tools are highly valuable.

In conclusion, this study seeks to bridge the gap in our understanding of how creative, hands-on activities like origami can support the cognitive development of middle childhood students. The findings have the potential to inform educational practices, curriculum development, and intervention strategies, ultimately contributing to more effective approaches for enhancing concentration and creativity in Thai classrooms and beyond.

2. METHOD

2.1. Population and sample

The study population consists of 40 middle childhood students currently enrolled in the upper primary level (grades 5-6) at Wat Nong Lan School, Kanchanaburi Province, Thailand. The sample was selected using purposive sampling technique based on the following criteria: studying in grades 5-6, having no prior experience in origami, and willing to participate in the study.

2.2. Research instruments

2.2.1. Origami activity set

The origami activities employed in this study were specially designed to promote concentration in middle childhood children. A total of 8 activities were included, spanning 16 hours of intervention time. These activities were divided into two types: geometric origami to create mathematical shapes, and imaginative origami to construct creative designs as shown in Figure 1. The activities were structured with increasing levels of difficulty to challenge and stimulate students' concentration. The development of the origami activity set followed these steps:

- Reviewing literature and research related to creating origami activities for children [15].
- Studying and determining the content of origami activities that promote concentration.
- Designing origami activity plans and materials.
- Validating the content and appropriateness of the activities by 3 experts in the field using item-objective congruence (IOC) index.

- Revising the activities based on experts' feedback.
- Conducting a pilot study with 10 students to test the feasibility and effectiveness of the activities.
- Finalizing the origami activity set for the main study.

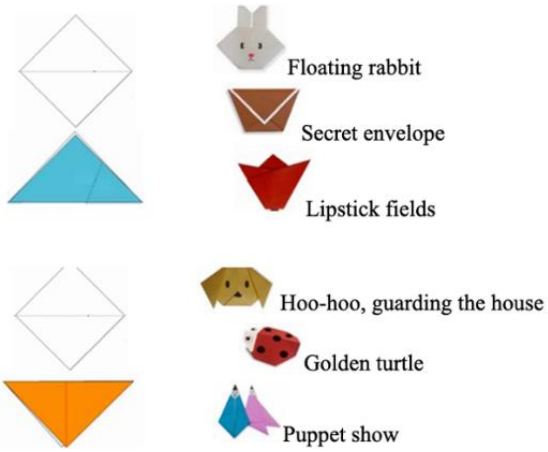

Figure 1. Show paper folding

2.2.2. Observation form for concentration behavior

The observation form for assessing children's concentration behavior was developed by the researchers. It comprises 5 areas of observable behavior that indicate attentiveness: focused attention on the task, patience and self-control, perseverance in completing the task, interest and enthusiasm, and responsiveness to instructions. Each area is rated on a 4-point scale, ranging from 1 (needs improvement) to 4 (excellent). The total score ranges from 5 to 20, with higher scores indicating better concentration. The development process of the observation form included the following:

- Studying theories and research on concentration behavior in children.
- Defining the content and scope of the observation form.
- Creating the observation form and scoring rubric.
- Validating the content validity by 3 experts using the IOC index.
- Revising the form based on experts' comments.
- Piloting the form with 10 students to check reliability using Cronbach's alpha coefficient (α=0.85).
- Preparing the final version of the observation form.

2.3. Data collection

The data collection was conducted over a period of 8 weeks, with 2 hours of origami intervention per week, totaling 16 hours. The steps were as follows:

- The researcher introduced the study objectives and process to the participants and obtained informed consent from their parents.
- The participants were asked to complete a pre-test of origami skills and their concentration behavior was assessed using the observation form.
- The origami intervention was carried out in 8 sessions, each lasting 2 hours. In each session, the researcher demonstrated the folding techniques and provided step-by-step instructions for the participants to follow. The participants then practiced folding on their own, with guidance and feedback from the researcher.
- During the intervention, the researcher observed and rated the participants' concentration behavior using the observation form.
- After the last session, the participants were asked to complete a post-test of origami skills and their concentration was assessed again.
- The researcher interviewed the participants to gather their opinions and feedback on the origami activities.

2.4. Data analysis

The data obtained from the pre-test and post-test of origami skills and concentration behavior were analyzed using descriptive statistics (frequency, percentage, mean, and standard deviation) and inferential

statistics (dependent t-test) at the 0.05 level of significance. The qualitative data from the interviews were analyzed using content analysis technique to identify common themes and patterns.

3. RESULTS

3.1. Impact of origami activities on children's preferences and concentration

Our study revealed a significant shift in children's attitudes towards origami activities, as shown in Figure 2 and their concentration levels. Table 1 presents a comprehensive overview of these changes. The data demonstrates a notable increase in children's preference for origami activities, with the percentage of children who liked origami rising from 75% to 87.5%. This 12.5% increase suggests that exposure to structured origami activities can positively influence children's attitudes towards this form of creative engagement. More strikingly, we observed a dramatic improvement in concentration levels, with the percentage of children meeting the concentration criteria soaring from 20% to 95%, a remarkable 75% increase.

These findings align with previous research by Wang *et al.* [16], who reported improved concentration in 4th-grade students engaged in origami activities. However, our study extends these findings to upper elementary students, addressing a gap in the literature noted by Spreafico [17]. The substantial improvement in concentration levels supports the hypothesis that origami activities can serve as an effective tool for enhancing cognitive focus in middle childhood.

Table 1. Changes in children's preferences for origami activities and concentration levels

Measure	Pre-intervention		Post-intervention		Change (%)
	n	%	n	%	
Preference:					
Like	30	75	35	87.5	+12.5
Dislike	10	25	5	12.5	-12.5
Concentration:					
Met criteria	8	20	38	95	+75
Did not meet	32	80	2	5	-75

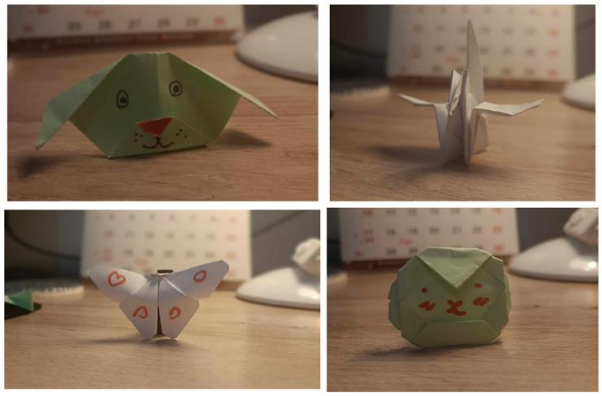

Figure 2. Show fold paper format

3.2. Statistical analysis of concentration behavior scores

To further quantify the impact of origami activities on concentration, we conducted a statistical analysis of concentration behavior scores before and after the intervention. Table 2 presents these results. The statistical analysis reveals a significant increase in mean concentration scores from 8.75 (SD=1.92) in the pre-test to 17.45 (SD=1.36) in the post-test. The paired-samples t-test yielded a t-statistic of 18.42 with a $p<0.001$, indicating a statistically significant difference between pre- and post-intervention scores.

Table 2. Statistical analysis of concentration behavior scores

Test	Mean	Standard deviation	t-statistic	p-value
Pre-test	8.75	1.92	18.42	<.001*
Post-test	17.45	1.36		

Note: *p<0.05

This substantial improvement in concentration scores (an increase of 8.7 points on average) provides strong evidence for the effectiveness of origami activities in enhancing concentration abilities. The reduced standard deviation in the post-test scores (from 1.92 to 1.36) suggests that the intervention not only improved overall concentration but also led to more consistent performance across the group. These results corroborate the findings of Amanda and Hidayat [18], who observed increased attentiveness in kindergarten students during origami tasks. However, our study demonstrates that these benefits extend to older children and can be quantified using standardized concentration measures.

The significant improvements in both preference for origami and concentration levels have several important implications for educational theory and practice:

- Multisensory learning: the success of origami activities in enhancing concentration supports theories of multisensory learning [19]. The tactile and visual nature of origami engages multiple senses, potentially leading to deeper cognitive engagement and improved focus.
- Self-efficacy and motivation: the increased preference for origami activities aligns with Bandura's concept of self-efficacy [20]. As children successfully complete origami tasks, their confidence in their abilities likely increases, motivating them to engage more deeply with subsequent challenges.
- Cognitive load theory: the structured nature of origami activities, with clear step-by-step instructions, may help manage cognitive load [21]. This could explain why children were able to maintain focus for extended periods, as the task complexity was appropriately balanced.
- Educational policy implications: the cost-effectiveness and accessibility of origami as an educational tool make it an attractive option for schools with limited resources. This study provides evidence-based support for incorporating hands-on, creative activities into standard curricula, potentially influencing educational policies towards more diverse learning approaches.
- Cross-cultural applicability: while this study was conducted in Thailand, the universal nature of origami suggests that these benefits could be applicable across different cultural contexts. This opens avenues for further cross-cultural studies on the impact of origami on cognitive development.
- Potential for special education: the significant improvement in concentration levels suggests that origami activities could be particularly beneficial for students with attention difficulties. Future research could explore the potential of origami as an intervention strategy in special education settings.

In conclusion, this study provides robust evidence for the positive impact of origami activities on concentration and engagement in upper elementary students. The findings not only support existing theories of cognitive development and learning but also open new avenues for research and practical applications in educational settings. As we continue to seek innovative ways to support children's cognitive development, structured creative activities like origami emerge as promising tools in the educator's toolkit.

4. DISCUSSION

The effectiveness of origami activities in enhancing children's concentration can be attributed to several unique characteristics of this art form. First, origami involves a structured and sequential process, where each step builds upon the previous one to create a final product. This systematic approach requires children to focus their attention, follow instructions carefully, and think ahead, thereby training their concentration and planning skills. The repeated folding actions also promote motor skill development and hand-eye coordination, which are crucial for maintaining focus and engagement in the task [22].

Moreover, the hands-on and tactile nature of origami encourages active participation and multisensory learning. By physically manipulating the paper, children engage their sense of touch, sight, and proprioception, which helps to anchor their attention and create a more immersive learning experience. This aligns with the theory of Fernandez [23], which posits that cognitive processes are deeply rooted in the body's interactions with the world. Engaging in motor actions, such as folding paper, can thus enhance cognitive functions like attention and memory.

The repetitive aspects of origami, such as making multiple folds or creating patterns, also contribute to its effectiveness in promoting concentration. Repetition allows children to practice and master specific skills, building their confidence and motivation to persevere in the face of challenges. This ties into the concept of self-efficacy [24], where successful experiences and a sense of mastery enhance one's belief in their ability to focus and complete tasks. As children progress through increasingly complex origami designs, they develop a growth mindset and learn to embrace the learning process [25].

Furthermore, the tangible and visible results of origami provide immediate feedback and a sense of accomplishment for children. As they transform a flat sheet of paper into a three-dimensional object, they can see the direct outcomes of their efforts and concentration. This positive reinforcement encourages them to stay engaged and committed to the activity, as they anticipate the satisfaction of completing each step and the

final product. The pride and ownership children feel over their creations can also boost their self-esteem and motivation to take on new challenges [26], [27].

In addition to its cognitive benefits, origami also offers opportunities for social interaction and collaborative learning. When children work on origami projects together, they can share ideas, help each other, and provide mutual encouragement. This social support can enhance their enjoyment and engagement in the activity, as well as foster important social skills like communication, cooperation, and empathy. Sociocultural theory emphasizes the role of social interaction in cognitive development, where learning occurs through collaboration with more skilled peers or adults [28]. Origami group activities can thus create a supportive environment that scaffolds children's learning and helps them maintain focus [29], [30].

4.1. Recommendations

Based on the results of this study, the following recommendations are proposed to promote the integration of origami activities in educational settings and beyond:

- Incorporate origami into school curricula: educators and school administrators should consider integrating origami activities into various subjects, such as mathematics, art, and science, to enhance students' concentration, creativity, and problem-solving skills. Origami can be used as a tool for teaching specific concepts, fostering hands-on learning, and providing engaging activities during class time.
- Provide teacher training and resources: to effectively implement origami in classrooms, teachers should receive adequate training and resources. Educational institutions and policymakers should invest in professional development programs that equip teachers with the knowledge and skills needed to incorporate origami into their teaching practices. Additionally, schools should provide access to origami materials and resources to support the implementation of these activities.
- Promote origami in after-school programs and extracurricular activities: beyond the classroom, origami can be promoted through after-school programs, clubs, and extracurricular activities. These settings offer opportunities for children to further explore their interests, develop their skills, and engage in creative pursuits. Schools and community organizations can partner to provide origami workshops, competitions, and exhibitions that showcase children's creations and foster a sense of accomplishment.
- Encourage parental involvement and home-based activities: parents and caregivers play a crucial role in supporting children's learning and development. Educators should provide guidance and resources to help parents incorporate origami activities at home. This can include sharing instructional videos, providing step-by-step guides, and suggesting age-appropriate projects. Engaging in origami activities together can strengthen parent-child bonds, promote positive interactions, and extend learning beyond the classroom.
- Conduct further research on the long-term effects and applications of origami: while this study provides evidence for the immediate benefits of origami on concentration and creativity, further research is needed to investigate the long-term effects and potential applications of these activities. Longitudinal studies can examine the impact of regular origami practice on children's cognitive development, academic performance, and social-emotional well-being. Additionally, research can explore the effectiveness of origami interventions for children with specific learning or behavioral challenges.

By implementing these recommendations, educators, policymakers, and parents can harness the power of origami to support children's holistic development and create engaging learning environments that foster focus, creativity, and perseverance. Through collaborative efforts and a commitment to evidence-based practices, we can unlock the potential of origami as a valuable tool for nurturing the minds and hearts of young learners.

4.2. Implications for future research-how to explore further

This study has demonstrated the positive effects of origami activities on middle childhood children's concentration and creative imagination. However, to gain a more comprehensive understanding of the potential benefits of origami, future research could explore its impact on other aspects of children's development, such as problem-solving skills, spatial reasoning, and social-emotional competence. Additionally, longitudinal studies that follow children's progress over an extended period could provide valuable insights into the long-term effects of origami practice on their cognitive and creative abilities.

Moreover, future studies could investigate the optimal duration and frequency of origami interventions to maximize their effectiveness. Comparing different intervention designs, such as individual vs. group sessions or structured vs. free-form activities, could help identify the most beneficial approaches for enhancing children's concentration and creativity. Furthermore, examining the role of teachers' or parents' involvement in guiding origami activities could shed light on the importance of adult support in fostering children's engagement and learning.

5. CONCLUSION

This study has successfully achieved its objectives of investigating the concentration behavior of middle childhood children before and after participating in creative origami activities and developing their concentration and imagination through these activities. The results confirm the research hypothesis that origami activities have a positive effect on the concentration and creativity of children in this age group.

The findings reveal a significant increase in children's liking for origami activities, from 75% before the intervention to 87.5% after participating in the 8-week program. More importantly, the percentage of children who met the criteria for concentration behavior rose from a mere 20% in the pretest to an impressive 95% in the post-test. Statistical analysis using paired-samples t-tests further confirms that the improvement in concentration scores is significant and not due to chance ($t=18.42$, $p<0.001$).

These results highlight the effectiveness of structured origami activities in enhancing concentration and creative imagination in middle childhood children. The clear procedural requirements and the hands-on nature of origami encourage children to focus, follow instructions carefully, and persist in completing the tasks. As one participant remarked, *"I have to concentrate and follow the steps carefully, otherwise the work will be ruined."* This statement encapsulates the heightened attentiveness and self-regulation that children develop through engaging in origami.

The findings of this study contribute to the growing body of research on the cognitive and developmental benefits of origami and provide a strong foundation for incorporating these activities into educational practices. By engaging in these structured, hands-on tasks, children develop essential skills that contribute to their overall cognitive development and well-being.

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AUTHOR CONTRIBUTIONS STATEMENT

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Ornnicha Kongwut	✓	✓		✓	✓	✓	✓			✓	✓	✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study. Written permission was obtained from Wat Nong Lan School administration, teachers, and students prior to inclusion in the study, and all personal information has been de-identified to protect participant privacy.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [OK]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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