



Efficacy of a culturally contextualized recreation program using northeastern Thai Folk Plays on executive functions in primary school students

Eficacia de un programa recreativo contextualizado culturalmente, basado en juegos populares del noreste de Tailandia, sobre las funciones ejecutivas en estudiantes de primaria

Authors

Sudaporn Samakphol ¹
Sukhontha Pummuang ¹
Tatchanon Chindapuk ¹
Nirut Sukdee ²
Tachapon Tongterm ³

¹Thailand National Sports University Sisaket Campus (Thailand)

²Thailand National Sports University Udon Thani Campus (Thailand)

³Sisaket Rajabhat University (Thailand)

Corresponding author:
Tachapon Tongterm
tachapon.t@sskru.ac.th

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Abstract

Introduction: Executive functions (EFs), including inhibitory control, cognitive flexibility, and planning, are essential for learning and adaptation in childhood. Motor-cognitive recreation can enhance these abilities, yet structured and culturally grounded CEPA interventions remain limited in Thai schools.

Objective: This study developed and evaluated a culturally contextualized recreation program based on Northeastern Thai folk plays within the CEPA framework and examined its effects on executive functions in primary students aged 10 to 12 years.

Methodology: A three-phase development process was followed by a one-group repeated-measures design. Forty students completed an eight-week program of nine structured folk-play activities emphasizing open-skill movement, decision-making, and cooperation. Executive functions were assessed using the Flanker Task, Trail Making Test-B, and Design Fluency Test across pre-, mid- and post-intervention.

Results: Significant improvements were observed in inhibitory control, cognitive flexibility, and planning. Faster reaction and completion times, along with higher planning scores, indicated continuous neurocognitive adaptation ($p < .001$).

Discussion: Findings support the CEPA framework by showing that culturally embedded and cognitively engaging activities can generate measurable neurocognitive benefits while reinforcing motivation and cultural connection in school contexts.

Conclusions: Folk-play-based recreation offers a practical, low-cost strategy for improving executive functions and supporting holistic child development. Its inclusion in school programs may enhance educational sustainability and preserve Thai cultural heritage.

Keywords

Thai folk plays; executive functions; cognitively engaging physical activity; cognitive flexibility; primary school.

Resumen

Introducción: Las funciones ejecutivas (FE), que incluyen el control inhibitorio, la flexibilidad cognitiva y la planificación, son esenciales para el aprendizaje y la adaptación infantil. Las actividades recreativas motor-cognitivas pueden fortalecer estas habilidades, pero las intervenciones CEPA estructuradas y culturalmente contextualizadas siguen siendo escasas en las escuelas tailandesas.

Objetivo: Este estudio desarrolló y evaluó un programa recreativo contextualizado culturalmente basado en juegos populares del noreste de Tailandia dentro del marco CEPA y analizó sus efectos en las FE de estudiantes de 10 a 12 años.

Metodología: Se aplicó un proceso de desarrollo en tres fases seguido de un diseño de medidas repetidas con un solo grupo. Cuarenta estudiantes completaron ocho semanas de nueve actividades estructuradas que enfatizaron habilidades abiertas, toma de decisiones e interacción cooperativa. Las FE se evaluaron mediante la Tarea Flanker, TMT-B y Design Fluency Test en fases pre, intermedia y final.

Resultados: Se observaron mejoras significativas en el control inhibitorio, la flexibilidad cognitiva y la planificación, reflejadas en tiempos más rápidos y puntuaciones más altas ($p < .001$).

Discusión: Los hallazgos respaldan el marco CEPA al demostrar que la recreación integrada cultural y cognitivamente genera beneficios neurocognitivos medibles y refuerza la motivación y la identidad cultural.

Conclusiones: La recreación basada en juegos populares es una estrategia práctica y de bajo costo para fortalecer las FE y promover el desarrollo infantil integral, contribuyendo a la sostenibilidad educativa y a la preservación cultural tailandesa.

Palabras clave

Juegos populares tailandeses; funciones ejecutivas; actividad física cognitivamente estimulante; flexibilidad cognitiva; control inhibitorio; planificación; educación primaria.

Introduction

The development of executive functions (EFs), encompassing inhibitory control, cognitive flexibility, and working memory, is a critical developmental milestone in middle childhood. These higher-order neurocognitive skills, primarily regulated by the prefrontal cortex, serve as the foundation for adaptive behaviors such as self-regulation, planning, and goal-directed learning (Bidzan-Bluma & Lipowska, 2018). Deficiencies in these skills can impede academic achievement, emotional regulation, and problem-solving abilities (Aguayo et al., 2022). In Thailand, particularly within the Northeastern region, national educational assessments have revealed that students' cognitive and self-regulatory skills remain below international benchmarks. This situation underscores the need for low-cost, culturally grounded, and pedagogically feasible interventions that can enhance cognitive development through learning experiences embedded within school environments.

Physical activity (PA) has increasingly been recognized as an effective, non-pharmacological means to promote brain plasticity and cognitive performance in children. The Motor-Cognition Integration hypothesis suggests that physical activities involving perception, decision-making, and motor coordination stimulate overlapping neural networks within the prefrontal cortex, facilitating the development of executive processes (Bao et al., 2024). Within this framework, activities categorized as Cognitively Engaging Physical Activity (CEPA) have been shown to produce greater cognitive benefits than traditional aerobic exercise by combining physical exertion with strategic and attentional demands (Schmidt et al., 2015; Hu et al., 2025). Empirical evidence from Thailand reinforces this notion. Tongterm et al. (2023) demonstrated that the Kra Dot Yang test, adapted from a local folk play, successfully integrates cognitive and motor components, confirming the potential of indigenous games as effective and culturally valid CEPA models for children in educational settings.

Traditional and folk plays across Southeast Asia inherently reflect the core attributes of CEPA through their dynamic, socially interactive, and cognitively stimulating nature. These activities combine physical coordination, strategic thinking, and social cooperation, which engage both motor and cognitive systems simultaneously (Charles et al., 2017). In Northeastern Thailand, folk plays such as Mon Hide the Cloth, Ling Ching Hang, Kradod Yang, and Jerd Gurb promote open-skill movement patterns that parallel executive processes like inhibition and cognitive flexibility (Tongterm et al., 2024; Fauzi et al., 2023). Because of their cultural familiarity and emphasis on enjoyment, these activities promote participation and motivation, particularly in schools with limited resources (Adi et al., 2022). Related research has further highlighted how indigenous recreational forms, such as transforming Jik Sen into a structured recreational activity for older adults, can strengthen both physical and cognitive domains across the lifespan (Tongterm et al., 2024). However, despite these benefits, educational interventions in Thailand often rely on generic activity models adapted from Western contexts, which may lack cultural resonance for Thai learners. Non-contextualized programs can lead to weak motivation, reduced engagement, and limited transfer of learning because students do not perceive the activities as meaningful or connected to their lived experiences. Culturally familiar activities, such as Northeastern Thai folk plays, can enhance intrinsic motivation, strengthen a sense of ownership, and create more sustainable engagement. Incorporating such activities into cognitive-enhancement programs therefore represents a pedagogically relevant and culturally responsive approach for promoting executive function development.

Yet, few studies have systematically examined executive function outcomes through standardized neurocognitive assessments in the context of Thai folk play. Despite these theoretical and practical foundations, a critical empirical gap remains. No study has rigorously examined the longitudinal efficacy of a structured, culturally contextualized folk play program on executive functions among Thai primary school students. While earlier research confirms that traditional games contribute to motor development and psychosocial growth (Adi et al., 2022; Hussain & Cheong, 2022; Fauzi et al., 2023), conclusive evidence on the direct impact of folk-based CEPA interventions on inhibitory control, cognitive flexibility, and planning is still limited. Addressing this gap is essential for validating the integration of indigenous recreation into evidence-based educational practice. Therefore, the present study aimed to: 1) develop a recreation program based on Northeastern Thai folk plays as a culturally contextualized form of Cognitively Engaging Physical Activity (CEPA); 2) examine its effects on executive functions, including cognitive flexibility, inhibitory control, and planning, in primary school students aged 10–12 years; and

3) compare executive function performance across three assessment points (pre-, mid-, and post-intervention) throughout an eight-week training period. The findings are expected to provide empirical foundations for incorporating folk-play-based recreation into the Thai educational system as a sustainable, low-cost, and culturally resonant approach to enhancing neurocognitive development.

Method

Study Design

This study employed a three-phase research and development design, followed by a quasi-experimental one-group repeated-measures approach. The research aimed to develop and evaluate a culturally contextualized recreation program using Northeastern Thai folk plays within the framework of Cognitively Engaging Physical Activity (CEPA). The intervention was implemented over eight weeks, with three assessment points (pre-, mid-, and post-intervention) to examine changes in executive functions among primary school students.

Participants

The participants were 40 students (20 males and 20 females) aged 10–12 years, enrolled in Grades 4–6 at a public primary school in Northeastern Thailand. Stratified random sampling was used to ensure equal representation across grade levels. All participants met inclusion criteria: good general health, no neurological or learning disorders, and regular attendance in physical education classes. Prior to data collection, informed consent was obtained from both the participants' guardians and the school administration in accordance with ethical guidelines for research involving children.

Procedure

The recreation program was systematically developed under the Cognitively Engaging Physical Activity (CEPA) framework, integrating local cultural elements with cognitive and motor learning principles. Nine Northeastern Thai folk plays (Kra Teng Kra Toi, Tee Kai, Ten Chang Cha, Maeo Kab Pla Yang, Ling Ching Hang, Non Son, Non Lek Paet, Wing Sam Kha, and Mak Hoon) were selected based on their cognitive complexity, physical engagement, and cooperative interaction. Each activity was analyzed for its contribution to inhibitory control, cognitive flexibility, and planning.

Expert validation was conducted by five specialists in sports science, recreation, and educational psychology, resulting in high content validity (IOC = 0.92; CVR = 0.801). A two-week pilot test confirmed program feasibility, enjoyment (4.68 ± 0.42 on a 5-point Likert scale), and full adherence to safety protocols. During the main intervention, students participated in nine structured activities over eight weeks, with three 60-minute sessions per week conducted under standardized supervision.

Measures

Three standardized computerized neurocognitive tests were used to assess executive functions (EFs).

1. Flanker Task (Inhibitory Control): Measured reaction time and accuracy under congruent and incongruent stimulus conditions.
2. Trail Making Test Part B (Cognitive Flexibility): Assessed task-switching ability and processing speed.
3. Design Fluency Test (Planning): Evaluated sequencing, working memory, and fluency in design generation.

All tests were administered using validated neurocognitive software under controlled conditions. Reaction time, completion time, and accuracy data were automatically recorded. The instruments demonstrated high internal consistency and test-retest reliability (ICC > 0.85).

Data collection procedure

Data were collected in three stages: pretest (Week 0), midtest (Week 4), and posttest (Week 8). Each testing session was conducted in the school's multipurpose hall under the supervision of trained evaluators. Participants completed the CEPA-based folk play program three times per week (45 minutes per session), incorporating warm-up, core activities, and cool-down phases. The exercise intensity was



maintained at a moderate-to-vigorous level (60–75% HRmax), monitored using wrist-based heart rate sensors. All sessions emphasized safety, cooperation, and enjoyment, aligning with pedagogical recreation principles.

Data analysis

Descriptive statistics (mean \pm SD) were used to summarize participant characteristics and performance scores. A one-way repeated measures Analysis of Variance (ANOVA) was applied to examine within-subject differences across the three time points (pre-, mid-, and post-intervention) for each executive function domain. Post hoc pairwise comparisons with Bonferroni adjustment were used to determine the progression pattern of improvements. Effect sizes (Cohen's *d*) were calculated to determine the magnitude of change, interpreted according to standard benchmarks (small = 0.2, medium = 0.5, large \geq 0.8). The significance level was set at $p < .05$ for all analyses.

Ethical considerations

This study was approved by the Human Research Ethics Committee of the National Sports University, Thailand (Approval No. ART 020/2567). All participants and their parents were fully informed about the study's objectives, procedures, and confidentiality assurances prior to participation. Written informed consent was obtained from both the students and their guardians. Participation was entirely voluntary, and students were free to withdraw from the study at any time without any negative consequences.

Results

The results of this study are presented according to the three research objectives, covering program development, empirical effects on executive functions, and time-course analysis of performance changes. Data are organized to demonstrate the systematic validation of the recreation program, followed by quantitative findings that reflect cognitive enhancement across inhibitory control, cognitive flexibility, and planning. Descriptive and inferential statistics are reported alongside graphical representations to provide a comprehensive view of the intervention's impact and progression throughout the eight-week period.

Program development and validation

The Culturally Contextualized Recreation Program was systematically developed under the Cognitively Engaging Physical Activity (CEPA) framework. Nine Northeastern Thai folk plays were selected based on cultural authenticity, cognitive demand, and motor complexity. These included Kra Teng Kra Toi, Tee Kai, Ten Chang Cha, Maeo Kab Pla Yang, Ling Ching Hang, Non Son, Non Lek Paet, Wing Sam Kha, and Mak Hoon.

Each folk play was designed to integrate open-skill movement, rule-based decision-making, and cooperative interaction to stimulate inhibitory control, cognitive flexibility, and planning. Expert evaluation confirmed high content validity (IOC = 0.92; CVR = 0.80). A two-week pilot test verified the program's feasibility and safety, showing an average enjoyment score of 4.68 ± 0.42 on a 5-point scale, with no injuries reported. Implementation fidelity exceeded 95 percent adherence to protocol.

The final eight-week intervention comprised three 60-minute sessions per week (10-minute warm-up, 40-minute main activity, and 10-minute cool-down). Intensity levels were maintained between 60–75% of maximum heart rate. Cognitive engagement was embedded through rapid decision-making, sequencing, coordination, and peer communication. The sequence of all nine plays and their targeted executive components are displayed in Table 1 and illustrated in Figures 1–9.

Table 1. Content structure of the Northeastern Thai folk play-based recreation program and targeted executive functions

No.	Folk Play	Thai Name	Core Executive Demand	Primary Cognitive Process	Motor-Cognitive Integration Feature	Executive Function Target
1	Kra Teng Kra Toi	กระแตงกระต้อย	Sustained attention, rhythm control	Cognitive flexibility	Sequential hopping and rhythm synchronization	Cognitive flexibility



2	Tee Kai	ตีไก่	Inhibition, planning	Inhibitory control	Reactive body movement under time pressure	Inhibitory control, planning
3	Ten Chang Cha	เต็นจางจะ	Rule switching	Cognitive flexibility	Cooperative-competitive alternation	Cognitive flexibility
4	Mao Kab Pla Yang	แมวกับปลาอย่าง	Auditory attention, working memory	Spatial cognition	Blindfolded pursuit and evasion	Auditory attention, working memory
5	Ling Ching Hang	ลิงชิงหาง	Strategic decision-making	Planning and inhibition	Response inhibition during dynamic chasing	Planning, situational awareness
6	Non Son	หนอนซ้อน	Sequencing, working memory	Planning	Alternating pursuit-escape cooperation	Working memory, cooperation
7	Non Lek Paet	หนอนเลขแปด	Dual-task coordination	Cognitive flexibility	Simultaneous attention and movement control	Cognitive flexibility
8	Wing Sam Kha	วิ่งสามขา	Synchronization, teamwork	Planning and self-regulation	Interpersonal rhythm coordination	Planning, coordination
9	Mak Hoon	หมากฮุน	Strategy and reaction control	Executive planning	Decision-making under competition pressure	Emotional regulation, decision-making

Table note: Each folk play was selected for its cognitive demand, motor complexity, and social engagement potential under the CEPA framework. Expert validation confirmed high content validity (IOC = 0.92; CVR = 0.80), demonstrating strong theoretical coherence and implementation feasibility.

Figure 1. Kra Teng Kra Toi demonstrates rhythmic hopping and group synchronization that foster sustained attention and cognitive flexibility.



Figure 2. Tee Kai illustrates rapid body movement and response inhibition under time pressure, emphasizing inhibitory control.



Figure 3. Ten Chang Cha depicts cooperative and competitive interaction that promotes rule switching and flexible adaptation.



Figure 4. Maeo Kab Pla Yang engages auditory attention and spatial working memory through blindfolded pursuit and evasion.



Figure 5. Ling Ching Hang demonstrates strategic planning and inhibitory control during dynamic chasing activity.



Figure 6. Non Son highlights cooperative sequencing and coordination during alternating pursuit roles.



Figure 7. Non Lek Paet shows dual-circuit coordination tasks that enhance cognitive flexibility and attention shifting.



Figure 8. Wing Sam Kha illustrates synchronized teamwork and planning through interpersonal rhythm coordination.



Figure 9. Mak Hoon depicts decision-making, strategic reaction, and emotional regulation in competitive play.



Effects on executive functions

Following program validation described in Section 4.1, the empirical effects were evaluated among 40 primary school students (mean age = 10.60 ± 1.03 years) to examine improvements in executive function performance. Assessments were conducted at three time points (pre-test T_1 , mid-test T_2 , and post-test T_3) using standardized computerized measures: the Flanker Task for inhibitory control, the Trail Making Test-B for cognitive flexibility, and the Design Fluency Test for planning.

Descriptive analyses revealed continuous and progressive improvement across all executive function domains. As shown in Table 2, mean reaction time (RT) in the Flanker Task decreased significantly from 526.88 ± 118.45 ms at T_1 to 383.95 ± 106.17 ms at T_3 , representing a 142.93-ms reduction, indicating enhanced inhibitory control. Similarly, completion time in the TMT-B improved from 120.47 ± 60.19 s at T_1 to 58.15 ± 31.30 s at T_3 , a reduction of 62.32 s reflecting better cognitive flexibility. Planning ability, as measured by the DFT Switching Dots score, increased steadily from 3.90 ± 2.63 at T_1 to 8.65 ± 2.73 at T_3 , yielding a mean gain of 4.75 points. These trends indicate cumulative neurocognitive enhancement throughout the eight-week intervention.

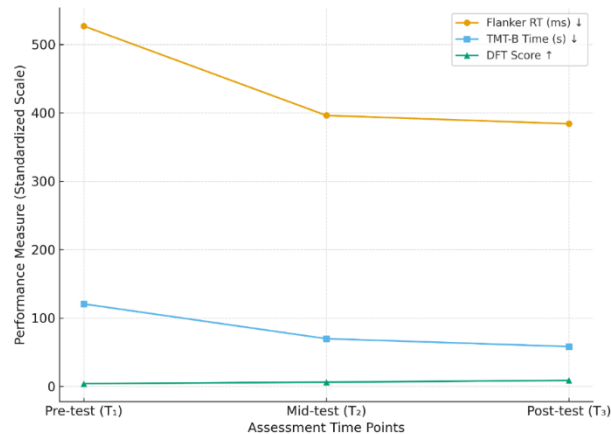
Table 2 presents descriptive statistics of executive function performance across time points, confirming consistent improvement in all variables. The steady decline in response and completion times, coupled with an increase in planning accuracy, demonstrates that participants progressively developed faster information processing, greater mental flexibility, and improved executive planning capacity.

Table 2. Descriptive statistics of executive function performance across time points (n = 40)

Executive Function Measure	T_1 (Pre-test) $\bar{X} \pm SD$	T_2 (Mid-test) $\bar{X} \pm SD$	T_3 (Post-test) $\bar{X} \pm SD$	Change ($T_1 \rightarrow T_3$)
Inhibitory Control (Flanker RT, ms)	526.88 ± 118.45	396.13 ± 113.00	383.95 ± 106.17	142.93 ms faster
Cognitive Flexibility (TMT-B Time, s)	120.47 ± 60.19	69.64 ± 25.21	58.15 ± 31.30	62.32 s faster
Planning (DFT Switching Dots Score)	3.90 ± 2.63	6.05 ± 2.57	8.65 ± 2.73	4.75 score increase

As shown in Table 2 and Figure 10, mean reaction times and completion times declined steadily, while planning scores increased consistently across all assessments. The time-course progression demonstrates continuous improvement in every executive function domain from T_1 to T_3 . The clear decline in Flanker RT and TMT-B completion time, together with the rising DFT scores, confirms that the program enhanced inhibitory control, cognitive flexibility, and planning. These changes reflect adaptive neurocognitive processes resulting from high cognitive-motor engagement under the CEPA framework embedded in Thai folk plays.

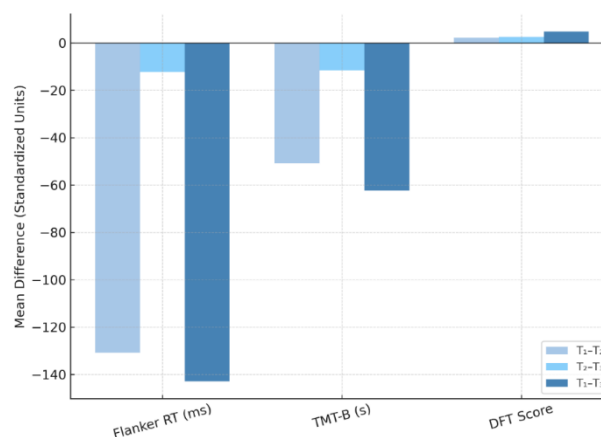
Figure 10. Time-course progression of executive function performance across pre-, mid-, and post-test stages.



This figure presents the mean scores of inhibitory control (Flanker RT), cognitive flexibility (TMT-B), and planning (DFT Switching Dots) across pre-test (T_1), mid-test (T_2), and post-test (T_3). The consistent improvements across all domains reflect the cumulative impact of the culturally contextualized recreation program on neurocognitive adaptation.

As illustrated in Figure 11, the pairwise mean differences (Δ) between each time interval (T_1-T_2 , T_2-T_3 , and T_1-T_3) further confirm progressive enhancement across the intervention period. The most substantial gains were observed in planning (DFT) and inhibitory control (Flanker RT), both achieving statistically significant enhancement ($p < .00$). These findings confirm that the intervention yielded progressive and sustained neurocognitive development rather than short-term effects.

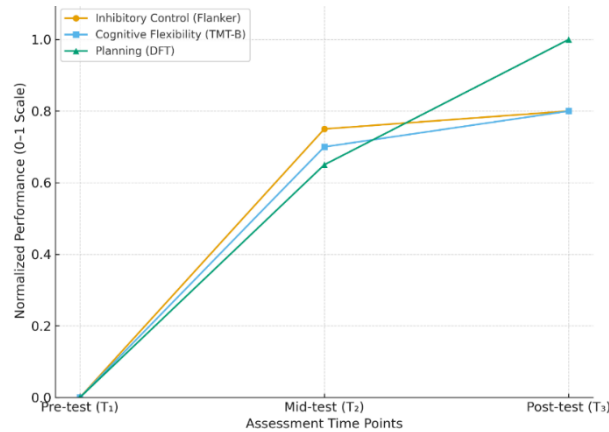
Figure 11. Pairwise comparisons of executive function improvements at sequential time points



The bar graph displays mean differences (Δ) between time points for each executive function domain. The largest gains were observed in planning (DFT Score) and inhibitory control (Flanker RT), confirming significant progressive enhancement ($p < .001$) throughout the intervention period.

As presented in Figure 12, the normalized executive function development trajectories (0–1 scale) highlight consistent upward trends across all measures. The pattern demonstrates a balanced progression among inhibitory control, cognitive flexibility, and planning, indicating that the integrated folk-play-based recreation model facilitated comprehensive executive function growth over time

Figure 12. Summary of executive function development trajectories during the eight-week program



This figure shows normalized performance trajectories (0–1 scale) for inhibitory control, cognitive flexibility, and planning. The upward trends across all domains demonstrate continuous, integrated cognitive improvement resulting from repeated participation in Thai folk-play-based CEPA activities.

Inferential statistics and time-course progression

A One-way Repeated Measures Analysis of Variance (ANOVA) was conducted to determine whether significant differences existed across the three time points (T₁, T₂, T₃) for each executive function variable. The results revealed a significant main effect of time for all measures ($p < .00$), indicating that the recreation program produced consistent and meaningful improvements throughout the intervention. Effect size analysis further demonstrated large to very large magnitudes of change, confirming strong practical significance and intervention efficacy (Table 3).

Table 3. Inferential statistics (one-way repeated measures ANOVA) for executive function measures (n = 40)

Measure	F	p	Cohen's d (T ₁ vs T ₃)	Effect Size Magnitude
Flanker Incongruent RT	21.14	.00	-142.93	Very Large
TMT-B Completion Time	22.70	.00	-62.32	Very Large
DFT Switching Dots Score	284.39	.00	+4.75	Extremely Large

Table note: All measures demonstrated significant improvements ($p < .00$), confirming strong time-course efficacy of the eight-week CEPA-based folk play program on executive functions.

Bonferroni-adjusted post-hoc comparisons revealed that performance at T₃ was significantly better than both T₁ and T₂ across all measures ($p = .00$). In the planning domain (DFT), significant improvements were also observed between T₂ and T₃ ($p = .00$), confirming a continuous and cumulative enhancement throughout the intervention period.

These results align with the time-course patterns shown in Figures 10 to 12, indicating that inhibitory control and cognitive flexibility improved significantly within the first four weeks, while planning displayed a gradual and sustained increase through week eight. This progression pattern reflects the adaptive neural and behavioral adjustments induced by sustained participation in cognitively engaging, open-skill folk play activities.

Summary of empirical findings



Collectively, the results verified that the developed recreation program was culturally valid, feasible, and effective in enhancing executive functions among primary school students. Significant improvements were observed across inhibitory control, cognitive flexibility, and planning, with strong effect sizes confirming practical efficacy. The consistent progression across time points highlights that repeated participation in rule-based, cooperative, and cognitively demanding folk play activities promotes both behavioral efficiency and neurocognitive adaptation. These findings collectively support the CEPA framework and provide a foundation for further discussion on its cognitive and educational implications in the subsequent section.

Discussion

The present study explored how a culturally contextualized recreation program built upon Northeastern Thai folk plays could enhance the executive functions of primary school students aged 10 to 12 years. The eight-week intervention showed clear and progressive improvement in inhibitory control, cognitive flexibility and planning. These outcomes affirm that when traditional play is carefully structured and delivered through active group participation, it can evolve into a meaningful and cognitively engaging form of physical activity that strengthens both the mind and body. The following discussion elaborates on these findings in relation to the research objectives.

Primary empirical findings and mechanistic rationale

The repeated-measures analysis revealed consistent improvement in executive performance across all three assessment periods. The gradual upward trend suggests that the effects were not temporary but reflected a process of cumulative neurocognitive adaptation. This developmental pattern corresponds with the CEPA framework, which emphasizes that complex physical activities integrating decision-making, rule switching and strategic movement activate interconnected neural systems in the prefrontal cortex responsible for executive regulation (Mao et al., 2024; Schmidt et al., 2015). In this study, inhibitory control and cognitive flexibility showed earlier gains, while planning demonstrated steady improvement across the intervention period. This pattern is consistent with known time-based adaptations commonly reported in CEPA research, where simpler executive processes tend to respond first, followed by more complex planning-related functions. The structure of the program itself, requiring sustained attention, self-correction and coordination, appears to have enhanced behavioral control and cognitive organization over time. Consistent with existing findings, activities that involve open-skill interaction and social coordination, such as games requiring inhibition and tactical responses, tend to yield greater executive benefits than closed-skill tasks focused on repetition (Xu et al., 2025). Within this context, the Northeastern Thai folk-play model emerges as both culturally authentic and scientifically grounded, providing a realistic application of CEPA principles within school-based recreation.

Analysis of specific executive function gains and neural mechanisms

A closer look at the three executive domains revealed unique developmental trajectories influenced by the cognitive and motor demands of each folk play. Inhibitory control improved through repeated participation in games that required rapid decision-making and impulse regulation (Shi & Feng, 2022). This repeated exposure to structured rules strengthened the children's ability to manage reactions and maintain focus under pressure. Gains in cognitive flexibility were reflected in quicker performance on tasks requiring mental switching, likely supported by dynamic exchanges and continuous adjustment of strategies during play (Yang et al., 2024). Planning showed the most noticeable progression, consistent with models of motor-cognitive integration where the combination of physical coordination and goal-directed reasoning reinforces sequential thinking (Bao et al., 2024). Collectively, these outcomes suggest that structured folk-play environments can serve as natural settings for cultivating executive skills, enabling children to practice attention, regulation and strategic thinking through playful yet cognitively demanding activities.

Psychosocial and cultural significance

Beyond measurable cognitive outcomes, the program provided psychosocial and cultural benefits. Each activity required teamwork, empathy and cooperative decision-making, which strengthened emotional regulation and social awareness among participants (Arifiyanti and Suparno, 2024; Fauzi et al., 2023).



Because the games were based on familiar cultural traditions, students engaged enthusiastically and demonstrated confidence with reduced anxiety during participation (Tongterm et al., 2024). This culturally grounded context also supported implicit learning, allowing children to strengthen executive skills naturally through social negotiation, rule-following and spontaneous problem-solving rather than through explicit instruction. These cultural connections helped transform the activities into meaningful experiences, linking traditional identity with contemporary educational practice.

Limitations and future directions

Although the findings demonstrate strong empirical support for the effectiveness of the program, certain limitations must be acknowledged. The one-group quasi-experimental design restricts causal interpretation, as it does not allow comparison with non-CEPA activities. However, the choice of a single-group design was appropriate for the initial phase of development, particularly because Phase 1 of an R and D model requires confirmation of feasibility, cultural suitability and initial efficacy before more resource-intensive experimental comparisons can be ethically and practically implemented within school systems. Future research should incorporate randomized controlled trials to validate the specific effects of culturally contextualized activities (Reyes-Amigo et al., 2025). Additional investigations using neuroimaging tools such as fNIRS or EEG may also help illuminate how folk-play participation influences prefrontal activation related to executive functioning. Long-term follow-up is important for examining whether these cognitive improvements persist and translate into academic or behavioral advantages. Broader implementation in different regions and age groups would help confirm the scalability and sustainability of CEPA-based folk-play programs within national education systems.

Taken together, these findings expand international understanding of how recreation grounded in local cultural contexts can serve as a validated, evidence-based approach to supporting child development. Integrating folk play with CEPA principles offers a feasible, low-cost and culturally relevant pathway for enhancing cognitive, emotional and social well-being while preserving the living traditions of Thai recreation.

Conclusions

This study successfully developed and validated a culturally contextualized recreation program using Northeastern Thai folk plays, demonstrating its effectiveness as a form of Cognitively Engaging Physical Activity (CEPA). The eight-week intervention produced significant and progressive improvements in inhibitory control, cognitive flexibility, and planning among primary school students aged 10 to 12, with consistent gains across pre-, mid-, and post-intervention assessments indicating sustained neurocognitive adaptation driven by structured decision-making, coordinated movement, and socially interactive play. These outcomes confirm the suitability of culturally familiar folk-play activities for implicit cognitive learning in authentic educational environments and provide foundational evidence for future comparative and longitudinal research aimed at examining broader applicability. Collectively, the findings establish folk-play-based recreation as an accessible, low-cost, and culturally grounded model that schools can adopt to strengthen both cognitive and social development. At the same time, its systematic integration supports the preservation of Thai cultural heritage, aligning traditional play with contemporary educational goals. Overall, the program offers a culturally informed and pedagogically meaningful pathway that reinforces children's holistic growth within modern education systems.

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Authors and translators' details:

Sudaporn Samakphol	samakphol.cs@hotmail.com	Author
Sukhontha Pummuang	s.pummuang@tnsu.ac.th	Author
Tatchanon Chindapuk	sense10tatchanon@gmail.com	Author
Nirut Sukdee	ter_chula@hotmail.com	Author
Tachapon Tongterm	tachapon.t@sskru.ac.th	Author and Translator