

Artículo de investigación

Title: BAPNE as a neurodidactic strategy for the development of executive functions in
Physical Education

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Abstract: This research aims to strengthen the training of future Physical Education teachers through a solid theoretical foundation, integrating an active, inclusive methodology aligned with the educational demands of the 21st century. The BAPNE method, focused on body percussion, stimulates brain activity through multiple stimuli, activating both hemispheres and promoting anátomo-funcional, biopsicosocial, and psychomotor integration. Objective: To innovate the teaching of Physical Education within the framework of the Ecuadorian curriculum by incorporating the BAPNE method, aimed at enhancing kinesthetic intelligence and executive functions in children and adolescents in today's society. Methodology: From the total population, a sample of 20% (100 students) from a basic education institution was selected, including sublevels from Early Childhood to Upper Basic. These students participated in 8 pedagogical Physical Education sessions implemented using the BAPNE method. Mixed instruments were used, including the adapted BRIEF-2 test, the teacher's reflective journal, focus group interviews, and a motor performance test based on the Psychomotor Development Scale (EDP). Results: The development

phases of the project include an initial diagnosis, analysis of results from a global perspective based on the BAPNE method, scientific production, teacher training, and the creation of a methodological guide. Conclusions: The design of a globalized didactic program based on this methodology enables the structuring of educational planning according to the development of multiple intelligences, with an emphasis on kinesthetic intelligence. The sequential organization of the program ensures that it can be easily adapted to different educational levels

Keywords: Ecuadorian curriculum; physical education; executive functions; kinesthetic intelligence; BAPNE method.

Resumen: Esta investigación propende el fortalecimiento con base teórica sólida la formación de los futuros docentes de Educación Física, integrando una metodología activa, inclusiva y en sintonía con las demandas educativas del siglo XXI. El método BAPNE, centrado en la percusión corporal, estimula la actividad cerebral a través de múltiples estímulos, activando ambos hemisferios y favoreciendo una integración anátomo-funcional, biopsicosocial y psicomotora. Objetivo: Innovar la enseñanza de la Educación Física en el marco del currículo ecuatoriano, mediante la incorporación del

método BAPNE, orientado a fortalecer la inteligencia kinestésica y las funciones ejecutivas en los niños y adolescentes de nuestra sociedad actual. Metodología: De la totalidad de la población se trabajó con muestra del 20% (100 estudiantes) de una unidad educativa básica, pertenecientes a los subniveles desde Inicial hasta Básico Superior, quienes participaron en 8 sesiones pedagógicas de Educación Física aplicadas bajo el enfoque del método BAPNE. Se utilizaron instrumentos mixtos, entre ellos el test adaptado BRIEF-2, el diario reflexivo del docente, entrevistas a grupos focales y una prueba de ejecución motriz basada en la Escala de Desarrollo Psicomotor (EDP). Resultados: Las fases de desarrollo del proyecto comprenden un diagnóstico inicial, análisis de resultados con perspectiva global a partir del método BAPNE, la producción científica, la capacitación docente y la elaboración de una guía metodológica. Conclusiones: El diseño de un programa didáctico globalizado basado en esta metodología permite estructurar la planificación educativa en función del desarrollo de múltiples inteligencias, con énfasis en la kinestésica. La organización secuencial del programa garantiza que pueda adaptarse con facilidad a diferentes niveles educativos

Palabras Clave: Currículo ecuatoriano; educación física; funciones ejecutivas; inteligencia kinestésica; método BAPNE

Introduction

In contemporary education, marked by high levels of digital stimulation and low cognitive self-regulation, it is essential to incorporate active methodologies that integrate body and mind into the teaching-learning process. Recent evidence indicates that executive functions—attention, working memory, inhibition, and cognitive flexibility—are more predictive of academic success than IQ (Diamond, 2013), making their stimulation from an early age an educational priority. In this context, the

BAPNE method (Biomechanics, Anatomy, Psychology, Neuroscience, and Ethnomusicology) emerges as an interdisciplinary alternative based on body percussion, whose rhythmic-cognitive approach promotes neuromotor skills and the development of higher-order cognitive abilities. Recent research highlights its contribution to creativity, self-regulation, and motor coordination, as well as its relevance in physical education programs (Romero-Naranjo, 2021; Alonso-Marco & Romero-Naranjo, 2022; Maupoey, 2022).

The purpose of this research is to incorporate the BAPNE method into the Ecuadorian curriculum to strengthen kinesthetic intelligence and executive functions in elementary school students, in line with the principles of inclusion and active learning promoted by the Ministry of Education (2013–2020). Using a mixed design, the effects of the method on neuromotor and cognitive performance are evaluated, assuming the hypothesis that the systematic implementation of BAPNE in physical education classes has a positive impact on the development of self-regulation, rhythmic coordination, and meaningful learning. Its relevance lies in offering a teaching method of high neuroeducational value for 21st-century schools.

Methodology

The research was conducted using a mixed approach, combining quantitative and qualitative procedures in a complementary manner. From an epistemological perspective, the study falls within socio-critical, holistic, and humanistic paradigms, considering that the educational phenomenon must be interpreted both in its social dimension

and in its effects on the student's overall development.

For the qualitative phase, an action research design was used to describe and document the transformations observed during the implementation of the BAPNE method in physical education sessions. In parallel, the quantitative phase adopted an explanatory approach with descriptive nuances, which allowed for the numerical measurement of changes associated with the development of executive functions and kinesthetic intelligence following the intervention.

The population consisted of 500 students from an Ecuadorian public institution, from Initial Education to the 10th year of Basic General Education (BGE). A 20%

sample (n = 100) was selected through stratified sampling by educational sublevel, ensuring representativeness by age and level of neuromotor development. Inclusion and exclusion criteria were established to ensure the appropriateness of the participants.

For data collection, various instruments were used, aligned with the nature of the variables: reflective teacher journals, group interviews, and checklists for the qualitative component; and the adapted BRIEF-2 and EDP tests for the quantitative component. Numerical data were processed using descriptive statistics in SPSS (v25), while qualitative records were analyzed through thematic coding and contextual interpretation.

Results and Discussion

Observable dimension	Descripción esperada	Observación anecdótica del docente
Attention during the activity	The student maintains attention without prolonged distractions	In five of the eight sessions, the student was easily distracted and required constant support to maintain attention.
Physical participation (clapping, stepping, gestures)	Participates actively with body movements	Participation occurred only when individual demonstrations were provided; the student still shows difficulty following clapping sequences
Following instructions	Follows simple instructions given by the teacher	Instructions were followed only when repeated several times and accompanied by visual support.
Emotional expression (joy, interest, rejection)	Expresses positive emotions toward the activity	The student expressed disinterest and avoided eye contact in most sessions.
Social interaction (collaboration and respect)	Interacts cooperatively with classmates	The student did not actively collaborate with peers and showed rejection of group activities.
Adapting to the rhythm (with or without support)	Adapts movements to the proposed rhythm	Difficulties were observed in synchronizing movements with the proposed rhythm.
Autonomy in execution	Performs the activity without direct assistance	Constant guidance was required to initiate tasks, indicating limited autonomy.
Response to auditory and motor stimuli	Responds appropriately to sounds and movements	Delayed or uncoordinated responses to auditory and motor stimuli were observed.

Note. Author's own elaboration (León, 2025) To measure the independent variable [BAPNE method] qualitatively, a reflective journal was kept during classes (8 sessions) with children aged 3 to 7 year. Teacher's Reflective Journal (3 to 7 years old)

Interpretation: In general, the observation of constant distractions, lack of initiative, difficulty following rhythms, and low social

engagement indicate that children have not yet consolidated key skills such as sustained attention, motor inhibition,

emotional self-regulation, and intersensory coordination. This indicates a low level of performance in executive functions and

neuromotor development expected for their age. In addition, students aged 8 to 10 years old were interviewed in focus group.

Table

Focus Group Interview (8 to 14 years old)

Participant	Facilitator's question	Group response
10-year-old students	How did you feel about the classes that included clapping, rhythms, and movements?	We really liked them because they weren't like normal classes. We didn't just run or do exercises, we also had to think quickly to keep up.
13-year-old students	How did you feel about the classes that included clapping, rhythms, and movements?	At first, we had trouble coordinating our clapping with our steps, but then our bodies knew what to do. It helped us concentrate better in other classes.
9-year-old students	What was the most difficult for you?	When they changed the rhythm very quickly, we sometimes got confused, but then we understood that we had to listen better and observe our classmates.
12-year-old students	What was the most difficult for you?	Working in pairs was a challenge. Many of us are used to doing things alone, but we learned to coordinate and trust each other more.
11-year-old students	Do you think these activities help you think or learn better?	Yes, because we used our minds and bodies at the same time. After these classes, we felt more alert and attentive in other subjects.
14-year-old students	What do you think about working in groups during these sessions?	We found it useful because it forced us to communicate and make decisions together. Although there was some disorganization at first, in the end we managed to coordinate better as a group.

Note. Author's own elaboration (León, 2025).

Interpretation: The application of the BAPNE method had a significant impact on students aged 8 to 14, not only at the motor level, but also cognitively and socially. The responses show a positive assessment of the approach, with explicit recognition of improvements in coordination, attention, cooperation, and motivation. These qualitative data support the use of the method as a comprehensive tool for the development of executive functions in the educational context.

Similarly, instruments were applied for the variable of executive functions and kinesthetic intelligence, for which the test by (Gioia, 2015) called Behavior Rating Inventory of Executive Function, Second Edition [BRIEF-2] was used.

The following rubric (Table 5) allows 30 items to be applied to the 100 students selected for the sample, see (Table 2). This ensures methodological consistency. Furthermore, with 17 students per sublevel (except for middle and upper elementary,

with 16), it is possible to make comparisons between levels to observe at which educational stage difficulties in executive functions are most prevalent

Table

Summary of results in the 30-item BRIEF-2 test at educational levels.

Statistics		Beginner_1	Beginner_2	Elementary_basic	Intermediate_basic	Advanced_basic
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0
Average		3,2000	3,2000	3,2000	3,2000	3,2000
Median		3,5000	3,5000	3,5000	3,5000	3,5000
Mode		4,00	4,00	4,00	4,00	4,00
Minimum		1,00	1,00	1,00	1,00	1,00
Maximum		4,00	4,00	4,00	4,00	4,00

Note:. Author’s own elaboration (León et al., 2025); data obtained from SPSS v.25.

Interpretation: Average score = 3.2 across all levels: Indicates that, on average, behaviors associated with executive dysfunction are frequent and tend toward the “very frequent” range. This means that students regularly experience difficulties with tasks such as impulse control, emotional regulation, working memory, planning, and cognitive flexibility. Median = 3.5: This suggests that at least 50% of the students evaluated have values above “frequent,” approaching “very frequent,” which reinforces the need for pedagogical intervention. Mode = 4: Most students marked “very frequent” as the most common response, reinforcing the idea of a widespread pattern of difficulties in executive functions. Minimum = 1 and Maximum = 4: There is variability, but all levels have

students who range from “never” to “very frequent” in their executive behavior, which is normal in large samples but concerning when the central tendency is high.

The results reflect a high and constant trend of difficulties in executive functions at all educational levels, from early childhood to upper elementary school. This situation can compromise self-regulated learning, task planning, and adaptation to changes or school rules.

Next, the instrument for measuring kinesthetic intelligence based on the EPD psychomotor development scale was applied. **4** = Excellent performance; **3** = Good performance; **2** = Fair performance; **1** = Poor performance.

Table

Instrument applied: “Psychomotor Development Scale” [PDS] at sublevels

Item	Component evaluated	Initial 1	Initial 2	Preparatory 1 basic	2-3-4 Básico Elemental	5-6-7 Basic o Intermedate	8-9-10 Basic Advanced
1. Coordination of jumps with alternating pattern	Gross coordination	1	1	2	2	1	2

2.			2	2	1	1	1	2
Zigzag movement between cones								
3.	Alternating bilateral clapping with rhythm of metronome	Fine coordination	2	2	1	1	1	2
4.	Imitation of simple rhythmic body sequence (clapping and thighs)	Simple rhythmic imitation	1	1	1	2	2	2
5.	Imitation of complex rhythmic sequence (clapping, steps, and turns)	Complex rhythmic imitation	1	1	1	2	1	1
6.	Walking in a straight line without losing balance	Dynamic balance	1	1	2	2	2	2
7.	Walking in a straight line with guided rhythm (metronome)	Dynamic balance + rhythm	1	1	1	1	1	1
8.	Manipulating a BAPNE tube following a rhythmic sequence	Manipulative dexterity with rhythm	2	1	1	1	1	1
9.	Coordinating hand and foot movements with a cross pattern	Intersegmental coordination	2	1	1	2	1	1
10.	Performing a sequence with movements	Kinesthetic motor synthesis	2	1	1	1	1	1

Note: Based on Rodríguez et al. (1996) and adapted by León et al. (2025).

Interpretation: The educational group or sublevel evaluated shows a low level of kinesthetic intelligence development in the EDP test. The persistent pattern of responses “1” and “2” reveals an urgent need to strengthen the physical component of the curriculum through active methodologies, such as the BAPNE method, rhythm games, guided physical expression, and motor circuits adapted by level.

Table

Descriptive statistics of the EDP test.
Statistics

	Initial_1	Initial_2	Preparatory Level 1 (Basic)	Basic_elementary	Basic_intermediate	Basic_advanced
NValid	10	10	10	10	10	10
Missing	0	0	0	0	0	0
Average	1,5000	1,2000	1,5000	1,2000	1,5000	1,2000
Median	1,5000	1,0000	1,5000	1,0000	1,5000	1,0000
Mode	1,00 ^a	1,00	1,00 ^a	1,00	1,00 ^a	1,00
Minimum	1,00	1,00	1,00	1,00	1,00	1,00
Maximum	2,00	2,00	2,00	2,00	2,00	2,00

a. There are multiple modes. The smallest value is displayed.

Note. Author’s own elaboration (León et al., 2025); data obtained from SPSS v.25

Interpretation: Measures of central tendency confirm the dominance of kinesthetic intelligence at all educational levels, with no clear improvements as students advance in age. This suggests that skills such as balance, coordination, motor imitation, and rhythm-body integration are not being adequately developed in the current physical education curriculum

General interpretation of the results in the qualitative and quantitative instruments of the BAPNE method in executive functions.

Finally, a comprehensive analysis of the quantitative and qualitative instruments applied is presented. The results of the instruments applied show that students aged 3 to 14 at the educational institution have inadequate development in both executive functions and kinesthetic intelligence for their age. These quantitative results from the BRIEF-2 test reveal means of 3.2 with a mode of 4, indicating a high frequency of dysfunctional behaviors related to attention, working memory, planning, and inhibition. Qualitative observations from the reflective journal also confirm these difficulties, reflecting poor autonomy, low concentration, and poor adaptation to motor stimuli.

averages between 1.2 and 1.5 in all sub-levels, with the most common performance being “poor,” especially in tasks involving dynamic balance, rhythmic coordination, and complex imitation. However, the focus group results revealed that students perceive the sessions using the BAPNE method positively, highlighting improvements in their attention, motivation, and teamwork. This discrepancy between low technical performance and high subjective assessment suggests that the BAPNE method has significant educational potential, as it integrates body and mind as a way to develop executive functions through movement. It is recommended that rhythmic-body strategies be incorporated into the Physical Education curriculum and that teacher training be strengthened to implement active neuroeducational methodologies that respond to these identified needs.

In terms of kinesthetic intelligence, the test based on the Psychomotor Development Scale (PDS) showed

Discussion

The comparative analysis reveals an interesting tension between the technical performance observed in students and the positive perception they expressed after the intervention with the BAPNE method.

Quantitatively, the scores obtained in the BRIEF-2 and EDP tests were mostly in the low ranges (poor–fair), revealing notable limitations in both executive functions and kinesthetic intelligence. However, qualitative inputs derived from interviews and teacher records show perceived improvements in concentration, group coordination, and willingness to perform tasks, indicating a favorable assessment of the method by students.

This reading dialogues with the ideas put forward by Naranjo (2021), who argues that BAPNE, by integrating body percussion with neuromotor and cognitive demands, is an effective means of activating executive functions in school contexts. Likewise, Alonso & Romero (2022) highlight that the use of body rhythm not only promotes motor skills but also reinforces working memory, selective attention, and motor planning.

From a critical perspective, Kirschner et al. (2006) warn that, in conditions of cognitive overload or low self-regulation, open methodologies may be less efficient than direct instruction. Similarly, Rink (2001) argues that repetitive motor training generates greater coordination advances than multiple and non-linear strategies, which provides a possible explanation for the low technical performance recorded.

Overall, the benefits perceived by students and the consistency with embodied learning theory (Shapiro, 2019) reinforce the pedagogical potential of the method, provided that its implementation is gradual, accompanied, and sequenced. This opens up a future research agenda aimed at verifying sustained effects in the Physical Education curriculum through longitudinal studies.

Conclusions

The literature review shows that the BAPNE method has a robust theoretical basis in neuroscience, psychomotor skills, and active pedagogy, which supports its use as an effective tool for stimulating neuromotor skills from a comprehensive approach. Researchers such as Romero-Naranjo and Alonso-Marco highlight its benefits in strengthening executive functions and motor coordination through the use of body percussion as a means of learning.

The results obtained in the evaluations reveal that, although students are still at an early stage in terms of technical mastery, the use of the BAPNE method has led to positive advances in their motor coordination, sense of rhythm, and social interaction. Its implementation contributes directly to the development of skills included in the Ecuadorian Physical Education curriculum, promoting meaningful learning through movement, with a direct connection to the students' social environment.

The design of a globalized teaching program based on this methodology allows educational planning to be structured around the development of multiple intelligences, with an emphasis on kinesthetic intelligence. It also strengthens cognitive skills such as working memory, sustained attention, and behavioral self-regulation. The sequential organization of the program ensures that it can be easily adapted to different educational levels.

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CONFLICTOS DE INTERESES

Los autores no refieren conflictos de intereses

Contribución de autores

Autor 1: conceptualización, investigación, administración del proyecto, redacción.

Autor 2: administración del proyecto, revisión, validación y edición.