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Original Article

Comparing the impact of neuromotricity BAPNE method and traditional methodology on selective attention and concentration among future teachers: A gender-based comparative study

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Abstract:
Currently, there is a lack of intervention studies in higher education that compare neuromotricity with traditional methodologies, with the majority focused on primary and secondary education. In this study, focusing on gender differences, we aimed to evaluate the influence of the traditional approach vs. the neuromotricity BAPNE method on selective attention and concentration. The study involved 294 students enrolled in the Didactics of Musical Expression course in the Early Childhood Education program at the University of Alicante, Spain. A quasi-experimental intra- and intersubject design was implemented, employing pretest–posttest measures, with a non-probabilistic convenience sampling method set at a confidence interval of 95% and a significance level of 5% ($p<.05$). The intervention consisted of sessions lasting one hour and fifty minutes, conducted twice a week for 21 sessions. The control group adhered to their regular program, focusing on the theoretical and practical exploration of prominent musical pedagogies of the 20th century, including Dalcroze, Kodály, Orff, and Willems. In contrast, the experimental group adhered to a theoretical–practical regimen based on the activity protocols of the neuromotricity BAPNE method. The evaluation utilized the 4th edition of the Spanish adaptation of the d2 test of selective attention and concentration by Brickenkamp & Seisdedos, published by TEA Ediciones. Statistical analysis was performed using SPSS v.25, and G*Power v. 3.1.9.7 was employed to calculate the effect size and statistical power. The results reveal that both methodologies yield statistically significant improvements ($p<.05$) among students of both genders. Additionally, the application of the neuromotricity BAPNE method demonstrates statistically significant differences ($p<.05$) between men and women treated with the traditional methodology, generally exhibiting a moderate effect size (>0.06) and a statistical power >.80.
Key Words: **Neuromotricity, BAPNE Method, Traditional methodology, Selective attention and concentration, Higher Education**

Introduction

Attention is a complex cognitive function that has been extensively studied throughout the ages and whose definition has varied from the classics to the present day. Since the mid-20th century, more than 25 attentional models have appeared (Romero-Naranjo, Pujalte-Cantó et al., 2023), usually influenced by each other, with common terms and with reworkings that introduce new data that have been further studied with neuroimaging techniques (Portellano & García, 2014). Of all the existing models, the BAPNE method, which will be developed below, is based on the one proposed by Sohlberg and Mateer (1987, 1989), because it enables the justification of its stimulation and rehabilitation activities, and because most of the tests validated in Spain are similar to the ideas proposed by this hierarchical model of attention (Piqueres et al. 2018). This model proposes six different types of attention in which each one requires the good functioning of the previous one:

- Arousal attention: ability to stay awake and maintain alertness. General activation of the organism.
- Focal attention: ability to concentrate attention on a stimulus, whether visual, auditory or tactile. It involves resisting distractions and/or shifting attention to another stimulus (if necessary).
- Sustained attention: ability to maintain a specific stimulus for a prolonged period of time.
- Alternating attention: the ability to shift the focus of attention between tasks involving different cognitive demands and to do so effectively.
- Selective attention: ability to choose relevant aspects of the attentional process by eliminating the distracting effects of a particular task.
- Divided attention: ability to attend to more than one stimulus without losing efficiency or avoiding errors in the execution of these stimuli.

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In relation to psychometric tests that assess attention, Portellano and García (2014) present a total of 18 tests on selective attention, either exclusively or as part of other aspects such as executive functions or different types of attention. Some of the most widely used and validated in Spain are: d2, PASAT, Stroop, TP-R, Brief Attention Test (BTA), Symbol Key B, and Number Key B belonging to the WISC-IV (Piqueres et al., 2018).

To date, there is no intervention research on neuromotricity and selective attention and concentration in Higher Education, nor on the impact it has on the gender of this population, since most of the research of this kind is aimed at the Primary and Secondary Education stages (Arnau-Mollá & Romero-Naranjo, 2022a, 2022b, 2024).

In Higher Education, we found studies on the improvement of selective attention and concentration through different themes using independent variables such as: active breaks (Lobach et al., 2024); mindfulness (Shih-Chun et al., 2023); play (Carpio, 2020); night light in classrooms (Vinicio et al., 2023); play (Carpio, 2020); night-time classroom brightness (Vinicio et al., 2023); use of active methodologies (Rodríguez-García et al., 2022); self-regulation (González, et al., 2018; Pacheco & Flores, 2021); sleep deprivation (Prado et al., 2017); or brain gymnastics (Ekerer, 2021). In addition, there are others that relate anxiety and selective attention before exams (Fernández-Castillo & Caurcel, 2015); and others that measure selective attention through encephalograms (Gutiérrez-Hernández et al., 2021) after physical exercise in university students (Flores et al., 2019).

On the other hand, in other non-university educational stages, we found studies in relation to selective attention in Primary Education, through Cooperative-High Intensity Interval Training (C-HIIT) training programmes for students with ADHD (Suárez-Manzano et al., 2021); vigorous extracurricular physical exercise (Reloba-Martínez et al., 2017); psycho-pedagogical programmes (Holgado et al., 2015); and in Secondary Education through active breaks (Ruiz-Ariza et al., 2021).

In relation to gender differences, there is a large literature presenting gender differences in cognitive tasks, but there is little empirical evidence on these differences in selective attention (Merritt et al., 2007). Moreover, the existing literature does not seem to shed much light due to the diversity of results obtained.

In Primary Education, Morente (2019) finds no differences between the selective attention of boys and girls karatekas aged 10-12 years with competitive experience after medium intensity training. On the contrary, Gelabert et al. (2023) observe a higher level of concentration in girls than in boys aged 10-12 years across three types of active breaks. Similarly, Suárez-Manzano et al. (2024) find that more physical activity gives girls with ADHD better performance in numeracy, linguistic reasoning, hyperactive-attentive behaviour, and attention span than boys.

On the other hand, in adults, Lozano-Cango and Bravo-Navarro (2021) in their study conducted on male and female referees aged 19-38 years in three categories claim that selective attention is higher in older and higher category males. In contrast, Merritt et al. (2007) presented two experiments with 18-35 year old college students using a basic Posner cueing paradigm in which females showed greater validity effects in tasks with endogenous cues, but not with a peripheral or exogenous cue. They showed that both sexes benefited from valid cues, and that women showed higher costs for invalid cues, while men benefited from invalid cues.

In compulsory music education taught in schools, the traditional methodologies of the early 20th century proposed by the great music educators Dalcroze, Orff, Kodaly, Willems, Martenot and Suzuki prevail (Cuevas, 2015; Montoya, 2017). Knowledge of the foundations of these methodologies is fundamental for future music education teachers at all educational stages, which is why it is practically compulsory content in all universities.

In relation to body movement, it is considered an effective means for the development of students' musical skills (Álamos-Gómez et al., 2023) since motor action is beneficial for rhythmic teaching (Polevoy, 2020; Vazou et al., 2020). Trives et al. (2018) approach the study of the precursors of movement and body percussion, while Trives-Martínez and Vicente-Nicolás (2013) delve into body percussion and the musical teaching methods cited above. Finally, Trives et al. (2014) analyse these active methodologies based on the *Escuela Nueva* to stipulate the relationship of their teaching-learning processes with attention linked to movement. They determine that most of them use movement and body percussion in relation to pitch, timbre, or intensity, but above all to work on rhythm. However, as far as attention is concerned, they do not make a direct treatment related to the previous aspects, that is to say, they do not make a systemic or systematic treatment of attention, even though some of them focus their research on psychophysiological characteristics.

On activities based on movement and body percussion used by these methodologies, but without a direct relationship with attention, without a control group and with a qualitative design, we found several intervention studies. In Secondary Education, on musical learning experience through Dalcroze (Sutela et al., 2020; Sutela et al., 2021); in Primary Education, on rhythm work through Orff activities (Toksoy & Başar, 2017); and in Higher Education, on intonation work through Kodaly (Aycan, 2017).

On the other hand, the BAPNE method is "(...) a method of cognitive, socioemotional, psychomotor and neurorehabilitative stimulation based on neuromotor skills whose objective is to work on executive functions" (Romero-Naranjo, 2019a, p. 2). Contrary to traditional methodologies, attention and body percussion are its main focus and not merely a didactic resource (Trives et al., 2014). This method justifies the possible stimulation of

the cognitive and executive functions of their activities based on the model of executive functions proposed by Tirapu-Ustárroz and Luna-Lario (2008).

The BAPNE method is made up of around 90 researchers from different disciplines, and is the only research group in the world (Neuromotricity and Motor Literacy 'Neuromotricity') that researches solely and exclusively on neuromotricity and the possible stimulation of cognitive and executive functions. For this purpose, it uses as a medium music-motor activities of body percussion based on the dual-task rhythmic-motor-cognitive paradigm (Arnau-Mollá & Romero-Naranjo, 2022a, 2022b, 2024).

This group has a very solid methodological basis in its nearly 200 publications, 57 of them indexed in Web of Science (Andreu-Cabrera & Romero-Naranjo, 2021; Andreu et al, 2024; Di Russo & Romero-Naranjo, 2023; Romero-Naranjo, 2013, 2020, 2022; Romero-Naranjo & Andreu-Cabrera, 2023a, 2023b, 2023c, 2023d; Romero-Naranjo et al. , 2022; Sayago-Martínez et al, 2021; Navaro-Maciá & Romero-Naranjo, 2024a, 2024b). Figure 1 shows the number of publications indexed in Web of Science.

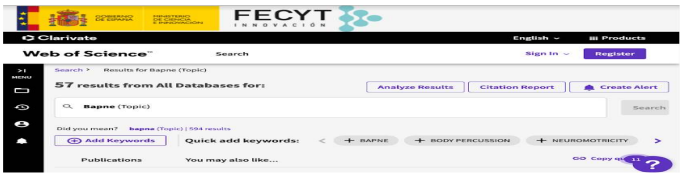

Figure 1. Publications of BAPNE research group in Web of Science

It is worth highlighting the quantitative intervention studies carried out with neuromotricity, with control and experimental groups, repeated measures (pretest-postest), and the use of validated tests in different populations:

- Primary Education (Arnau-Mollá & Romero-Naranjo, 2020; Carretero-Martínez et al., 2014; Castelló et al., 2019; Cozzutti et al., 2017; Díaz, 2016); Romero-Naranjo, Pujalte-Cantó et al., 2023; Torró-Biosca et al., 2019).
- Secondary Education (Álvarez & Romero-Naranjo, 2019; Fabra-Brell & Romero-Naranjo, 2017; Piqueres-Juan et al., 2019; Romero-Naranjo, Sayago-Martínez et al., 2023; Latre-Navas et al., 2019).
- Music conservatories (Moral et al., 2020; Ros-Silla et al., 2019).
- Older population (Crespo-Colomino et al., 2014; González et al., 2019; Pons-Terres et al., 2014; Romero-Naranjo, 2014).
- Therapy with adults (Romero-Naranjo et al., 2014).

Among these, with the same design as this study, quasi-experimental, repeated measures (pretest-postest), d2 as an instrument for assessing selective attention and concentration, control group and experimental group, and with statistically significant results in favour of the experimental group, we find: those carried out by Aranu-Mollá and Romero-Naranjo (2020) with N=67 students in 3rd year of Primary Education in Valencia (Spain), and by Romero-Naranjo, Pujalte-Cantó et al. (2023) with N=114 students in 5th year of Primary Education in Alicante (Spain); the one carried out by Piqueres-Juan et al. (2019) in 1st year of Secondary Education with N=57 students in Alicante (Spain); and the one carried out by Ros-Silla et al, (2019) with N=27 students from the Elementary Conservatory of Music in Castellón (Spain).

On the other hand, although assessing attention through other different attention tests, we find those conducted by Cozzutti et al. (2017) in Friuli Venezia Giulia (Italy) with N=40 children in 3rd year of Primary Education assessing executive functions, attention and concentration; the one carried out by Álvarez and Romero-Naranjo (2019) with N=61 students in 1st year of Secondary Education in Ceuta (Spain); and the one carried out by Romero-Naranjo, Sayago-Martínez et al. (2023) in the region of Murcia (Spain) in students in 3rd year of Secondary Education in which anxiety and attention were assessed.

The positive correlation between physical activity or physical fitness and selective attention and concentration in both childhood and adolescence is more than evidenced through a multitude of studies (Booth et al., 2013; Budde et al., 2008; Cádenas-Sánchez et al., 2017; Domínguez-González et al., 2018; Shih-Chun et al., 2017; Moral 2022; Moral-Campillo et al., 2020; Páez-Maldonado et al., 2020; Pérez-Lobato et al., 2016; Reigal, Moral-Campillo et al., 2020; Reigal, Moral-Campillo, Morillo-Baro et al., 2020; Rosa et al., 2019; Trudeau & Shephard, 2008; Vanhelst et al., 2016; Verret et al., 2012; Westfall et al., 2018), with cardiorespiratory fitness and oxygen consumption being the strongest predictors of cognitive, psychosocial and academic functioning (Domínguez-González, 2018; Moral, 2022; Moral-Campillo et al., 2020; Pérez-Lobato et al., 2016; Rodríguez-García et al., 2022).

On a physiological level, in a BAPNE neuromotricity activity session, an average of 100-120 heartbeats per minute are maintained, with peaks of up to 140, and an average calorie consumption of 850 calories, as well as a high degree of attention and concentration (Crespo et al., 2015). Similarly, in the BAPNE FIT activity programme, a maximum of 189 beats per minute is reached, helping and increasing maximum oxygen consumption and heart rate (Romero-Naranjo & Llorca-Garnero, 2023), to which Alonso-Marco and Romero-Naranjo (2022) add that the movements performed are not harmful or aggressive and are suitable for any type of

population. In reference to the didactic part, the BAPNE method has a session structure divided into three very precise parts (Initiation rite, cognitive stimulation, and closing rite) whose aims and objectives have been published recently and which lay the foundations on how to teach body percussion using the BAPNE method (Arnau-Mollá & Romero-Naranjo, 2023a, 2023b; Asurmendi-Tellería & Romero-Naranjo, 2022; Romero-Naranjo et al., 2023). Finally, Rodríguez-García et al. (2022) state that active methodologies are widely known by university physical education teachers, but that only a small percentage of teachers apply them in the classroom. In contrast, for years, the BAPNE neuromotricity method has been regularly applied as part of the content of different subjects in different Bachelor's, Master's and Master's Degrees at the University of Alicante, committing to the learning and academic and responsible use of neuromotricity by future teachers of Music and Physical Education in Infant, Primary and Secondary Education.

In accordance with the theoretical framework set out above, the purpose of this study is, considering the gender variable, to find out the effect of traditional methodology and the neuromotricity BAPNE method on selective attention and concentration in four groups of students of Didactics of Musical Expression of the Degree of Early Childhood Education Teacher at the University of Alicante. To do this, we will have to answer the following research questions:

1) Are there pre-intervention differences in pupils' selective attention and concentration according to gender and methodology used?
2) What impact will the use of the neuromotricity BAPNE method have after the intervention on the selective attention and concentration of students according to gender?
3) What impact will the use of the traditional methodology have after the intervention on the selective attention and concentration of students according to gender?
4) Are there any post-intervention differences in students' selective attention and concentration according to gender and methodology used?
5) Which group will show the greatest improvement in selective attention and concentration after the intervention?

In order to answer these research questions, we set out the following objectives:

1) To compare quantitatively the initial state of selective attention and concentration among students according to gender and methodology used, and to determine whether or not there are statistically significant differences between them.
2) To quantitatively assess the impact of the neuromotricity BAPNE method on selective attention and concentration according to the gender of the pupils after the intervention.
3) To find out quantitatively the impact of the traditional methodology on selective attention and concentration according to the pupils' gender after the intervention.
4) To quantitatively compare the effect of the traditional methodology and the neuromotricity BAPNE method on selective attention and concentration in men and women.
5) To determine which methodology has the greatest impact on selective attention and concentration, and which gender benefits the most.

Material & methods

Participants

The sample consisted of N=294 students of the University of Alicante from seven groups, aged between 18 and 42 years (mean=19.94 and SD=3.471), with similar socioeconomic and cultural characteristics, and divided into an experimental group (n=179) and a control group (115). The students were taking the subject Didactics of Musical Expression, belonging to the first year of the Degree in Early Childhood Education.

85.37% were females with an age range between 18 and 42 years (mean=20.00 and SD=3.644), while 14.63% were males between 18 and 28 years of age (mean=19.53 and SD=2.197). Table 1 shows the descriptive statistics of the sample.

Table 1. Descriptive statistics of the sample

Group	Subgroup	F	%	W	%W	Men	%Men	%Cum.	A-R	Mean age	SD
Experimental	G1	45	15.31	37	12.59	8	2.72	15.31	18-37	19.33	3.148
	G2	45	15.31	41	13.95	4	1.36	30.61	18-33	19.42	2.667
	G3	47	15.99	42	14.29	5	1.70	46.60	18-42	19.70	4.096
	G4	42	14.29	39	13.27	3	1.02	60.88	18-27	19.14	1.933
Total Experimental		179	60.88	159	54.08	20	6.80	60.88	18-42	19.41	3.073
Control	G5	38	12.93	29	9.86	9	3.06	12.93	18-33	20.42	3.739
	G6	39	13.27	33	11.22	6	2.04	26.19	18-38	21.33	4.949
	G7	38	12.93	30	10.20	8	2.72	39.12	18-32	20.50	2.618
Total Control		115	39.12	92	31.29	23	7.82	39.12	18-38	20.76	3.886
Total		294	100	251	85.37	43	14.63	100	18-42	19.94	3.471

Note: F=Frecuence, %=Percentage, W=Women, M=Men, %Cum.= Cumulative percentage, A-R=Age Range, SD=Standard deviation.

For this study, the data were analysed separately, forming four groups according to gender and the methodology applied, in which the experimental group worked by means of the neuromotricity BAPNE method, and the control group with the traditional methodology. Table 2 shows the configuration of the four groups and their descriptive statistics.

Table 2. Descriptive statistics of the groups according to gender and methodology

Groups	Gender-methodology	n	%	%Cum.	A-R	Mean age	SD
Experimental	Women-Neuromotricity BAPNE method	159	54.08	54.08	18-42	19.50	3.212
	Men-Neuromotricity BAPNE method	20	6.80	60.88	18-23	18.65	1.424
Control	Women-Traditional methodology	92	31.29	92.18	18-38	20.87	4.167
	Men-Traditional methodology	23	7.82	100	18-28	20.30	2.476
	Total	294	100	100	18-42	19.94	3.471

Note: n=sample, %Cum.=Cumulative percentage, A-R=Age range, SD=Standard deviation.

Design

A non-probability convenience sampling, with a 95% confidence interval and a significance level of 5% ($p<0.05$), as well as a quasi-experimental intra-inter-subject design with pre- and post-intervention measures (pretest-posttest) were used.

Instrument

As an assessment instrument, the Spanish adaptation of the "d2" attention test in its fourth revised edition published by TEA (Brickenkamp & Seisdedos, 2012) was used. This test is applied to children, adolescents and adults to assess their capacity for selective attention and concentration. It can be administered individually or collectively and lasts between eight and ten minutes, including prompts.

This is a cancellation task, in which test takers must correctly perform the task by discriminating visual stimuli across 14 lines, marking only the letters "d" with two dashes. In each of the 14 lines, the test takers must work as fast as possible, trying not to make mistakes, with 20 seconds for each line.

Selective attention and concentration is measured through the scores obtained in the following variables: total responses (TR), total hits (TA), omissions (O), commissions or errors (TC), total test effectiveness (TOT), concentration index (CON), line with the highest and lowest number of attempts (TR+) and (TR-), and variance or difference index (VAR).

According to Brickenkamp and Seisdedos (2012) the test has a high reliability ($r>.90$) in most studies and irrespective of the statistic used, and in special samples it ranges between .70 and .80. Depending on the comparison measure, sample and scale used, this test relates well to other tests of attention and concentration (.31-.71) and has a Crombach's alpha above .90 (Pawlowski, 2017, 2020). Table 3 shows the meaning, measurement and calculation of the variables.

Table 3. Meaning of d2 test scores

Score	Meaning	Measurement	Calculation
TR	Total responses	Processing speed, amount of work done and motivation	Sum of TR+ (rows 1 to 14)
TR+	Row with the highest number of responses	-	-
TR-	Row with the lowest number of answers	-	-
TA	Total number of correct answers	Relevant stimuli correctly marked	Sum of TA (rows 1 to 14)
TO	Total omissions	Relevant stimuli not marked	Sum of O (rows 1 to 14)
TC	Total commissions	Unmarked relevant stimuli	Sum of C (rows 1 to 14)
TOT	Total Test Effectiveness	Attentional and inhibitory control and the relationship between speed and accuracy	TOT=TR - (O+C)
CON	Concentration index	Concentration or trade-off between speed and accuracy of the test	CON = TA - C
VAR	Variability of the test	Stability and consistency over time, variation or fluctuation in working mode	VAR = (TR+) - (TR-)

Note: (Brickenkamp & Seisdedos, 2012).

Procedure

After the presentation of the project to the Research Ethics Committee of the University of Alicante (CEIUA) for its evaluation and subsequent approval under file number 2022CEI005054, the first session was devoted to explaining the research to potential participants and signing the participant information sheet, informed consent, basic clause and extended data protection information.

In the following session, the first evaluation (pretest) was carried out on the two groups of participants (control and experimental) applying the selective attention and concentration test d2 on the same day and in the same environmental conditions.

Subsequently, an intervention of 21 theoretical-practical sessions lasting one hour and fifty minutes twice a week was applied. This intervention took place over 11 weeks between February and May 2023, without taking into account the local holiday of Santa Faz and the Easter holiday period.

As an intervention:

- The experimental group varied its programming and received a theoretical-practical treatment based on the neuromotor activity protocols of the BAPNE method published in the manuals Body percussion-programación didáctica, vols. 1 and 2 (Romero-Naranjo, 2018a, 2018b). These protocols of music-motor activities have different degrees of complexity and are based on the dual task and the possible stimulation of executive functions and cognitive functions, offering a high degree of stimulation to students (Arnau-Mollá & Romero-Naranjo, 2022c).
- In contrast, the control group continued with their usual programme of traditional methodology and focused on the theoretical-practical study of the great musical pedagogues of the 20th century: Émile Jaques-Dalcroze, Zoltán Kodály, Carl Orff and Edgar Willems.

At the end of the intervention period, the second assessment (postest) was given to the two groups of participants on the same day and in the same environmental conditions, and finally the statistical analysis of the data was carried out for the extraction of results.

This study complied with and respected the ethical principles of the Helsinki declaration for human research. Participation in the research was voluntary and no financial or academic incentives were obtained. In order to participate, all of the following inclusion criteria had to be met:

- Reading and signing of the participant information sheet.
- Sign the informed consent form.
- Signature of the basic clause and the extended data protection information.
- Minimum attendance of 80% of the intervention sessions.
- Correct performance of the evaluation test before and after the intervention.

Statistical analysis

In the statistical analysis, SPSS v.25 was used for descriptive and inferential statistics; G*Power v. 3.1.9.7 for the extraction of effect size and statistical power (Erdfelder et al., 1996; Faul et al., 2007); and Microsoft Excel for making tables.

Before applying the corresponding parametric or non-parametric statistical tests, the assumptions of normality were checked. To ascertain the homogeneity or normality of the samples, the Kolmogrorov-Smirnov goodness-of-fit tests were applied to groups with more than 50 participants, and the Shapiro-Wilk test for groups with less than 50 participants. In addition, the Levene test for homogeneity of variances was applied to check homoscedasticity.

Based on the results obtained, and in order to determine whether there were statistically significant differences between the groups, the parametric one-factor Anova test was applied to the variables that met the requirements of normality in the four groups, and the non-parametric Kruskal-Wallis test to all those that did not meet them in any of the four groups.

In the intra-subject analysis, to determine whether there were statistically significant differences between the pretest and postest within each group, the parametric related samples t Student test and the non-parametric Wilcoxon signed-rank test were applied.

The magnitude of effect size (d) and statistical power (1-β) were calculated in G*Power in the family of related samples t-tests and interpreted as .20=small, .50=medium, .80=large, and statistical power 1-β=.80 with an alpha error (α) .05 (Cohen, 1988, 1992).

On the other hand, in the inter-subject analysis, to determine whether there were statistically significant differences between the groups in the post-test and in the difference variables (pretest minus postest), the parametric one-factor Anova test was applied to the variables that met the requirements of normality in the four groups, and the non-parametric Kruskal-Wallis test was applied to all those that did not meet them in any of the four groups.

Bonferroni post hoc tests for parametric and Games-Howell for non-parametric tests were then used to determine between exactly which groups there were statistically significant differences.

As an index of effect size, in the inter-subject analysis, the epsilon square (ε^2) was calculated because according to Okada (2013) it presents less bias in small samples than those used in the analysis of variances eta square ($\eta 2$) and omega square (ω 2), and because it is presented as an alternative to estimate the effect size in the Kruskal-Wallis test (Ventura-León, 2019).

The magnitude of the effect size (ε^2) was interpreted as very small (<.01), small (.01-.05), moderate (.06-.13), and large (≥.14) according to the most commonly applied values in educational research (López-Martín & Ardura-Martínez, 2023).

Finally, statistical power (1-β) in G*Power was calculated via partial eta squared (η2) in the ANOVA: Fixed effects, omnibus, one-way statistical test, with a probability alpha error (α) of .05, and the generally accepted cut-off point for statistical power of 1-β=.80 was taken.

Results

No statistically significant baseline differences were found in the pretest between any of the four groups, women-experimental (W.E), men-experimental (M.E), women-control (W.C), and men-control (M.C). The parametric and non-parametric tests are shown in Table 4 and Table 5.

Table 4. No difference at baseline in the Kruskal-Wallis test

Variable	Kruskal-Wallis												
	W.E		M.E		W.C		M.C		H	gl	Sig.	ε²	1-β
	Md	R	Md	R	Md	R	Md	R					
TR+PRE	42.00	20	42.00	13	40.00	23	42.00	14	2.592	3	.459	.01	.22
TR-PRE	24.00	37	26.00	18	24.00	42	23.00	20	3.005	3	.391	.01	.24
TAPRE	169.00	191	184.00	164	166.00	200	167.00	77	1.883	3	.597	.01	.17
OPRE	18.00	170	15.50	113	17.00	120	25.00	61	1.128	3	.770	<.01	.08
CPRE	1.00	13	1.00	6	1.00	13	1.00	8	2.156	3	.541	.01	.10
CONPRE	167.00	202	181.50	163	166.00	212	166.00	78	1.946	3	.584	.01	.16
VARPRE	16.00	37	15.50	21	17.00	34	18.00	20	2.514	3	.473	.01	.22

Note: W.E=Women-Experimental, M.E=Men-Experimental, W.C=Women-Control, M.C=Men-Control, Md=Median, R=Range, H=Kruskal-Wallis statistic, gl=Degrees of freedom, Sig.=Significance, ε²=Effect size, 1-β=Statistical power.

Table 5. No differences at baseline in one-factor Anova test

Variable	1-factor Anova								F	gl	Sig.	ε²	1-β
	W.E		M.E		W.C		M.C						
	M	SD	M	SD	M	SD	M	SD					
TRPRE	462.07	72.030	474.30	68.956	448.78	77.650	454.70	59.160	1.007	3, 290	.390	<.01	.28
TOTPRE	432.22	66.592	444.10	74.170	421.15	71.434	426.17	55.002	0.872	3, 290	.456	<.01	.24

Note: W.E=Women-Experimental, M.E=Men-Experimental, W.C=Women-Control, M.C=Men-Control, M=Mean, SD= Standard deviation, F=Anova statistic, gl=Degrees of freedom, Sig=Significance, ε²=Effect size, 1-β=Statistical power.

Intra-subject analysis

Statistically significant differences were found between pretest and postest for all variables in the W.E. group (except TO), with a small effect size in TC and VAR, medium in TR+, and large in TR, TR-, TA, TOT and CON, and a statistical power >.80.

In contrast, no statistically significant differences were found in TO where the pretest scores (Md=18.00; R=170) were similar to the postest scores (Md=17.00; R=184) Z=-1.340, p=.180, d=.02, 1-β=.06. Table 6 shows the results obtained by the W.E group.

Table 6. Intra-subject analysis results of the Women-Experimental group

Var.	Pretest				Postest				Wilcoxon				t Student (Paired)						
	Md	R	M	SD	Md	R	M	SD	Z	Sig. (Bil.)	d	1-β	M	Dev.	t	gl	Sig	d	1-β
TR	464.00	341	462.07	72.030	559.00	349	550.14	67.553	-10.738	<.001	.89	1.00							
TR+	42.00	20	41.03	5.569	47.00	20	44.89	3.695	-8.833	<.001	.58	1.00							
TR-	24.00	37	23.18	6.059	29.00	36	30.82	6.902	-9.585	<.001	.83	1.00							
TA	169.00	191	168.48	33.949	214.00	225	213.43	41.381					-44.950	28.820	-19.667	158	<.001	.84	1.00
TO	18.00	170	28.16	28.496	17.00	184	27.45	30.241	-1.340	.180	.02	.06							
TC	1.00	13	1.69	2.170	0.00	21	0.94	2.370	-5.293	<.001	.23	.82							
TOT	431.00	323	432.22	66.592	525.00	350	521.75	69.008					-89.528	48.371	-23.338	158	<.001	.93	1.00
CON	167.00	202	166.79	34.619	213.00	246	212.49	42.386					-45.698	30.027	-19.190	158	<.001	.84	1.00
VAR	16.00	37	17.85	6.389	14.00	34	14.08	6.291	-5.504	<.001	.42	1.00							

Note: Var=Variable, Md=Median, R=Range, M=Mean, SD= Standard deviation, Z=Statistic Wilcoxon, Sig.(Bil.)=Bilateral significance, d=Effect size, 1-β=Statistical power, Dev.=Deviation, t=T-Value, gl=Degrees of freedom.

For the M.E. group, statistically significant differences were found between pretest and postest for most variables, with small (TR+, VAR) and medium (TR, TR-, TA, TOT, CON) effect sizes and statistical power <.80, except for TR- (1-β=.87).

In contrast, no statistically significant differences were found in TO, where pretest scores (Md=15.50; R=113) were similar to those of the postest (Md=16.50; R=120) Z=-.604, p=.546, d=.01, 1-β=.05, nor in TC, with similar scores between pretest (Md=1.00; R=6) and postest (Md=1.00; R=7) Z=-.441, p=.659, d=.04, 1-β=.05. Table 7 shows the results obtained by the M.E group.

Table 7. Intra-subject analysis results of the Men-Experimental group

Var.	Pretest				Postest				Wilcoxon				t Student (Paired)						
	Md	R	M	SD	Md	R	M	SD	Z	Sig. (Bil.)	d	1-β	M	Dev.	t	gl	Sig	d	1-β
TR	494.50	233	474.30	68.956	562.50	264	546.15	90.890	-3.043	.002	.63	.74							
TR+	42.00	13	41.20	4.607	47.00	17	44.05	5.042	-2.707	.007	.42	.41							
TR-	26.00	18	25.20	5.473	33.50	27	32.10	7.813					-6.900	7.553	-4.086	19	.001	.72	.87
TA	184.00	164	173.40	41.872	202.00	164	210.90	54.837					-37.500	31.775	-5.278	19	<.001	.54	.64
TO	15.50	113	28.50	27.372	16.50	120	29.05	35.113	-0.604	.546	.01	.05							
TC	1.00	6	1.70	1.895	1.00	7	1.60	2.062	-0.441	.659	.04	.05							
TOT	456.50	246	444.10	74.170	496.50	270	515.50	92.858					-71.400	65.475	-4.877	19	<.001	.60	.72
CON	181.50	163	171.70	41.711	200.50	167	209.30	55.733					-37.600	32.181	-5.225	19	<.001	.54	.63
VAR	15.50	21	16.00	4.690	13.00	22	11.95	6.878					4.050	6.992	2.590	19	.018	.49	.54

Note: Var.=Variable, Md=Median, R=Range, M=Mean, SD= Standard deviation, Z=Statistic Wilcoxon, Sig.(Bil.)=Bilateral significance, d=Effect size, 1-β=Statistical power, Dev.=Deviation, t=T-Value, gl=Degrees of freedom.

As for the W.C group, statistically significant differences were found between pretest and postest in practically all variables (except TO), with a small (TR+, VAR) to medium (TR, TR-, TA, TOT, CON) effect size, and a statistical power ≥.80, except in TC (1-β=.23) and VAR (1-β=.46).

In contrast, no statistically significant differences were found in TO where the pretest scores (Md=17.00; R=120) were similar to those of the postest (Md=16.00; R=193) Z=-1.512, p=.131, d=.02, 1-β=.05. Table 8 shows the results obtained by the W.C group.

Table 8. Intra-subject analysis results of the Women-Control group

Var.	Pretest				Postest				Wilcoxon				t Student (Paired)						
	Md	R	M	SD	Md	R	M	SD	Z	Sig. (Bil.)	d	1-β	M	Dev.	t	gl	Sig	d	1-β
TR	454.50	440	448.78	77.650	522.50	316	511.70	71.530					-62.913	67.856	-8.893	91	<.001	.60	1.00
TR+	40.00	23	40.07	5.709	46.00	17	43.26	4.530	-4.794	<.001	.44	.98							
TR-	24.00	42	22.75	6.664	28.00	41	27.64	7.112	-5.341	<.001	.50	1.00							
TA	166.00	200	164.26	32.402	198.50	218	195.10	40.229	-7.202	<.001	.60	1.00							
TO	17.00	120	25.97	23.713	16.00	193	25.32	31.031	-1.512	.131	.02	.05							
TC	1.00	13	1.66	2.082	0.00	30	1.15	3.248	-3.494	<.001	.13	.23							
TOT	427.50	442	421.15	71.434	499.50	330	485.23	70.845					-64.076	49.729	-12.359	91	<.001	.64	1.00
CON	166.00	212	162.60	33.229	196.50	216	193.95	41.016	-7.216	<.001	.59	1.00							
VAR	17.00	34	17.32	6.139	15.00	31	15.62	5.783	-2.036	.042	.20	.46							

Note: Var.=Variable, Md=Median, R=Range, M=Mean, SD= Standard deviation, Z=Statistic Wilcoxon, Sig.(Bil.)=Bilateral significance, d=Effect size, 1-β=Statistical power, Dev.=Deviation, t=T-Value, gl=Degrees of freedom.

In reference to the M.C group, statistically significant differences were found between pretest and postest in most of the variables (except in TO and TC), with small (TR+, TR-, VAR) and medium (TR, TA, TOT, CON) effect sizes and a statistical power ≥.80 in TR, TA, TOT, and <.80 in TR+, TR-, CON, VAR.
However, no statistically significant differences were found in TO, where pretest scores (Md=25.00; R=61) were similar to postest scores (Md=22.00; R=85) Z=-.601, p=.548, d=.03, 1-β=.05, nor in TC, with similar scores between pretest (Md=1.00; R=8) and postest (Md=0.00; R=7) Z=-.445, p=.656, d=.07, 1-β=.06. Table 9 shows the results obtained by the M.C group.

Table 9. Intra-subject analysis results of the Men-Control group

Var.	Pretest				Postest				Wilcoxon				t Student (Paired)						
	Md	R	M	SD	Md	R	M	SD	Z	Sig. (Bil.)	d	1-β	M	Dev.	t	gl	Sig	d	1-β
TR	454.00	179	454.70	59.160	502.00	235	508.48	64.680					-53.783	54.554	-4.728	22	<.001	.61	.80
TR+	42.00	14	41.43	5.409	46.00	12	43.39	4.293	-2.381	.017	.28	.25							
TR-	23.00	20	22.96	5.304	28.00	30	26.91	7.348					-3.957	8.003	-2.371	22	.027	.44	.52
TA	167.00	77	165.48	25.119	185.00	125	190.83	31.678	-3.925	<.001	.63	.80							
TO	25.00	61	27.26	16.380	22.00	85	28.30	24.944	-0.601	.548	.03	.05							
TC	1.00	8	1.26	2.027	0.00	7	1.48	2.213	-0.445	.656	.07	.06							
TOT	432.00	163	426.17	55.002	471.00	228	478.70	58.466					-52.522	44.093	-5.713	22	<.001	.65	.85
CON	166.00	78	164.22	24.985	185.00	125	189.35	31.754	-3.848	<.001	.62	.79							
VAR	18.00	20	18.48	4.708	17.00	27	16.48	7.298					2.000	8.650	1.109	22	.279	.23	.18

Note: Var.=Variable, Md=Median, R=Range, M=Mean, SD= Standard deviation, Z=Statistic Wilcoxon, Sig.(Bil.)=Bilateral significance, d=Effect size, 1-β=Statistical power, Dev.=Deviation, t=T-Value, gl=Degrees of freedom.

Inter-subject analysis

The results of the Kruskal-Wallis test identified an effect of methodology and gender in the postest on the variables TR, TR+, TR-, TA, CON and VAR, with an effect size between small and moderate, and a statistical power ≥.80 except in TR+ and VAR (<.80). Similarly, an effect was also identified for the variables resulting from subtracting pretest scores from postest scores DifTR, DifTR-, DifTA, DifTOT and DifCON, with a small to moderate effect size and a statistical power ≥.80. In contrast, no statistically significant differences were found in the postest in the TO and TC variables, nor in the DifTR+, DifTO and DifTC difference variables.

On the other hand, from ANOVA analysis we found effect of methodology and gender on total test performance (TOT) $F(3, 290)=6.542$, $p=<.001$, $\varepsilon^2=.05$, $1-\beta=.97$. Table 10 shows the results obtained between the four groups in the Kruskal-Wallis test.

Table 10. Results of the Kruskal-Wallis test between the four groups

Variable	Kruskal-Wallis												
	W.E		M.E		W.C		M.C		H	gl	Sig.	ε²	1-β
	Md	R	Md	R	Md	R	Md	R					
TRPOST	559.00	349	562.50	264	522.50	316	502.00	235	20.342	3	<.001	.07	.98
DifTR	-86.00	307	-84.50	345	-67.00	400	-47.00	224	15.869	3	.001	.05	.92
TR+POST	47.00	20	47.00	17	46.00	17	46.00	12	10.729	3	.013	.04	.77
DifTR+	-3.00	18	-2.00	16	-3.00	35	-1.00	16	3.133	3	.372	.01	.37
TR-POST	29.00	36	33.50	27	28.00	41	28.00	30	15.439	3	.001	.05	.96
DifTR-	-8.00	50	-7.50	35	-6.00	44	-4.00	32	9.593	3	.022	.03	.80
TAPOST	214.00	225	202.00	164	198.50	218	185.00	125	16.740	3	.001	.06	.91
DifTA	-44.00	246	-41.00	146	-33.50	168	-23.00	90	26.988	3	<.001	.09	.98
TOPOST	17.00	184	16.50	120	16.00	193	22.00	85	1.235	3	.745	<.01	.08
DifTO	1.00	266	3.00	85	1.00	263	3.00	95	0.415	3	.937	<.01	.06
TCPOST	0.00	21	1.00	7	0.00	30	0.00	7	5.540	3	.136	.02	.18
DifTC	0.00	28	0.00	11	0.00	26	0.00	11	5.033	3	.169	.02	.32
DifTOT	-89.00	400	-82.00	284	-70.00	304	-45.00	163	24.338	3	<.001	.08	.99
CONPOST	213.00	246	200.50	167	196.50	216	185.00	125	17.324	3	.001	.06	.91
DifCON	-45.00	268	-41.00	145	-33.00	169	-23.00	96	28.956	3	<.001	.10	.98
VARPOST	14.00	34	13.00	22	15.00	31	17.00	27	9.044	3	.029	.03	.72
DifVAR	3.00	51	4.00	31	1.00	41	3.00	26	4.615	3	.202	.02	.40

Note: W.E=Women-Experimental, M.E=Men-Experimental, W.C=Women-Control, M.C=Men-Control, Md=Median, R=Range, H=Kruskal-Wallis statistic, gl=Degrees of freedom, Sig.=Significance, ε²=Effect size, 1-β=Statistical power.

Post hoc test results

The post hoc analyses carried out with the Games-Howell statistic showed a statistically significant improvement in the postest of the W.E group compared to the W.C and M.C groups in the variables TR, TA, and CON, with an effect size between small and moderate, and a statistical power ≥.80 with the W.C group, and <.80 with the M.C group. In addition, statistically significant differences were also found in the difference variables DifTR, DifTA, DifTOT, DifCON, with a small to moderate effect size, and a statistical power ≥.80.

Similarly, post hoc analyses also using the Games-Howell statistic showed a statistically significant improvement of the W.E group over the W.C group in TR+ and TR-, and in the DifTR- difference variable, with a small effect size and a statistical power ≥.80.

On the other hand, the post hoc analyses carried out with the Bonferroni statistic showed that the W.E group obtained a higher TOT score in the postest (M=521.75; SD=69.008) than the W.C group (M=485.23; SD=70.845), p=.001, 95% CI [11.93, 61.11], ε^2=.06, 1-β=.98, and than the M.C group (M=478.70; SD=58.466), p=.040, 95% CI [1.17, 84.93], ε^2=.04, 1-β=.81.

Table 11 shows the statistically significant differences in the post hoc analyses of the W.E group versus the W.C group, and Table 12 shows the statistically significant differences between the W.E and M.C groups.

Table 11. Differences found in post hoc tests between W.E and W.C groups

Variable	Statistics				Games-Howell (Post Hoc)			ε^2	1-β
	W.E		W.C			CI 95%			
	Md	R	Md	R	Sig.	Lower	Upper		
TRPOST	559.00	349	522.50	316	<.001	14.63	62.25	.06	.99
DifTR	-86.00	307	-67.00	400	.012	-46.17	-4.14	.05	.92
TR+POST	47.00	20	46.00	17	.020	0.19	3.08	.04	.87
TR-POST	29.00	36	28.00	41	.004	0.79	5.57	.04	.94
DifTR-	-8.00	50	-6.00	44	.028	-5.27	-0.21	.03	.82
TAPOST	214.00	225	198.50	218	.004	4.53	32.13	.05	.93
DifTA	-44.00	246	-33.50	168	.001	-23.46	-4.76	.07	.97
DifTOT	-89.00	400	-70.00	304	.001	-42.17	-8.73	.07	.98
CONPOST	213.00	246	196.50	216	.004	4.45	32.64	.05	.92
DifCON	-45.00	268	-33.00	169	.001	-23.87	-4.83	.08	.97

Note: W.E=Women-Experimental, W.C=Women-Control, Md=Median, R=Range, Sig=Significance, CI=Confidence interval, ε^2=Effect size, 1-β=Statistical power.

Table 12. Differences found in the post hoc tests between W.E and M.C groups

Variable	Statistics				Games-Howell (Post Hoc)			ε^2	1-β
	W.E		M.C			CI 95%			
	Md	R	Md	R	Sig.	Lower	Upper		
TRPOST	559.00	349	502.00	235	.036	2.15	81.17	.04	.79
DifTR	-86.00	307	-47.00	224	.039	-67.17	-1.40	.04	.87
TAPOST	214.00	225	185.00	125	.021	2.68	42.52	.05	.71
DifTA	-44.00	246	-23.00	90	.004	-33.89	-5.31	.08	.88
DifTOT	-89.00	400	-45.00	163	.004	-64.08	-9.93	.07	.93
CONPOST	213.00	246	185.00	125	.018	3.10	43.18	.06	.71
DifCON	-45.00	268	-23.00	96	.003	-35.09	-6.04	.09	.88

Note: W.E=Women-Experimental, M.C=Men-Control, Md=Median, R=Range, Sig.=Significance, CI=Confidence interval, ε^2=Effect size, 1-β=Statistical power.

Dicussion

The purpose of this study is to determine the effect of the traditional methodology and the neuromotricity BAPNE method on selective attention and concentration according to gender of the students of Didactics of Musical Expression of the Degree of Early Childhood Education Teacher at the University of Alicante.

Due to the impossibility of comparing these results with other studies, since there is no research comparing the BAPNE neuromotricity method and traditional methodologies in Higher Education in terms of gender, the results will be discussed on the basis of the most related works and in a more general way.

In response to the first research question, no statistically significant baseline differences in selective attention and concentration between the methodology-gender groups are found in this study. These results are in full agreement with those obtained by Álvarez-Morales and Romero-Naranjo (2019), Ros-Silla et al. (2019), and Romero-Naranjo, Sayago-Martínez et al., (2023) and partially in agreement with Romero-Naranjo, Pujalte-Cantó et al. (2023), who on the other hand did find differences in onset in some variables (TR-, TOT, and CON). On the other hand, some related research did not provide this data (Arnau-Mollá & Romero-Naranjo, 2019; Piqueres-Juan et at., 2019).

By concordance in the ages of our participants (18-42) with the Ecuadorian male and female referees studied by Lozano-Cango and Bravo-Navarro (2021) with ages ranging from 19-38, our results are different, since they state that the older and more senior male referees have higher rates of selective attention and concentration than their female counterparts. This comparison is consistent, as they base their results on a single

measurement without applying any treatment. In reference to the second research question, after the intervention with the BAPNE neuromotricity method, statistically significant differences appear in both females and males in all variables, except in TO in females, and in TO and TC in males.

In general, females obtained a larger effect size than males, becoming large in TR, TR-, TA, TOT and CON, and a statistical power >.80. In contrast, the statistical power of males was lower than the cut-off score (.80), possibly due to the small sample size (n=20).

Although these results, at first glance, might lead us to think that women benefit more from this methodology, this is not really the case, since, as we will see below, there are no statistically significant differences between men and women treated with the BAPNE neuromotricity method.

Without taking into account the gender variable, and referring only to the methodology used, these results coincide completely with those found by Romero-Naranjo, Pujalte-Cantó et al. (2023) in their intra-subject analysis, in which TO is the only variable that does not show statistically significant differences between pretest and postest. Moreover, it fully coincides in a large effect size in the variables TR, TR-, TA, TOT and CON. Other related studies evaluated with the d2 (Arnau-Mollá & Romero-Naranjo, 2019; Piqueres-Juan et at., 2019), although with statistically significant differences in their inter-subject analyses in favour of the experimental group treated with the BAPNE neuromotricity method, do not present intra-subject analyses with which to compare our results.

When comparing our results with those obtained by other studies that assess attention with different tests (Álvarez-Morales & Romero-Naranjo, 2019; Cozzutti et al., 2017; Romero-Naranjo, Sayago-Martínez et al., 2023), we found similarities in that the group treated with the BAPNE neuromotricity method improved their attention scores in a statistically significant way in the postest. This suggests that regardless of the educational stage (Primary, Secondary, Higher Education) this methodology provides students with cognitive improvements related to attention. In response to the third research question, after the intervention with traditional methodology, both females and males improve statistically significantly on all variables except TO for females, and TO and TC for males. Both groups obtain a small to medium effect size. Again, the group formed by n=23 males obtains a statistical power <.80 in four variables, we believe this is due to the small sample size.

These results are quite similar to those found by Romero-Naranjo, Pujalte-Cantó et al. (2023) in which the group treated with traditional methodology also did not improve in TO, TC, and VAR, although they did improve in the remaining ones. It differs in that a medium to large effect size was found, while in our study it was between small and medium. Comparing our results, now with works that perform intra-subject analysis, but evaluated through other attention tests (Álvarez-Morales & Romero-Naranjo, 2019; Cozzutti et al., 2017; Romero-Naranjo, Sayago-Martínez et al., 2023), we find that their groups treated with traditional methodology also obtain statistically significant differences in the postest.

These results could indicate that the traditional musical methodology in Spain, influenced by the great musical pedagogues of the 20th century, promotes cognitive improvements in attentional aspects independently of the educational stage (Primary, Secondary, Higher Education) and in Primary Education students in Italy.

In reference to the fourth research question, in the ANOVA analysis there were statistically significant differences according to the gender of the participants and the methodology used as treatment in most of the variables and in their differences except for DifTR+, TO, DifTO, TC, DifTC, DifVAR. The effect size found in the significant differences ranged from small to moderate, the latter being predominant in TR, TA, DifTA, DifTOT, DifTOT, CON and DifCON. The statistical power was >.80 for almost all significant variables except for TR+ and VAR where it was very close to the cut-off point of .80 (.77 and .72 respectively).

We found a result common to all research using d2 (Arnau-Mollá & Romero-Naranjo, 2020; Piqueres-Juan et al., 2019; Ros-Silla et al., 2019) in TR and TA, except in Romero-Naranjo, Pujalte-Cantó et al. (2023) who found baseline differences between groups in these variables. Furthermore, we broadly agree with Piqueres-Juan et al. (2019) in that no significant differences appear in TO and TC and differ with Arnau-Mollá and Romero-Naranjo (2020) and Ros-Silla et al. (2019) in that they do.

Moreover, these results are consistent with those presented by Ekerere (2021) through cererbral gymnastics, Rodríguez-García et al. (2022) through active methodologies, and Flores et al. (2019) through physical exercise in which they all find differences between groups in selective attention. The physical load of neuromotricity, in addition to cognitive stimulation, could have triggered differences in the right temporal cortex of the students that explain the changes in selective attention after physical exercise, as occurred in Flores et al. (2019) after evaluating the participants in their research with an encephalogram.

In response to the fifth and final research question, post hoc analyses showed statistically significant differences of the W.E group versus the W.C and M.C groups in TR, TA, TOT, CON, and in their difference variables DifTR, DifTA, DifTOT, DifCON. In addition, significant differences also appeared between W.E and W.C in TR+, TR-, and DifTR-. The effect size ranges from small to moderate with both groups and the statistical power, with respect to the W.C group, is always >.80 and with respect to M.C as well, except in TR, TA, CON (.79, .71, .71) possibly due to the sample size of the M.C group (n=23).

If we look at the variable differences of the main indicators (DifTA, DifTOT and DifCON) we observe in favour of W.E always a moderate effect size and a statistical power >.80 in both groups (W.C and M.C), although a slightly higher effect size (+.01) in TA and CON with the M.C group.

In terms of gender, these results coincide with those obtained by Romero-Naranjo, Sayago-Martínez et al. (2023) in that women treated with neuromotricity statistically significantly improved their attention levels compared to women who used traditional methodology, while the same was not observed among men. Unfortunately, for the time being, we are left with the question of whether there were differences between females and males who used neuromotricity, as they do not present this type of analysis in their study.

The teaching implications derived from the results of this study are several. On the one hand, we know that both methodologies lead to significant improvements in selective attention and concentration of the students of Didactics of Musical Expression within the Degree in Early Childhood Education at the University of Alicante. On the other hand, we also know that by applying the BAPNE neuromotricity method, or at least by increasing its practical presence within the contents of the sessions, we can contribute to cognitive improvements in students, not only in the female gender, with a greater presence within the Degree in Early Childhood Education Teaching, but also in the male gender, since there were no differences between males and females treated with neuromotricity.

Furthermore, if the presence of this methodology is increased in the sessions of all groups and in the different Degrees and Masters of the University of Alicante, students will not only receive quality teaching that prepares them for their future teaching, having benefited from cognitive improvements in selective attention and concentration in their teaching-learning process, but they will also have a strongly justified tool based on scientific evidence that they will be able to apply to students in Infant, Primary and Secondary Education in the not too distant future. The limitations of this study are that the samples of the men's groups were relatively small, which may have led in some cases to a lower statistical power than desired. Likewise, the large numerical difference between women and men should be sufficient for us to take these results with caution.

As lines for the future, we could alleviate the limitations described above by carrying out an experimental study with a random sample, although with a smaller number of participants, equating participation in terms of gender and methodology. On the other hand, and much more interestingly, the brain activity of the participants could be recorded using encephalogram techniques to observe neuropsychological changes in selective attention and concentration through neuromotricity. Finally, research could be carried out in pre-school education by the future teachers who have participated in this research to see if the transfer can really be made to the youngest children.

Conclusions

After an intervention of 21 theoretical-practical sessions of one hour and fifty minutes with N=294 students of Didactics of Musical Expression of the Degree of Master in Education of the University of Alicante, in which the effect on selective attention and concentration of the traditional methodology based on the great musical pedagogues of the 20th century (Dalcroze, Orff, Kodaly and Willems) and the BAPNE neuromotricity method in men and women of mean age=19.94 and SD=3.471 we can conclude that:

On the one hand, no pre-intervention baseline differences in selective attention and concentration are found between male and female students.

On the other hand, both the BAPNE neuromotricity method and the traditional methodology provide statistically significant improvements in selective attention and concentration for both males and females.

Finally, there are statistically significant differences according to the gender of the participants and the methodology used, where women treated with BAPNE neuromotricity method obtain more cognitive benefits in selective attention and concentration than women and men treated with traditional methodology, but not than men treated with BAPNE neuromotricity method.

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References

Álamos Gómez, J., Tejada, J., & Moreno, L. (2023). Conexiones cognitivas entre expresión corporal y formación rítmica en Educación Primaria. Un estudio con docentes de música en Chile. *Revista Interuniversitaria de Formación del Profesorado. Continuación de da Antigua Revista de Escuelas Normales*, *98*(37.3), 187-202. https://doi.org/10.47553/rifop.v98i37.3.100661

Alonso-Marco, M., & Romero-Naranjo, F. J. (2022). Introducción al análisis cinemático de los movimientos básicos de la percusión corporal según el Método BAPNE. *Retos*, *46*, 950–971. https://doi.org/10.47197/retos.v46.94773

Álvarez-Morales, L. J., & Romero-Naranjo, F. J (2019). Pilot study into executive functions with muslim and christian pupils in the city of Ceuta using body percussion. *The European Proceedings of Social & Behavioural Sciences EpSBS*, *60*, Article 92. https://dx.doi.org/10.15405/epsbs.2019.04.02.92

Andreu-Cabrera, E. & Romero-Naranjo, F. J. (2021). Neuromotricidad, Psicomotricidad y Motricidad. Nuevas aproximaciones metodológicas. *Retos*, *42*, 924 938. https://doi.org/10.47197/retos.v42i0.89992

Andreu Cabrera, E., Romero Naranjo, F. J., & Lorenzo Lledó, A. (2024). Motor skills and Neuromotricity. Theoretical-practical justification through the BAPNE method. *Retos*, *52*, 338–349. https://doi.org/10.47197/retos.v52.101707

Arnau-Mollá, A. F., & Romero-Narnjo, F. J. (2020). Quantitative study on selective attention in children aged 8-9 years through bodypercussion. *European Proceedings of Social and Behavioural Sciences*, *84*(6), 50-60. https://doi.org/10.15405/epsbs.2020.05.6

Arnau-Mollá, A., & Romero-Naranjo, F. (2022a). A bibliometric study on body percussion based on high impact search engines. *Retos, 45*, 679-692. doi: 10.47197/retos.v45i0.92653

Arnau-Mollá, A. F., & Romero-Naranjo, F. J. (2022b). Body percussion as a pedagogical resource. Bibliometric study on body percussion based exclusively on secondary search engines. *Retos, 46*, 809–825. doi: 10.47197/retos.v46.95178

Arnau-Mollá, A. F., & Romero-Naranjo, F. J. (2022c). Body percussion research as an object of study based on neuromotricity and executive functions: Research design. In M. d. M. Molero Jurado, A. B. Barragán Martín, M. d. M. Simón Márquez, & Á. Martos Martínez (Comps.), *Innovación Docente e Investigación en Educación: Experiencias de Cambio en la Metodología Docente* (pp. 775-785). Dykinson, S.L.

Arnau-Mollá, A. F. & Romero-Naranjo, F. J. (2023a). Foundation and didactics of the main part of the session in the bapne method. Cognitive stimulation. In A. Martos Martínez, M. M. Simón Márquez, J. J. Gázquez Linares, P. Molina Moreno, & S. Fernández Gea (Comps.), Innovación Docente e Investigación en Educación: Nuevas Tendencias Para el Cambio en la Enseñanza Superior (pp. 873-888). Dykinson, S.L.

Arnau-Mollá, A. F. & Romero-Naranjo, F. J. (2023b). Structure and foundation for starting a session through bapne's method. The initiation rite. In A. Martos Martínez, M. M. Simón Márquez, J. J. Gázquez Linares, P. Molina Moreno, & S. Fernández Gea (Comps.), Innovación Docente e Investigación en Educación: Nuevas Tendencias Para el Cambio en la Enseñanza Superior (pp. 849-862). Dykinson, S.L.

Arnau-Mollá, A. F., & Romero-Naranjo, F. J. (2024). Bibliometric evolution of body percussion: Impact and gender in scientific-academic publications. *Retos*, *51*, 1025–1054. https://doi.org/10.47197/retos.v51.101450

Asurmendi Telleria, E. & Romero-Naranjo, F.J. (2022). How to teach body percussion through neuromotricity in the BAPNE method. In M.M. Molero Jurado, A.B. Barragán Martín, M.M. Simón Márquez, & Á. Martos Martínez (Comps.), Innovación Docente e Investigación en Educación: Experiencias de Cambio en la Metodología Docente (pp. 767-774). Dykinson, S.L.

Aycan, K. (2017). Kodály Metodundan Uyarlanan Deşifre Şarkı Söyleme Uygulamaları. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *17*(4), 1683–1701. https://doi.org/10.17240/aibuefd.2017.17.32772-363960

Booth, J. N., Tomporowski, P. D., Boyle, J. M., Ness, A. R., Joinson, C., Leary, S. D.,& Reilly, J. J. (2013). Associations between executive attention and objectively measured physical activity in adolescence: Findings from ALSPAC, a UK cohort. *Mental Health and Physical Activity*, *6*(3), 212-219. https://doi.org/10.1016/j.mhpa.2013.09.002

Brickenkamp, R., & Seisdedos Cubero, N. (2012). *D2: Test de atención: manual* (4ª ed. revisada). Madrid: TEA.

Budde, H., Voelcker-Rehage, C., Pietraßyk-Kendziorra, S., Ribeiro, P., & Tidow, G. (2008). Acute coordinative exercise improves attentional performance in adolescents. *Neuroscience Letters*, *441*, 219-223. https://doi.org/10.1016/j.neulet.2008.06.024

Cádenas-Sanchez, C., Vanhelst, J., Ruiz, J. R., Castillo-Gualda, R., Libuda, L., Labayen, I., & Moreno, L. A. (2017). Fitness and fatness in relation with attention capacity in European adolescents: The HELENA study. *Journal of Science and Medicine in Sport*, *20*(4), 373-379. https://doi.org/10.1016/j.jsams.2016.08.003

Carretero-Martínez, A., Romero-Naranjo, F. J, Pons-Terres, J. M, & Crespo-Colomino, N. (2014). Cognitive, visual-Spatial and psychomotor development in students of primary educa-tion through the body percussion - BAPNE method. *Procedia – Social and Behavioral Sciences*, *152*(October 7, 2014), 1282-1287. https://doi.org/10.1016/j.sbspro.2014.09.363

Carpio Lozada , B. (2020). Desarrollo de la atención selectiva a través del juego en estudiantes de educación superior [Development of selective attention through play in higher education students]. *Comuni@cción: Revista de Investigación en Comunicación y Desarrollo*, *11*(2), 131–141. https://doi.org/10.33595/2226-1478.11.2.425

Castelló Juan, B., Antón Suay, M. T., Flores Morales, N., Vicedo Reche, M., & Romero Naranjo, F. J. (2019). Evaluating Executive Functions in Primary School Children in Alicante Using Body Percussion. *European Proceedings of Social & Behavioural Sciences*, *70*, 559-566. https://doi.org/10.15405/epsbs.2019.04.02.70

Cohen, J, (1988). *Statistical Power Analysis for the Behavioral Sciences*. (2nd ed.), New Jersey: Lawrence Erlbaum Associates.

Cohen, J. (1992). Cosas que he aprendido (Hasta ahora). *Anales de Psicología / Annals of Psychology*, *8*(1-2), 3–17.

Cozzutti, G., Guaran, F., Blessano, E., & Romero Naranjo, F. J. (2017). Effects on Executive Functions in the BAPNE Method; A Study on 8-9 Years Old Children in Friuli Venezia Giulia, Italy. *Procedia-Social and Behavioral Sciences, 237*, 900-907. https://doi.org/10.1016/j.sbspro.2017.02.126

Crespo Colomino, N., Alonso Sanz, A., Romero Naranjo, F. J., Moreno Cebrián, C., Pozzo, T., Andreu Guerrero, R., Liendo Cárdenas, A., & Romero Naranjo, A. A. (2015). ¿Para qué sirve la percusión corporal - método bapne? In Raimundo A. R. P, & María Begoña, A. G. (Eds.). *Innovación y enseñanza en educación primaria* (1st ed., pp. 215-228). Editum.

Crespo-Colomino, N., Romero-Naranjo, F. J., Pons Terres, J. M., Carretero-Esteve, A., & Perez-Bravo, E. (2014). Perceived sensations related to the state of flowing factors produced during the performance of cognitive stimulation: Exercises through the didactics of the body percussion BAPNE method. *Erpa International Congress on Education (Erpa Congress 2014), 152*, 1201-1206. https://10.1016/j.sbspro.2014.09.299

Cuevas Romero, S. (2015). La trascendencia de la educación musical de principios del siglo xx en la enseñanza actual. *Magister: Revista Miscelánea de Investigación*, *27*(1), 37-43. doi: 10.1016/j.magis.2015.05.002

Díaz Pérez, A. (2016). *Trastorno del desarrollo de la coordinación: Programa de intervención a través de la música, la danza y la percusión corporal (método BAPNE)* [Tesis Doctoral. Universidad de Murica]. DIGITUM.

Di Russo, S., & Romero-Naranjo, F. J. (2023). Body percussion and traditional dances. The case of Ball dels Moretons in Mallorca. *Retos*, *49*, 442–458. https://doi.org/10.47197/retos.v49.97609

Domínguez-González, F., Moral-Campillo, L., Reigal-Garrido, R. E., y Hernández-Mendo, A. (2018). Condición física y atención selectiva en una muestra preadolescente. *Cuadernos de Psicología del Deporte*, *18*(2), 33-42.

Ekerer, C., Gonca, I. N. C. E., & Över, M. F. (2021). Sekiz haftalık yapılandırılmış Brain Gym aktivite programının üniversite öğrencilerinin seçici dikkat, inhibitör kontrol ve bilişsel esneklik üzerine etkisi. *Cukurova Medical Journal*, *46*(2), 814-824. https://doi.org/10.17826/cumj.871110

Erdfelder, E., Faul, F. & Buchner, A. (1996). GPOWER: A general power analysis program. *Behavior Research Methods, Instruments, & Computers* 28, 1–11. https://doi.org/10.3758/BF03203630

Fabra-Brell, E., & Romero-Naranjo, F. J. (2017). Social competence between equals through body percussion according to method BAPNE in secondary students. *Procedia-Social and Behavioral Sciences*, *237*(February 21, 2017), 829-836. https://doi.org/10.1016/j.sbspro.2017.02.179

Faul, F., Erdfelder, E., Lang, AG. *et al.* (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods* 39, 175–191. https://doi.org/10.3758/BF03193146

Fernández-Castillo, A., & Caurcel, M. J. (2015). State test-anxiety, selective attention and concentration in university students. *International Journal of Psychology*, *50*(4), 265-271. https://doi.org/10.1002/ijop.12092

Flores Ferro, E., Maureira Cid, F., Díaz Muñoz, H., Navarro Aburto, B., Gavotto Nogales, O., & Matheu Pérez, A. (2019). Efectos de una sesión de ejercicio físico sobre la actividad neurofisiológica durante la resolución de una prueba de atención selectiva. *Retos*, *36*, 391–397. https://doi.org/10.47197/retos.v36i36.68960

Gelabert, J., Sánchez-Azaña, V., Palou, P., & Muntaner-Mas, A. (2023). Efectos agudos de los descansos activos sobre la atención selectiva en escolares. *Revista de Psicología del Deporte/Journal of Sport Psychology*, *32*(2), 277–286.

González Gómez, C., Veas Iniesta, A., Fernández Carrasco, F., Jover Mira, I., Navarro Soriai, I., Alejandro Priore, A., González Armario, M. M., & García Muñoz, D. (2018). Los procesos cognitivos de autorregulación clave para la mejora de la calidad en los diferentes aprendizajes en el ámbito universitario: la atención ejecutiva. Una experiencia en el aula. In Rosabel, R. V. (Coord.) *Memorias del Programa de Redes-I3CE de calidad, innovación e investigación en docencia universitaria: Convocatoria 2017-18* (pp. 847-864). Instituto de Ciencias de la Educación.

González Sánchez, O. S., Romeu López, C. E., & Romero-Na-ranjo, F. J (2019). Pilot study of executive functions in el-derly adults in care homes. *The European Proceedings of Social & Behavioural Sciences EpSBS*, *60*, Article 95. https://dx.doi.org/10.15405/epsbs.2019.04.02.95

Gutiérrez-Hernández, D. A., Gómez Díaz, M. S., García-Quezada, M. I., Olivares-Vera, D. A., & Díaz-Rodríguez, M. (2021). Comparison of Test D2 with Electroencephalographic Signals to Measure Attention and Concentration in University Students. In Teresa, G., Filipe, P., & Manuel Filipe, S. (Eds.). *International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability* (pp. 547-558). Cham: Springer International Publishing.

Holgado Morlans, B., & Alonso Díaz, L. (2015). Evaluación de un programa psicopedagógico para la mejora de la atención en estudiantes de educación primaria. *Revista Española de Orientación y Psicopedagogía*, *26*(2), 26-44.

Latre-Nava, S., Martínez-Fernández, X., Rodríguez-Masafrets, A., Puigdevall-Cayuela, A., Torre, G., Finestres-Alverola, J., & Romero-Naranjo, F. J (2019). Cognitive stimulation in adolescents at risk of exclusion using the BAPNE® method. *The European Proceedings of Social & Behavioural Sciences EpSBS,60*, Article 62. https://dx.doi.org/10.15405/epsbs.2019.04.02.62

Lobach, Y., Romero Ramos, O. ., López Ceballos, C. E., Romero-Ramos, N., González Suárez, A. J., & Niźnikowski, T. (2023). Descansos activos mediante la danza: una experiencia en alumnos universitarios [Brain breaks through dance: an experience with university students]. *Retos*, *51*, 683–689.

López-Martín, E., & Ardura-Martínez, D. (2023). El tamaño del efecto en la publicación científica [Effect size in scientific publishing]. *Educación XX1*, *26*(1), 9-17. https://doi.org/10.5944/educxx1.36276

Lozano-Cango, C. O., & Bravo-Navarro, W. H. (2021). Procesos atencionales en árbitros profesionales de fútbol. *Revista Arbitrada Interdisciplinaria Koinonía*, *6*(2), 415-431. http://dx.doi.org/10.35381/r.k.v6i2.1246

Merritt, P., Hirshman, E., Wharton, W., Stangl, B., Devlin, J., & Lenz, A. (2007). Evidence for gender differences in visual selective attention. *Personality and individual differences*, *43*(3), 597-609. https://doi.org/10.1016/j.paid.2007.01.016

Montoya Rubio, J. C. (2017). El recorrido de las metodologías de principios del siglo xx en la enseñanza de la música en España: Aproximación bibliográfica e interpretativa. *Anuario Musical*, (72), 219-232. doi: 10.3989/anuariomusical.2017.72.10

Moral Bofill, L., Vicedo Molla, F., & Romero Naranjo, F. J. (2020). Estudio piloto de variables socio-Emocionales, ansie-dad y flow en alumnos de grado profesional de música me-diante actividades BAPNE [Pilot study of socio-Emotional variables, anxiety and flow in music students through BAPNE activities]. *Educatio Siglo XXI, 38*(2), 193-212. https://doi.org/10.6018/educatio.432971

Moral Campillo, L. (2022). Actividad física, condición física, funcionamiento cognitivo y psicosocial en preadolescentes y adolescentes. [Doctoral Theses. Universidad de Málaga]. Riuma.

Moral-Campillo, L., Reigal-Garrido, R.E., y Hernández-Mendo, A. (2020). Actividad física, funcionamiento cognitivo y psicosocial en una muestra preadolescente. *Revista de Psicología del Deporte*, *29*, 123-132.

Morente Oria, H. (2019). Mejora de la atención post-ejercicio en escolares deportistas. *Journal of Physical Education and Human Movement*, *1*(1), 63–69. https://doi.org/10.24310/JPEHMjpehm.v1i1.5563

Navarro-Maciá, V., & Romero Naranjo, F. J. (2024a). Jazz y percusión corporal. Propuesta de estrategias creativas con el método BAPNE (Jazz and body percussion. A proposal of creative strategies with the BAPNE method). *Retos*, *51*, 509–518. https://doi.org/10.47197/retos.v51.100544

Navarro-Maciá, V., & Romero Naranjo, F. J. (2024b). Percusión corporal y blues. Un acercamiento neuromotor a través del método BAPNE (Body percussion and blues. A neuromotor approach through BAPNE method). *Retos*, *51*, 970–978. https://doi.org/10.47197/retos.v51.101238

Okada, K. (2013). Is omega squared less biased? A comparison of three major effect size indices in one-way ANOVA. *Behaviormetrika*, *40*(2), 129-147. https://doi.org/10.2333/bhmk.40.129

Pacheco Sosa, C., & Flores Olvera, D. M. . (2021). Self- Regulation Learning Diagnosis through Technologies applied to University Students. *EDUTECH REVIEW. International Education Technologies Review / Revista Internacional de Tecnologías Educativas*, *7*(2), 139–149. https://doi.org/10.37467/gka-revedutech.v7.2578

Páez-Maldonado, J. A., Reigal, R. E., Morillo-Baro, J. P., Carrasco-Beltrán, H., Hernández-Mendo, A., & Morales-Sánchez, V. (2020). Physical Fitness, Selective Attention and Academic Performance in a Pre-Adolescent Sample. International Journal of Environmental Research and Public Health, 17, 6216. https://doi.org/10.3390/ijerph17176216

Pawlowski, J. (2017). Atención sostenida en adultos universitarios: Evidencia de validez de constructo del Test d2. *PsicoInnova*, *1*(2), 1-17. https://doi.org/10.54376/psicoinnova.v1i2.7

Pawlowski, J. (2020). Test de Atención d2: Consistencia interna, estabilidad temporal y evidencias de validez. *Revista Costarricense de Psicología*, *39*(2), 145-165. http://dx.doi.org/10.22544/rcps.v39i02.02

Pérez-Lobato, R., Reigal, R.E., & Hernández-Mendo, A. (2016). Relaciones entre la práctica física, condición física y atención en una muestra adolescente. *Revista de Psicología del Deporte*, *25*(1), 179-186.

Piqueres Juan, I., Sánchez González, E., Serna Domínguez, M., Trives Martínez, E. A., García Sala, M., & Romero-Naranjo, F. J. (2018). Aproximación a la justificación de la atención selectiva a través de la percusión corporal-Método BAPNE. In C. Guerrero Romera, & P. Miralles Martínez (Eds.), *Innovación y modelos de enseñanza-Aprendizaje en la educación superior* (pp.141-152). Edit.um. https://doi.org/10.6018/editum.2679

Piqueres-Juan, I., Sarmiento-Alienes, S., Sánchez-González, E., & Romero-Naranjo, F. J. (2019). Pilot study into sustained and selective attention using the BAPNE method. *The European Proceedings of Social & Behavioural Sciences*, *60*(93), 751-759. https://doi.org/10.15405/epsbs.2019.04.02.93

Polevoy, G. (2020). Development of a sense of rhythm in children 8-9 years old with the help of exercise 'Classic's'. *Sri Lanka Journal of Child Health*, *49*(2), 140-144. http://dx.doi.org/10.4038/sljch.v49i2.8961

Pons-Terres, J. M., Romero-Naranjo, F. J., Carretero-Martinez, A., & Crespo-Colomino, N. (2014). Perceptions towards wellness and life quality through body percussion - BAPNE method and cognitive stimulation in elderly people. *Erpa International Congress on Education (Erpa Congress 2014), 152*, 1108-1113. https://10.1016/j.sbspro.2014.09.283

Portellano Pérez, J. A., & García Alba, J. (2014). *Neuorpsicología de la atención, las funciones ejecutivas y la memoria*. Vallehermoso, Madrid, España: Editorial Síntesis S.A.

Prado Rivera, M. A., Sierra Ramírez, A. A., Martínez Díaz, L. V., & Morris Camacho, J. V. (2017). Conservación de la atención a pesar de la privación de sueño en estudiantes de Psicología. *Revista de Psicología Universidad de Antioquia*, 9(1), 31-42. https://doi.org/10.17533/udea.rpsua.v9n1a0

Reigal R.E., Moral-Campillo L., Juárez-Ruiz de Mier R., Morillo-Baro J.P., Morales-Sánchez, V., Pastrana, J.L., & Hernández-Mendo, A. (2020) Physical Fitness level is related to attention and concentration in adolescents. *Frontiers in Psychology* ,*11*, article 110. https://doi.org/10.3389/fpsyg.2020.00110

Reigal, R.E., Moral-Campillo, L., Morillo-Baro, J.P., Juárez-Ruiz de Mier, R., Hernández-Mendo, A., y Morales-Sánchez, V. (2020). Physical Exercise, Fitness, Cognitive Functioning, and Psychosocial Variables in an Adolescent Sample. International Journal of Environmental Research and Public Health, 17, 1100. http://doi.org/10.3390/ijerph17031100

Reloba-Martínez, S., Reigal-Garrido, R. E., Hernández-Mendo, A., Martínez-López, E. J., Martín-Tamayo, I., & Chirosa-Ríos, L. J. (2017). Efectos del ejercicio físico extracurricular vigoroso sobre la atención de escolares. *Revista de Psicologia Del Deporte*, *26*(2), 29–36.

Rodriguez-Garcia, L., de la Cruz-Campos, J.-C., Martin-Moya, R., & Gonzalez-Fernandez, F.-T. (2022). Active Teaching Methodologies Improve Cognitive Performance and Attention-Concentration in University Students. *Education Sciences*, *12*(8). https://doi.org/10.3390/educsci12080544

Romero-Naranjo, F. J. (2013). Science & art of body percussion: A review. *Journal of Human Sport & Exercise, 8*(2), 442-457. https://doi.org/10.4100/jhse.2012.82.11

Romero-Naranjo, F. J. (2014). Body percussion and memory for elderly people through the BAPNE method. *6th International Conference on Intercultural Education "Education and Health: From a Transcultural Perspective", 132*, 533-537. https://10.1016/j.sbspro.2014.04.349

Romero-Naranjo, F. J. (2018a). *Bodypercussion: Programación didáctica. Volumen 1.* (28th ed.). Alicante: Ramón Torres Gosálvez.

Romero-Naranjo, F. J. (2018b). *Bodypercussion: Programación didáctica. Volumen 2.* (28th ed.). Alicante: Ramón Torres Gosálvez.

Romero-Naranjo, F. J. (2019a). *Africa for children: Neuromotricity and executive functions. 2-99 años* (1st ed.). Barcelona: Body music-Body Percussion Press.

Romero-Naranjo, F. J. (2020). Percusión corporal y "Solfeo cognitivo". Recursos pedagógicos según el método BAPNE [Body percussion and "Cognitive solfeggio". Pedagogical resources according to the BAPNE method]. *Pensamiento Actual*, *20*(35), 105-121. https://doi.org/10.15517/PA.V20I35.44398

Romero-Naranjo, F. J. (2022). Visuomotor skills and neuromotricity in the BAPNE method. Real-Time signaling as a learning resource. In M. A. de la Ossa Martínez (Ed.). *La educación y formación musical en el siglo XXI. ¿Somos competentes para el enfoque competencial?* (pp. 303-325). Silex Ediciones.

Romero-Naranjo, F. J., & Andreu-Cabrera, E. (2023a). Condición física y Neuromotricidad. Justificación teórico-práctica según el método BAPNE [Physical condition and neuromotricity. Theoretical-practical justification according to the BAPNE method]. *Retos*, *50*, 215–227. https://doi.org/10.47197/retos.v50.98712

Romero-Naranjo, F. J., & Andreu Cabrera, E. (2023b). Los Diez Pilares de la Neuromotricidad. Justificación teórico-práctica según el método BAPNE [The ten pillars of neuromotricity. Theoretical-practical justification according to the BAPNE method]. *Retos*, *50*, 357–370. https://doi.org/10.47197/retos.v50.98333

Romero-Naranjo, F. J., & Andreu Cabrera, E. (2023c). Neuromotricidad como recurso interdisciplinar. Justificación teórico-práctica a través del método BAPNE [Neuromotricity as an interdisciplinary resource. Theoretical-practical justification through the BAPNE method]. *Retos*, *49*, 350–364. https://doi.org/10.47197/retos.v49.98903

Romero-Naranjo, F.J., & Andreu-Cabrera, E. (2023d). Neuromotricity as a new paradigm. *Journal of Human Sport & Exercise*, *18*(1). https://doi.org/10.14198/jhse.2023.181.16

Romero-Naranjo, F. J., Andreu-Cabrera, E., & Arnau-Mollá, A. F. (2022). Neuromotricidad y esquema corporal. Bases para el uso de la percusión corporal en las ciencias de la educación física y el deporte [Neuromotricity and body schema. Bases for the use of body percussion in the sciences of physical education and sport]. *Retos*, *47*, 615–627. https://doi.org/10.47197/retos.v47.95922

Romero-Naranjo, F. J., Arnau-Mollá, A. F., & Andreu-Cabrera, E. (2023). Strategies for ending a session in the BAPNE method: The closing rite. In A. Martos Martínez, M. M. Simón Márquez, J. J. Gázquez Linares, P. Molina Moreno, & S. Fernández Gea (Comps.), Innovación Docente e Investigación en Educación: Nuevas Tendencias Para el Cambio en la Enseñanza Superior (pp. 901-913). Dykinson, S.L.

Romero-Naranjo, F. J, Crespo-Colomino, N., Liendo-Cardenas, A., Maria Pons-Terres, J., & Carretero-Martinez, A. (2014). Drugs and body percussion: Rehabilitation therapy using the BAPNE method. *Erpa International Congress on Education (Erpa Congress 2014), 152*, 1128-1132. https://10.1016/j.sbspro.2014.09.287

Romero-Naranjo, F. J., & Llorca-Garnero, J. (2023). Ergospirometry & body percussion. Case study based on BAPNE FIT method. *Retos*, *48*, 674–683. https://doi.org/10.47197/retos.v48.97928

Romero-Naranjo, F. J., Pujalte Cantó, F. J., & Arnau-Mollá, A. F. (2023). Body percussion and selective attention. Interdisciplinary quantitative study through neuromotricity activities BAPNE method based on the dual task in Primary Education. *Retos*, *48*, 844–860. https://doi.org/10.47197/retos.v48.97661

Romero-Naranjo, F. J., Sayago-Martínez, R., Jiménez-Molina, J. B., & Arnau-Mollá, A. F. (2023). Pilot Study of the Assessment of Anxiety and Attention through Body Percussion and Neuromotricity in Secondary School Students in Physical Education, Music and Visual Arts classes. *Retos*, *47*, 573–588. https://doi.org/10.47197/retos.v47.95595

Ros-Silla, E., Valcarcel-Marsa, S., Jaikel-Arce, D., Berlai, S., Giglio, R., Payro-Escobar, A., & Romero-Naranjo, F. J. (2019). Attention in conservatoire students using body percussion following the BAPNE method. *The European Proceedings of Social & Behavioural Sciences EpSBS*, *60*, Article 57. https://doi.org/10.15405/epsbs.2019.04.02.57

Rosa Guillamón, A., Garcia Canto, E., & Carrillo López, P. J. (2019). Relación entre capacidad aeróbica y el nivel de atención en escolares de primaria. *Retos*, *35*, 36–41. https://doi.org/10.47197/retos.v0i35.60729

Ruiz-Ariza, A., López-Serrano, S., Mezcua-Hidalgo, A., Martínez-López, E. J., & Abu-Helaiel, K. (2021). Efecto agudo de descansos físicamente activos en variables cognitivas y creatividad en Educación Secundaria. *Retos*, *39*, 635–642. https://doi.org/10.47197/retos.v0i39.78591

Sayago-Martínez, R., Salerno, G., Di Russo, S., Arnau-Mollá, A., & Romero-Naranjo, F. J. (2021, June 03-05). *Socioemotional aspects of music-Motor activitiees according to the BAPNE method* (Written submission). ERPA 2021 International Congresses on Education, Sakarya, Turkiye.

Shih-Chun K., Drollette, E. S., Scudder, M. R., Raine, L. B., Westfall, D. R., Pontifex, M. B., & Hillman, C. (2017). Aerobic fitness is associated with cognitive control strategy in preadolescent children. *Journal of Motor Behaviour*, *49*(2), 150–162. https://doi.org/10.1080/00222895.2016.1161594

Shih-Chun K., Baumgartner N. W., Pritt T, Wu S., Schmitt, S. Ulrich-French, S., & Chun-Hao W. (2023). Acute effects of mindful interval exercise on cognitive performance in a higher education setting. *Psychol Sport Exerc*, 64, Article 102326, 1-8. https://doi.org/10.1016/j.psychsport.2022.102326

Sohlberg, M. M., & Mateer, C. A. (1987). Effectiveness of an attention-training program. *Journal of Clinical and Experimental Neuropsychology, 9*(2), 117–130. https://doi.org/10.1080/01688638708405352

Sohlberg, M. M. y Mateer, C. A. (1989). Theory and remediation of attention disorders. In M. M. Sohlberg y C. A. Mateer (Eds). *Introduction to Cognitive Rehabilitation* (pp. 110-135). Nueva York: Guildford Press.

Suárez-Manzano, S., López-Serrano, S., Abu-Helaiel Jadallah, K., & Yela Pantoja, L. Y. (2021). Efecto crónico del C-HIIT sobre la calidad del sueño y atención selectiva en jóvenes TDAH (Chronic effect of C-HIIT on the quality of sleep and selective attention in young ADHD). *Retos*, *41*, 199–208. https://doi.org/10.47197/retos.v0i41.83189

Suárez-Manzano, S., Solas-Martínez, J. L., Loureiro, V., & Rusillo-Magdaleno, A. (2024). La práctica de actividad física se asocia con mejor cálculo matemático, razonamiento lingüístico, com-portamiento y atención en chicas TDAH. *Retos*, *51*, 1388–1394. https://doi.org/10.47197/retos.v51.101337

Sutela, K., Juntunen, M., & Ojala, J. (2020). Applying music-And-Movement to promote agency development in music education: A case study in a special school. *British Journal of Music Education, 37*(1), 71-85. https://doi.org/10.1017/S0265051719000184

Sutela, K., Ojala, J., & Kielinen, M. (2021). Developing agency through music and movement. *Research Studies in Music Education, 43*(2), 195-211. https://doi.org/10.1177/1321103X20934084

Tirapu-Ustárroz, J., & Luna-Lario, P. (2008). Neuropsicología de las funciones ejecutivas. *Manual de neuropsicología*, *2*, 219-59.

Toksoy, A. C., & Başar, Ş. (2017). 6-12 Yaş Orta-Ağır Zihin-sel Yetersizliği Olan Çocuklar İçin Ritim Uygulamaları. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *17*(1), 384–399. https://doi.org/10.17240/aibuefd.2017.17.28551-304642

Torró-Biosca, R., Aparici-Mínguez, F., Arnau-Mollá, A. F., Ulate-Orozco, R. M., Cabrera-Quirós, D. A., & Romero-Naranjo, F. J. (2019). Pilot study into the executive functions of children aged 8-9 BAPNE method. *The European Proceedings of Social & Behavioural Sciences EpSBS*, *60*, Article 94. https://dx.doi.org/10.15405/epsbs.2019.04.02.94

Trives-Martínez, E. A., Romero-Naranjo, F. J., Pons-Terrés, J. M., Romero-Naranjo, A. A., Crespo-Colomino, N., Liendo-Cárdenas, A., Jauset-Berrocal, J. A., Quarello, A., Pezzutto, E., & Tripovic, Y. (2014). Los métodos didáctico musicales y la atención en relación al movimiento. In M. T., Tortosa Ybáñez; J. D., Álvarez Teruel, & N. Pellín Buades (Coords.), *XII Jornadas de Redes de Investigación en Docencia*

Universitaria. El reconocimiento docente: innovar e investigar con criterios de calidad (pp. 1066-1079). Alicante: Universidad de Alicante.

Trives Martínez, E. A., Romero Naranjo, F. J., Serna Domínguez, M., Sánchez González, E., Piqueres de Juan, I., & García Sala, M. (2018). Aproximación al estudio de los precursores del movimiento y la percusión corporal en educación. In P. Miralles Martínez & C. Guerrero Romera (Eds.), *Metodologías Docentes Innovadoras en la Enseñanza Universitaria*, (pp. 355-367). Murcia: Edit.um.

Trives-Martínez, E. A., & Vicente-Nicolás, G. (2013). La percusión corporal y los métodos didácticos musicales. In M. T., Tortosa Ybáñez; J. D., Álvarez Teruel, & N. Pellín Buades (Coords.), *XI Jornadas de Redes de Investigación en Docencia Universitaria. Retos de futuro en la enseñanza superior: docencia e investigación para alcanzar la excelencia académica* (pp. 1748-1759). Alicante: Universidad de Alicante.

Trudeau, F., & Shephard, R. J. (2008). Physical education, school physical activity, school sports and academic performance. *International Journal of Behavioral Nutrition and Physical Activity*, *5*, 10. https://doi.org/10.1186/1479-5868-5-10

Vanhelst, J., Béghin, L., Duhamel, A., Manios, Y., Molnar, D., De Henauw, S., & Gottrand, F. (2016). Physical activity is associated with attention capacity in adolescents. The Journal of Pediatrics, 168, 126-131. https://doi.org/10.1016/j.jpeds.2015.09.029

Ventura-León, J. L. (2019). Tamaño del efecto para Kruskal-Wallis: aportes al artículo de Domínguez-González et al. *Investigación en educación médica*, *8*(30), 135-136. https://doi.org/10.1016/j.riem.2017.07.002

Verret, C., Guay, M. C., Berthiaume, C., Gardiner, P., & Béliveau, L. (2012). A physical activity program improves behavior and cognitive functions in children with ADHD: an exploratory study. Journal of Attention Disorders, 16(1), 71-80. https://doi.org/10.1177/1087054710379735

Vinicio Diaz, T. D., Guamán Freire, M. R., & Basantes Paredes, A. C. (2023). Niveles de iluminación nocturna: Atención selectiva en estudiantes de educación superior [Night-time illumination levels: Selective attention in higher education students]. *Revista Ibérica de Sistemas e Tecnologias de Informação*, (E56), 142-154.

Vazou, S., Klesel, B., Lakes, K. D. y Smiley, A. (2020). Rhythmic physical activity intervention: exploring feasibility and effectiveness in improving motor and executive function skills in children. *Frontiers in Psychology*, *11*, 556249. https://doi.org/10.3389/fpsyg.2020.556249

Westfall, D. R., Gejl, A. K., Tarp, J., Wedderkopp, N., Kramer, A. F., Hillman,C.H., & Bugge, A. (2018). Associations between aerobic fitness and cognitive control in adolescents. Frontiers in Psychology, 9, 1298. https://doi.org/10.3389/fpsyg.2018.01298