DOCTORAL THESIS

Effects of instructional models in physical education for integral development in elementary education students

Universidad del País Vasco
Euskal Herriko Unibertsitatea

JOSUNE RODRIGUEZ NEGRO

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DOCTORAL PROGRAMME IN PHYSICAL ACTIVITY AND SPORT

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Amari, dena emateagatik trukean ezer espero gabe,

Amamari, ahaleginaren balioa irakasteagatik,

Ayoyori, egon ez arren, ni gidatzeagatik

Lagunei, beti prest egoteagatik.

ESKER ONAK

En la suma de agradecimientos que se detallan en este capítulo, se atisba la historia de una amante de la educación que, en su afán por superarse, intenta día tras día dar continuidad a su formación académica, científica y personal. A lo largo de esta investigación he contado con el apoyo de muchas personas, a las que debo mi gratitud, puesto que no me cabe duda de que, sin la orientación, ejemplo y apoyo de muchos, no hubiera llegado hasta aquí. No puedo empezar de otra forma que no sea dando las gracias a **Javier Yanci,** director de esta tesis doctoral, por ayudarme y por creer en mi. Quiero agradecer no solo la cantidad de tu ayuda, sino también la calidad de esta. Tus comentarios y consejos en este camino han sido acertados, críticos, cariñosos y geniales como solo tu sabes serlo. No solo eres culpable de que este trabajo haya visto la luz, sino también de la profesional que soy hoy en día. Siempre ha sido, es y será un lujo trabajar contigo: de verdad, gracias.

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En tercer lugar, debo agradecer de manera especial y sincera a mi **familia y amigos**. Estaré siempre agradecida a mi ama, por educarme como persona y brindarme la oportunidad de ser libre en cuanto al camino de mi formación académica. Gracias por ser un ejemplo de lucha y superación, y por desear siempre lo mejor para mi. Y sobre todo gracias por el amor y la dedicación recibida. A mi amama y a mi ayoyo, por hacerme crecer como persona con las importantísimas lecciones de vida que me habéis dado y que jamás olvidaré; gracias por vuestra inmensa colaboración forjando mi personalidad. Y gracias también a mis amigos por ese soporte incondicional que siempre me han dado para poder hacer lo que me ilusionaba sin

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DEKLARAZIOA

Doktorego tesi honen autoreak, Josune Rodríguez Negro, lanaren diseinutik hasita publikazioen azken momentura arte parte hartu du eta, nola ez, tesi hau idatzi du. Bide honetan, lana diseinatu behar izan du, bibliografiaren azterketa egin du, gorputz hezkuntzako saioetan datuak jaso ditu, datu hauen analisia egin du, emaitzen interpretazio sakona egin du eta eztabaida egokia egiten saiatu da. Bestalde, artikuluak aldizkarietan publikatu ahal izateko egin behar den prozesuaren arduraduna izan da. Hala ere, lan hau ezin izango zen Javier Yanci Irigoyen tutorearen gidaritza gabe aurrera eraman, lan osoan zehar lagundu duelako pausuz pausu, lan hau hasi zenetik amaitu den momentura arte.

Honetaz gain, ikerketa hau Eusko Jaurlaritzako doktorego aurreko bekaren laguntzaz burutu da (erreferentzia zenbakia: PRE_2016_1_0171, PRE_2017_2_0279 eta PRE_2018_2_0132) eta Euskal Herriko Unibertsitateak (UPV/EHU) eskainitako zerbitzuekin. Bestalde, ikerketa hau burutzeko orduan ez da inongo interesen gatazkarik egon eta doktorego aurreko bekaren finantzaketak ikerketaren emaitzetan ez du inolako eraginik izan.

IRAKURKETARAKO AHOLKUAK

Esku artean daukazuen doktorego tesia artikulu bilduma formatuaren bidez egin da. Edukien ildoa jarraitzeko gomendagarria da sarrerako kapitulutik hastea. Bertan, doktorego tesiaren artikuluetan landutako gaiei buruzko marko teorikoa azaltzen da. Bigarren kapituluak ikerketa helburuei pasu emango dio, eta helburuei erantzuna eman nahian, hurrengo kapituluetan (hirugarren kapitulutik zazpigarren kapitulura) aldizkari edota editorial internazionaletan argitaratutako bost artikulu aurkeztuko dira. Konkretuki, hirugarren kapituluan lehenengo artikulua aukezten da "*Motor skills differences by gender in early elementary education students*" titulupean. Bertan 6 eta 8 urte arteko Lehen Hezkuntzako umeen oreka, objektuak harrapatzeko gaitasuna, punteria eta norabidea aldatzeko gaitasuna aztertzen dira, eta gaitasun motor hauen arteko erlazioa zehazten da. Lehen Hezkuntzako etapako gaitasun motorren ikuspegi orokorra lortzeko, bigarren artikuluaren titulua "*Motor skills differences by gender in 9-to 11-year-old elementary education students*" da. Artikulu horretan, 9 eta 11 urte arteko Lehen Hezkuntzako umeen oreka, objektuak harrapatzeko gaitasuna, punteria eta norabidea aldatzeko gaitasuna aztertzen dira. Hirugarren artikuluaren titulua, "*Effects of different balance interventions for primary school students*" da. Kasu honetan, ordea, bi esku-hartzeek (instrukzio zuzeneko eredua (DIM) eta jolas taktikoen eredua (TGM)) duten eragina aztertzen da, konkretuki Lehen Hezkuntzako ikasleen oreka estatiko eta dinamikoan. Bide beretik jarraitzen du laugarren artikuluak, bere titulua "*Which instructional models influence more on perceived exertion, affective valence, physical activity level and class time in physical education?*" dena. Kasu honetan, aldiz, helburua ezarritako bi esku-hartzeek ikasleen hautemandako esfortzuan, gogobetetasunean, jarduera fisikoaren mailan eta gorputz hezkuntzako saioetako denbora erabilgarrian duten eragina aztertzea da. Azken artikulua zazpigarren kapituluan aurkezten da, *"Effects of two different instructional models on creativity, attention and impulse control among primary school students"* titulupean. Bertan, esku-hartzeen eragina aztertzen da, Lehen Hezkuntzako ikasleen sormenean, arretan eta oldarkortasunaren kontrolean. Tesi honen azken zatian ondorio orokorrak, proposamen praktikoak, mugak eta etorkizuneko ikerketa lerroak aurkezten dira, hurrenez hurren.

Azkenik, hizkuntzari buruzko aipamen bat: tesia, funtsean, euskaraz aurkezten da baina barneratutako artikuluak nazioartekoak izanik, kapitulu batzuk ingelesez idatziak daude. Beraz, tesian zehar bi hizkuntza agertuko dira: euskara eta ingelesa. Gainera, esker onak gaztelaniaz idatzi dira, aipatutako pertsonek uler dezaten. Testuan aurkitzen diren artikuluen formatua bateratua izan da, hala ere, artikuluen azal originalak eskuragarri azaltzen dira eranskinetan.

Irakurketa errazteko asmoarekin, laburduren esanahiak beti eskura izango dira orrialde markatzailean.

LABURPENA

Doktorego tesi honen helburuak honakoak ziren: 1) sexuen arteko desberdintasunak aztertu orekan, objektuen kontrolean eta norabidea aldatzeko gaitasunean (CODA), eta 2) bi irakaskuntza metodologia Lehen Hezkuntzako ikasleen garapen integralean duten eragina aztertzea. Oreka (estatikoa eta dinamikoa), erantzun psikologikoak (hautemandako esfortzua eta gogobetetasuna), jarduera fisiko maila, heziketa fisikoko saioetako denbora erabilgarria eta funtzio kognitiboak (sormena, arreta eta oldarkortasuna) 380 ikasleetan (6-12 urte) aztertu ziren. Ikasleak banatu ziren hiru taldeetan: inolako esku-hartzerik gabeko kontrol taldea, instrukzio zuzeneko ereduaren (DIM) taldea eta jolas taktikoen ereduaren (TGM) taldea. Sexuen arteko desberdintasunetan, neskek mutilak baino oreka estatiko eta dinamiko hobea erakutsi zuten. Mutilek, ordea, neskek baino gaitasun hobea erakutsi zuten objektuak harrapatzeko trebestasunean, punterian eta CODAn. Bestalde, desberdintasunak igarri dira DIM eta TGMren artean orekan, hautemandako esfortzuan, jarduera fisiko mailan, heziketa fisikoko saioetako denbora erabilgarrian, sormenean eta arretan ($p < 0.01$, ES = -0.4tik 1.1ra). Doktorego tesi honetan lortutako emaitzek Lehen Hezkuntzako ikasleen gaitasun motorretan sexua eta adina faktore bereizgarriak izan daitezkeela adierazten dute, baita gorputz hezkuntzako saioetan erabilitako irakaskuntza metodologiak Lehen Hezkuntzako ikasleen garapen integralean eragina izan dezakeela.

LABURDURAK

BMI = Body Mass Index.

CEISH = Ethics Committee for Research related to Human Beings.

CG = Control Group.

CL = Confidence Limits.

CODA = Change of Direction Ability.

CV = Coefficient of Variation.

DIM = Direct Instructional Model.

ES = Effect Size.

FS = Feeling Scale.

G = Grade.

ICC = Intraclass Correlation Coefficient.

M = Mean.

OME = Osasunaren Mundu Erakundea

MABC-2 = Movement Assessment Battery for children – 2.

MAT = Modified Agility Test.

PA = Physical Activity.

PE = Physical Education.

RPE = Rating of Perceived Exertion.

SD = Standard Desviation.

SPSS = Statistical Package for Social Sciences.

TEM = Typical Error of Measurement.

TGM = Tactical Games Model.

UPV/EHU = University of the Basque Country.

WHO = World Health Organization.

AURKIBIDEA

LEHENENGO KAPITULUA

SARRERA

Education is much more than physical education, but very little without it.

Hammeleck

Lehenengo kapitulua. Sarrera

1.1.Hezkuntza sistema Euskal Autonomia Erkidegoan

Haur guztiek dute hezkuntza eta irakaskuntza jasotzeko eskubidea, haurrak eta nerabeak zaintzeko eta babesteko otsailaren 18ko 3/2005 Legeak dioen bezala. Oinarrizko hezkuntza derrigorrezkoa eta doakoa da eta pertsonaren garapen integralari laguntzen dio. Oinarrizko hezkuntza estatu mailan arautzen duen legea abenduraren 9ko, 8/2013, Hezkuntzaren kalitatea hobetzeko Lege Organikoa da (LOMCE, 2013). Hala ere, Euskal Autonomia Erkidegoko oinarrizko hezkuntza arautzen duen dekretu ofiziala dago ere, abenduaren 22ko Oinarrizko Hezkuntzaren curriculuma zehaztu eta Euskal Autonomia Erkidegoan ezartzen duena, 236/2015 Dekretua, baita Heziberri 2020 plana ere, euskal hezkuntza-sistema hobetzeko eta berariazko erronkei erantzuna emateko eratu zena. Oinarrizko hezkuntzaren helburua ikasleen gaitasunak dimentsio guztietan ahalik eta gehien garatzea da, eta bertan bizitza osorako oinarri sendoak ezartzen dira (236/2015 Dekretua).

Oinarrizko hezkuntza bi etapatan banatuta dago. Lehenengo sei urteek Lehen Hezkuntza osatzen dute, eta ondorengo lau urteek derrigorrezko bigarren hezkuntza (LOMCE, 2013). Normalean Lehen Hezkuntza 6 urtetik 12 urtera da, eta derrigorrezko bigarren hezkuntza 12 urtetik 16 urtera. Lehen Hezkuntzako maila bakoitzak gutxienez 875 ordu ditu urtean. Lehen Hezkuntza izaera globala eta ikaskuntza integratuak izan arren, jakintza-arlotan egituratuta dago; euskara eta literatura, gaztelania eta literatura, atzerriko lehen hizkuntza, matematika, naturaren zientziak, gizarte-zientziak, balio sozial eta zibikoak (edo erlijioa), arte-hezkuntza eta gorputz hezkuntza (236/2015 Dekretua).

1.2 Gorputz hezkuntza Lehen Hezkuntzaren barnean

Esan bezala, etapako jakintza-arloen artean, gorputz hezkuntza dago, ikasgai espezifikoa eta ez tronkala dena (LOMCE, 2013). Lehen Hezkuntzako ikastetxeetan dauden gorputz hezkuntzako orduak gutxiegi dira (Osasunaren Mundu Erakundea, OME, 2010), erreferentziako ordutegia astero 1,5-2 ordukoa da eta (236/2015 Dekretua). Eskolaren xede nagusia oinarrizko konpetentziak garatzea da, baina gorputz hezkuntzaren kasuan, zeharkako konpetentziez aparte, diziplina barruko konpetentzia motorra garatzen da ere. Konpetenzia motorra esparru motorreko egoerei aurre egitea modu autonomoan, kritikoan, sortzailean eta espresiboan datza (Heziberri, 2020). Bestalde, gorputz hezkuntzako Lehen Hezkuntzako etapako helburuak honako hauek dira: ahalmen motorrak eta hautemate-gaitasunak aztertzea, trebetasun fisikoak garatzea, arazo motorrak ebazteko printzipioak aplikatzea, kultura desberdinetako jolas-tradizioak eta kirolak ezagutzea, gorputzaren eta mugimenduaren adierazpen-bitartekoen berri izatea eta jarduera fisikoa egitea eta bere garrantzia aitortzea (Heziberri, 2020).

1.3. Gaitasun motorrak gorputz hezkuntzan

Oinarrizko gaitasun motorrak hiru taldetan sailkatu daitezke: oreka, manipulazio eta lokomozio gaitasunak (Gallahue & Cleland-Donnelly, 2007), eta gaitasun hauen garapena gorputz hezkuntzako helburu nagusietarikoa da (Mckenzie et al., 2002). Izan ere, gaitasun horiek haurtzaroan eskuratzea funtsezkoa da bizitza osoan zehar bizimodu aktiboa lortzeko (Fahimi, Aslankhani, Shojaee, Beni, & Gholhaki, 2013) eta osasun hobea izateko (Lopes, Maia, Rodriguez, & Malina, 2012). Halaber, gaitasun motorrak oso garrantzitsuak dira eguneroko praktikarako (MacNamara et al., 2011), aisialdirako (Goodway & Robinson, 2015) eta kirol modalitate desberdinetarako (Gabbard, 2011). Gaitasun motorren garapena garrantzitsua da haurren garapen fisiko, psikologiko, sozial eta akademiko egoki bat lortzeko ere (Iverson, 2010; Lubans, Morgan, Cliff, Barnett, & Okely, 2010; Westendorp, Hartman, Houwen, Smith, & Visscher, 2011).

Faktore batzuk, hala nola ikasleen adinak (Barnett et al., 2016) eta sexuak (Schedler, Kiss, & Muehlbauer, 2019), eragina dute ikasleen gaitasun motorretan. Sexuen araberako desberdintasunak igarri dira oreka test batzuetan, non neskak mutilak baino emaitza hobeak izaten dute (Engel-Yeger, Rosenblum, & Josman, 2010; Rodríguez-Negro & Yanci, 2019; Ruiz, Graupera, Gutiérrez, & Miyahara, 2003; Schedler, Kiss, & Muehlbauer, 2019). Sexuen arteko desberdintasunak nabaritu dira, mutilek emaitza hobeak eskuratuz objetuak kontrolatzeko trebetasunean (Bravo, Rodríguez-Negro & Yanci, 2017; Engel-Yeger, Rosenblum, & Josman, 2010; Ruiz, Graupera, Gutiérrez, & Miyahara, 2003) eta norabidea aldatzeko gaitasunean (CODA) (Meylan, Cronin, Oliver, & Rumpf, 2014; Yanci, Cámara, Vizcay, & Young, 2016). Adin bereko neska eta mutilen arteko desberdintasunak gaitasun motorretan garapen neuromuskularragatik (Eguchi & Takada, 2014), integrazio sentsorialagatik (Steindl, Kunz, Schrott-Fischer, & Scholtz, 2006) edo orekaren kasuan, kontrol posturalaren estrategiengatik (Smith, Ulmer, & Wong, 2012) izan daitezkeela aipatu da.

Hala ere, ikerketa batzuk ez dute desberdintasunik aurkitu nesken eta mutilen arteko orekaren garapenean (Butz, Sweeney, Roberts, & Rauh, 2015; Libardoni et al., 2017; Schedler, Kiss, & Muehlbauer, 2019), objektuak kontrolatzeko trebetasun batzuetan (Bravo, Rodríguez-

Negro, & Yanci, 2017; Logan, Robinson, Rudisill, Wadsworth, & Morera, 2014), eta CODAn (Yanci, Los Arcos, Castillo, & Camara, 2017). Hori dela eta, 6 eta 11 urte arteko ikasleen arteko desberdintasuna gaitasun motorretan oraindik eztabaidagarria da.

1.4. Gorputz hezkuntzaren rola ikasleen garapen integralean

Gorputz hezkuntzan gaitasun motorrak landu behar dira, Euskal Autonomia Erkidegoko kurrikulumeko bigarren eduki multzoan “norberaren ezagutza eta kontrola” agertzen den bezala (236/2015 Dekretua). Ikerketek erakusten dutenez, gorputz hezkuntzako saioetan Lehen Hezkuntzako umeen gaitasun motorrak garatzen dira (Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2015; Wälchli et al., 2017). Halaber, gorputz hezkuntzak umeen garapen integralari laguntzen dio, ikasleek aldi berean konpetentzia bat baino gehiago ikasten dutelako (Heziberri, 2020) eta erantzun psikologikoak eta funtzio kognitiboak hobetzen dituztelako (Kulinna et al., 2018; Vanhelst et al., 2016). Erantzun psikologikoen artean, hobekuntzak ikusi dira ahaleginaren pertzeptzioan (RPE) eta umeen gogobetetzean (Fairclough et al., 2016; Moore & Fry, 2017).

Bestalde, ikaskuntza-irakaskuntza prozesuan garapen motorra eta kognitiboa elkarrekin lantzea beharrezkoa da (236/2015 Dekretua), gorputz hezkuntzak efektu positiboak izan ditzakelako Lehen Hezkuntzako ikasleen funtzio kognitiboetan (Kulinna et al., 2018; Vanhelst et al., 2016). Konkretuki efektuak sormenean (Bollimbala, James, & Ganguli, 2019; Colzato, Szapora, Pannekoek, & Hommel, 2013), arretan (Gallotta et al., 2015; Kulinna et al., 2018) eta oldarkortasunaren kontrolean (Den Heijer et al., 2017) ditu, eta hauek ikaskuntzan eta errendimendu akademikoan dute eragina (Stevens & Bavelier, 2012). Gainera, esan dugun bezala, adin hauetako ikasle askok ez dituzte ariketa fisikoko gomendio minimonik betetzen (OME, 2010), eta gorputz hezkuntzako saioek lagundu dezakete asteko ariketa fisikoko maila handitzen (Harvey, Song, Baek, & Van der Mars, 2015). Beraz, kalitatezko gorputz hezkuntza ezinbestekoa da gaitasun motorrak hobetzeko, baita alderdi psikologikoak, kognitiboak eta osasunerako funtzioak hobetzeko ere.

1.5. Ikuspegi metodologikoa gorputz hezkuntzan

Goputz hezkuntza testuinguru aproposena da ume kopuru handi batekin esku-hartze bat gauzatzeko (Boddy, Fairclough, Atkinson, & Stratton, 2012) eta umeen garapen integralean eragin positiboa izateko (Fairclough et al., 2016; García et al., 2018). Kontuan hartzen badugu gorputz hezkuntako ordu kopurua ikastetxeetan eskasa dela eta askotan umeek gomendatutako ariketa fisiko kopuru minimoa ez dutela betetzen (OME, 2010), Lehen Hezkuntzarako irakaskuntza metodologia egokiena zein den ezagutzea beharrezkoa izan daiteke. Irakaskuntza metodologiak unitate didaktiko bakoitzean ikaskuntza emaitzak lortzea sustatzen duten plan integralak eta koherenteak dira. Gorputz hezkuntzako saioetan normalean zortzi irakaskuntza metodologia desberdin erabili izan ohi dira: instrukzio zuzena, sistema pertsonalizatutako eredua, ikaskuntza kooperatiboa, kirol hezkuntza, ikaskideekiko irakaskuntza, ikerketa eredua, jolas taktikoak eta erantzun pertsonal eta sozialerako irakaskuntza eredua (Metzler, 2011). Hauen artean, Lehen Hezkuntzako gorputz hezkuntzako saioetan bi dira nagusi: instrukzio zuzena (DIM) eta jolas taktikoen eredua (TGM) (Metzler, 2011).

DIM ereduan, normalean edukiak isolatuta irakasten dira, ariketa errepikakor eta indibidualen bitartez (Ishihara et al., 2017). Halaber, erabakiak hartzeko iturri nagusia irakasleak dira, eta ikasleek irakasleak egindako mugimenduak errepikatzen dituzte (Gurvitch & Metzler, 2010; Metzler, 2011). Nahiz eta DIMarekin epe laburreko hobekuntzak egoten diren (Porter et al., 2007), ikertzaileek gozamen falta aurkitu dute umeen artean metodologia hau erabiltzerakoan (Wall & Côt, 2007). Bestalde, TGM eredua dago, Lehen Hezkuntzako ikuspegi metodologikoarekin (jolas-izaerako metodologia) bat egiten duena (236/2015 Dekretua). Jolas taktikoen ereduarekin, irakasleek testuinguru errealeko ariketen bidez irakasten dute (Metzler, 2011). TGM ereduan gaitasun motorrak ez ezik, jolasarekin lotutako garapen kognitiboa eta koordinazio mugimendu konplexuak ere behar dira (Trajković, Krističević, & Sporiš, 2017; Trajković et al., 2016). Halaber, ikasleek jolasean gertatzen diren egoerei moldatzeko gaitasuna erabiltzen dute (Miller, 2015; Trajković, Krističević, & Sporiš, 2017).

Gorputz hezkuntzan kalitatezko saioak diseinatzea eta irakaskuntza metodologia egokiak hautatzea garrantzitsua den arren (Behringer et al., 2011; Faigenbaum et al., 2015), oraindik eztabaidagarria da zein den irakaskuntza metodologia egokiena Lehen Hezkuntzako etapan ikasleen garapen integrala bultzatzeko (Hardy et al., 2011). Bi irakaskuntza metodologia horien ondorioak gaitasun motorretan, eremu psikologikoan, ariketa fisiko mailan, irakasteko eta aktiboki ikasteko denboran eta funtzio kognitiboetan aztertzen dituzten ikerketa gutxi daude. Ezinbestekoa da jakitea zeintzuk diren ondorioak gorputz hezkuntzako irakasleek hori kontuan izanda irakaskuntza metodologia bat edo bestea aukeratu dezaten. Gainera, programa horien eraginak adinaren eta sexuaren araberakoak diren jakitea ere beharrezkoa da.

1.6. Erreferentzi bibliografikoak

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BIGARREN KAPITULUA

HELBURUAK

No one should teach who is not in love with teaching.

Margaret E. Sangster

Bigarren kapitulua. Helburuak

Doktorego tesi honen helburuak honako hauek izan dira:

- Lehenengo helburua: sexuen arteko desberdintasunak aztertu orekan, objektuen kontrolean eta norabidea aldatzeko gaitasunean (CODA), 6 eta 11 urte bitarteko Lehen Hezkuntzako ikasleengan.
- Bigarren helburua: orekaren, objektuen kontrolaren eta CODAren arteko erlazioa ezagutzea Lehen Hezkuntzako ikasleengan.
- Hirugarren helburua: bi irakaskuntza metodologia desberdinek (instrukzio zuzeneko eredua (DIM) eta jolas taktikoen eredua (TGM)) Lehen Hezkuntzako ikasleen oreka estatikoan eta dinamikoan duten eragina aztertzea.
- Laugarren helburua: bi irakaskuntza metodologia desberdinek (DIM eta TGM) Lehen Hezkuntzako ikasleen hautemandako esfortzuan, gogobetetasunean, jarduera fisiko mailan eta gorputz hezkuntzako saioetako denbora erabilgarrian duten eragina aztertzea.
- Bostgarren helburua: bi irakaskuntza metodologia desberdinek (i.e. DIM eta TGM) Lehen Hezkuntzako ikasleen sormenean, arretan eta oldarkortasunaren kontrolean duten eragina aztertzea.

MOTOR SKILLS DIFFERENCES BY GENDER IN EARLY ELEMENTARY EDUCATION STUDENTS

Education is all a matter of building bridges.

Ralph Ellison

Paper 1

Motor skills differences by gender in early elementary education students

Josune Rodríguez-Negro, Francisco Javier Huertas-Delgado and Javier Yanci

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Chapter 3. Paper 1

Motor skills differences by gender in early elementary education students

Josune Rodríguez-Negro[1], Francisco Javier Huertas-Delgado[2] and Javier Yanci[1]

[1]Faculty of Physical Education and Sport, University of the Basque Country, UPV/EHU, Vitoria-Gasteiz, Spain; [2] Centro de Magisterio la Inmaculada, University of Granada, Granada, Spain

Abstract

The aims of the present study were to analyse the gender differences in balance, catching, aiming and change of direction ability (CODA) in elementary education students and to determine the relationship among these motor skills. Balance, catching, aiming and CODA were assessed in 197 elementary education students (6–8). Girls presented higher values in static and dynamic balance tests. However, boys obtained better results in the Movement Assessment Battery for Children-2 (MABC-2) aiming test and in the Modified Agility Test (MAT). It also seems that the age affects the gender difference, as gender differences in CODA did not appear until older ages (>7 years). Moreover, the results showed a significant moderate correlation between some tests. Gender could be a differentiating factor in the motor competence of elementary education students. The moderate associations found among different skills showed that, despite they are considered as independent, there is as association between them.

Key words: children; balance; aiming; catching; agility.

Introduction

Fundamental motor skills can be classified in three groups: balance, manipulative and locomotor skills (Gallahue & Cleland-Donnelly, 2007), and the development of these motor skills are one of the main objectives of physical education (PE) programmes (Mckenzie et al., 2002). In fact, the acquisition of these skills during childhood is crucial for achieving a lifelong active lifestyle (Fahimi, Aslankhani, Shojaee, Beni, & Gholhaki, 2013). Moreover, the 52% of the young people do not satisfy current health-related physical activity (PA) recommendations (Roman, Serra-Majem, Ribas-Barba, Pérez- Rodrigo, & Aranceta, 2008), even if children who feel confident of their abilities and have higher motor competence experience a lower decrease in PA levels throughout childhood (Gabbard, 2011). Therefore, the development of these skills may be important to achieve international recommendations in youth. Even more, motor skills development, besides being important for physical, psychological, and social development in children (Lubans, Morgan, Cliff, Barnett, & Okely, 2010) also facilitate the acquisition of language (Iverson, 2010) and academic abilities such as reading and mathematics (Westendorp, Hartman, Houwen, Smith, & Visscher, 2011).

In addition, motor skills like balance, aiming, catching and change of direction ability (CODA) have been studied because they are also highly relevant for everyday practice (MacNamara et al., 2011), recreational activities (Goodway & Robinson, 2015) and different sport modalities (Gabbard, 2011). Motor skills interventions carried out during PE lessons can improve motor competence in children (Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2015). Therefore, knowing the initial characteristics of the development of motor skills according to the age and gender would aid in providing specific knowledge to PE teachers to help improving their intervention programmes.

Many factors such as age (Barnett et al., 2016), weighty status (Gentier et al., 2013), amount of PA done (Gentier et al., 2013), and perceived competence (Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006) are differentiating factors for motor skills. Gender was also related to the development of motor skills as Engel-Yeger, Rosenblum, and Josman (2010) observed in 4–12 years Israeli children, where girls performed better in balance and boys in ball skills. In this sense, Ruiz, Graupera, Gutiérrez, and Miyahara (2003) reported that boys from 7 to 10 years old got better scores than girls in ball skills, and that girls (7–8 years) performed better than boys in balance in Spanish children, and Logan, Robinson, Rudisill, Wadsworth, and Morera (2014) did not found differences in catching and aiming in 6–7 years old children.

Similarly, Yanci, Los Arcos, Reina, Gil, and Grande (2014b) and Mckenzie et al. (2002) did not observed any significant difference between boys and girls in 5- to 8-year-old students.

Furthermore, it has not been clearly ascertained yet the influence of age and gender on elementary school students' motor skills, so it could be necessary to deepen in their influence in 6- to 8-year-old students. The relationship between balance, aiming, catching and CODA in students of elementary education would give valuable information to know if they are independent motor skills or not (Salaj & Markovic, 2011). Actually, to determine if the improvement in one skill is potentially beneficial for another skill could be useful for PE professionals to know which skills should be emphasized in each programme. To the best of our knowledge, no study has analysed the relationship between these four skills together in 6- to 8-year-old students.

For this reason, the purposes of the study were: (1) to determine the gender differences in motor skills, both in the total of students and in the different age groups, and (2) to analyse the relationship between the static and dynamic balance, aiming, catching and change of direction ability.

Methods

Participants

A total of 197 students (6–8 years) selected by convenience from a Spanish elementary education public school were enrolled in this study. Participants were divided into two groups attending to their gender (boys, n = 98 and girls, n = 99), and into three groups according to their elementary education grade, namely, 1st grade of elementary education (G1, n = 61, 6 years), 2nd grade (G2, n = 74, 7 years), 3rd grade (G3, n = 62, 8 years). The age, body height, body mass, and body mass index (BMI) of all participants are summarized in Table 1. The management team of the elementary education school to which the students belonged approves the study. Before participation, participants and parents were informed about the aim and the design of the study, and signed an informed consent. The study was performed in accordance with the Helsinki Declaration (2013) and was approved by the Ethics Committee (CEISH, code PRE_2016_1_0170) of the University of the Basque Country (UPV/EHU).

Table 1. Participants' descriptive characteristics.

	All	Boys	Girls	G1	G2	G3
Age (yr)	7.08 ± 0.86	7.02 ± 0.87	7.13 ± 0.85	6.02 ± 0.13	7.09 ± 0.29	8.10 ± 0.29
Mass (kg)	27.68 ± 6.47	27.76 ± 6.25	27.61 ± 6.71	24.30 ± 4.79	27.01 ± 4.99	31.88 ± 7.29
Height (m)	1.26 ± 0.07	1.26 ± 0.07	1.25 ± 0.07	1.19 ± 0.06	1.27 ± 0.05	1.31 ± 0.05
BMI (kg/m^2)	17.24 ± 2.69	17.25 ± 2.64	17.23 ± 2.74	16.96 ± 2.33	16.68 ± 2.45	18.21 ± 3.05

Results are presented by mean ± standard deviation. BMI = Body mass index. G1 = first grade of elementary education, G2 = second grade, G3 = third grade.

Measures

Anthropometric measurement: The height (m) and body mass (kg) were measured in each participant. They were measured to the nearest 0.1 cm and 0.1 kg using a weighing scale with tallimeter (SecaTM 709, Hamburg, Germany).

MABC-2 Balance tests: The Movement Assessment Battery for Children-2 (MABC-2) (Henderson, Sugden, & Barnett, 2007) is a formalized standardized test to identify motor competence in children. It is divided into three age bands (age band 1: 4–6 years, age band 2: 7–10 years, age band 3: 11–16 years). In this study, one-leg balance (MABC-2 static balance) and walking on a line balance (MABC-2 dynamic balance) activities were included, and the time (seconds) or the number of steps that participants were in balance were measured. Students had two test trials for each test, and the best score was used for data analysis. The MABC-2 has been found to have good reliability (Intraclass correlation coefficient, ICC, were 0.75 and 0.80 for balance and total MABC-2 score respectively) (Henderson et al., 2007).

Standing stork tests: Static balance was measured throw the standing stork balance test, which is used to monitor participants' ability to maintain a state of balance in a static position (Miller, 2013). To administer the Stork test, the participants were made to stand comfortably on both feet with hands on the hip and instructed to lift one leg and place the toes of that foot against the knee of the other leg. Participants were then asked to raise the heel and stand on their toes on command. The stopwatch was started as the heel was raised from the floor. The stopwatch was stopped if the hand(s) came off the hips or the supporting foot swiveled or moved in any direction, or the non-supporting foot lost contact with the knee, or the heel of the supporting foot touched the floor. Every participant was made to perform three attempts with each leg and the best of the three attempts was recorded as final measure.

MABC-2 Aiming and catching test: The aiming and catching skills were assessed with the aiming and catching subtests of the MABC-2 (Henderson et al., 2007), which consists of throwing ten times a beanbag or a ball over a mat and catching ten times a beanbag or a ball, depending on the participants' age band. The number of successful trials over ten was measured and recorded. The MABC-2 has been found to have good reliability (ICC = 0.84) for aiming and catching tests (Henderson et al., 2007).

Modified Agility Test (MAT): CODA was assessed with the MAT (Sassi et al., 2009), and using the protocol by Yanci, Reina, Los Arcos, and Cámara (2013) for elementary school students. The total distance covered was 20 m and a photocell (MicrogateTM Polifemo Radio Light, Bolzano, Italy) was placed on the start/finish line to record the time taken for the test. The path done by the participants to complete the test is shown in the Figure 1. All participants performed the test 3 times with 2 min of rest between trials, and the best of the three scores was chosen for the analysis.

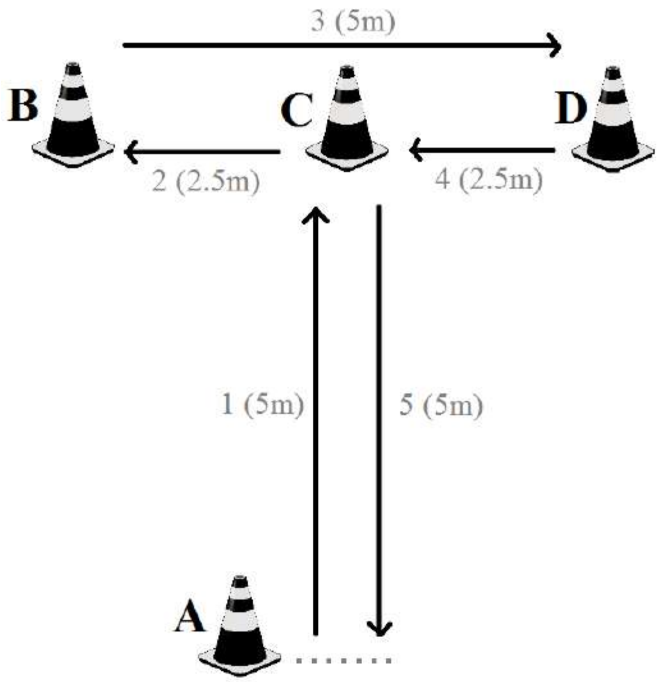

Figure 1. Modified Agility Test

Procedure

In this study, we examined the balance, aiming, catching and CODA of elementary education children during PE sessions carried out in January, at the beginning of the first trimester of the 2016. Tests were carried out during morning school hours at the sports centre of the school. In the first session, anthropometric measurement and all balance tests were done. During the second session, 48 h later, aiming test, catching test and MAT were performed. In the weeks prior to conducting the tests, children received an oral explanation about the test procedure and they completed some trial tests to become familiar with them.

Data analysis

Descriptive data are presented as mean ± standard deviation (SD). The normal distribution of results for the variables applied was tested using the Kolmogorov–Smirnov and Levene test and statistical parametric techniques were conducted. ANOVA test was used to determine whether any significant differences existed between boys and girls groups both in the total of the participants and in each age range (i.e. G1-G6). The mean differences between boys and girls group in each case were calculated in percentage (Mean Dif. %): [(Mean2-Mean1)*100]/Mean1. Furthermore, practical significance was assessed by calculating Cohen's effect size. Effect sizes (ES) of above 0.8, between 0.8 and 0.5, between 0.5 and 0.2 and lower than 0.2 were considered as large, moderate, small, and trivial, respectively. Pearson correlation coefficients (r) and 90% confidence limits (CL) were calculated to determine the relationships among the results obtained from all tests (i.e. the MABC-2 static and dynamic balance tests, the standing stork right and left leg tests, the MABC-2 catching and aiming tests and the MAT) for all students and for boys and girls group. The following scale of magnitudes was used to interpret the correlation coefficients: <0.1, trivial; 0.1–0.3, small; 0.3–0.5, moderate; 0.5– 0.7, large; 0.7–0.9, very large; > 0.9, nearly perfect. Magnitude-based inferences were subsequently applied to qualify the uncertainty in the correlation estimates, using the method previously described (Hopkins, Marshall, Batterham, & Hanin, 2009). These relationships were then qualified via probabilistic terms and assigned using the following scale: 25–75%, possibly; 75–95%, likely; 95–99.5%, very likely; >99.5%, most likely (Hopkins et al., 2009). Data analysis was performed using the Statistical Package for Social Sciences (SPSS, version 20.0 for Windows, Chicago, IL, USA). Statistical significance was set at $p < 0.05$ or possibly (>75%).

Results

The MABC-2 static and dynamic balance tests, the standing stork right and left leg tests, the MABC-2 catching and aiming tests and the MAT results for total sample and for boys and girls are presented in Table 2. Girls group obtained better results than boys in the MABC-2 static balance test ($p < 0.05$, ES = 0.2, small), in the MABC-2 dynamic balance test ($p < 0.01$, ES = 0.4, small) and in the standing stork right ($p < 0.01$, ES = 0.5, moderate) and left leg tests ($p < 0.01$, ES = 0.4, small). However, boys obtained better results in the MABC-2 aiming test ($p < 0.01$, ES = −0.5, moderate) and in the MAT ($p < 0.01$, ES = 0.4, small) than their counterparts. No significant differences between boys and girls groups were observed in the MABC-2 catching test ($p > 0.05$, ES = −0.1, trivial).

Table 2. The MABC-2 static and dynamic balance tests, the standing stork right and left leg tests, the MABC-2 catching and aiming tests and the MAT results for total sample and for boys and girls groups.

	Total sample	**Boys**	**Girls**	**Mean Dif. (%)**	**ES**
Balance					
MABC-2 static (s)	8.55 ± 7.30	8.01 ± 7.53	9.09 ± 7.06*	13.48	0.2
MABC-2 dynamic (steps)	7.83 ± 4.93	6.83 ± 4.95	8.83 ± 4.92**	29.28	0.4
Standing right (s)	21.41 ± 18.30	17.43 ± 19.09	25.38 ± 17.58**	45.61	0.5
Standing left (s)	20.02 ± 17.81	18.95 ± 18.17	25.08 ± 17.47**	32.34	0.4
Catching and aiming					
MABC-2 Catching (hits)	6.03 ± 2.90	5.91 ± 3.05	6.16 ± 2.77	4.23	0.1
MABC-2 Aiming (hits)	6.44 ± 1.70	6.86 ± 1.58	6.02 ± 1.81**	-12.24	-0.5
Change of direction ability					
MAT (s)	11.43 ± 1.50	11.19 ± 1.49	11.67 ± 1.51**	4.28	0.4

Mean Dif. = mean differences, ES = effect size. MABC-2 = Movement Assessment Battery for Children-2. MAT = modified agility test. Significant difference with boys group (* $p < 0.05$, ** $p < 0.01$).

The analysed motor skills test results attending to the gender in all the age groups are presented in Table 3. In the MABC-2 static balance test, significant differences between boys and girls ($p < 0.05$, ES = 0.3, small) were observed in G1 and in the MABC-2 dynamic balance test in all the groups ($p < 0.05–0.01$, ES = 0.3–0.7, small to moderate). In the standing stork balance test, significant gender differences were observed in all the groups for both, right ($p < 0.05$, ES = 0.3–0.5, small to moderate) and left leg ($p < 0.05$, ES = 0.3–0.5, small to moderate) tests. If we focus in the catching and aiming skills, no significant differences were found between boys and girls in the MABC-2 catching test ($p > 0.05$, ES = 0.1, trivial). In the MABC-2 aiming test, however, significant gender differences were found in tall the groups ($p < 0.05–0.01$, ES = −0.5 to −0.7, moderate). Finally, related to the CODA, significant differences were observed between boys and girls in the MAT in G3 ($p < 0.01$, ES = 0.9, large).

Table 3. The MABC-2 static and dynamic balance tests, the standing stork right and left leg tests, the MABC-2 catching and aiming tests and the MAT results for total sample, boys and girls in all grades.

		Balance				**Catching and aiming**		**Change of direction ability**
		MABC-2 static balance test	MABC-2 dynamic balance	Standing stork right	Standing stork left	MABC-2 Catching	MABC-2 Aiming	MAT
G1	Total simple	6.48 ± 6.81	8.73 ± 4.97	12.75 ± 11.53	13.55 ±12.33	8.06 ± 1.57	7.18 ± 1.48	11.70 ± 1.28
	Boys	5.75 ± 6.21	8.23 ± 5.09	9.89 ± 10.68	10.54 ± 11.46	7.95 ± 1.58	7.50 ± 1.33	11.63 ± 1.16
	Girls	7.50 ± 6.57*	9.43 ± 4.63*	16.34 ± 11.77*	17.30 ± 12.62*	8.20 ± 1.61	6.74 ± 1.59*	11.79 ± 1.45
	Mean dif. (%)	30.4	14.6	65.2	64.1	3.1	-10.1	1.4
	ES	0.3	0.3	0.5	0.5	0.1	-0.5	0.1
G2	Total sample	8.78 ± 7.33	8.09 ± 4.82	17.33 ± 17.12	19.04 ± 16.98	4.84 ± 2.78	6.11 ± 1.70	11.30 ± 1.41
	Boys	8.13 ± 5.53	6.45 ± 4.32	15.88 ± 15.78	16.55 ± 15.95	5.02 ± 2.83	6.70 ± 1.68	11.30 ± 1.54
	Girls	9.33 ± 8.6	9.64 ± 4.82**	22.63 ± 18.35*	21.26 ± 17.76*	5.09 ± 2.65	5.57 ± 1.56**	11.31 ± 1.31
	Mean dif. (%)	14.8	49.4	42.50	28.4	1.39	-16.9	0.1
	ES	0.1	0.7	0.4	0.3	0.1	-0.7	0.1
G3	Total sample	9.71 ± 8.21	6.75 ± 4.87	31.03 ± 19.44	30.05 ± 19.46	5.56 ± 3.04	6.34 ± 1.72	11.31 ± 1.50
	Boys	10.26 ± 9.08	6.00 ± 4.86	26.81 ± 16.97	30.14 ± 19.36	5.41 ± 3.10	6.84 ± 1.64	10.66 ± 1.39
	Girls	9.20 ± 7.44	7.39 ± 4.86*	34.70 ± 21.55*	35.96 ± 19.87*	5.71 ± 3.07	5.84 ± 1.70**	11.92 ± 1.36**
	Mean dif. (%)	-10.3	23.1	20.4	19.30	5.5	-14.6	11.8
	ES	-0.1	0.3	0.3	0.3	0.1	-0.6	0.9

Mean Dif. = mean differences, ES = effect size. MABC-2 = Movement Assessment Battery for Children-2. MAT = modified agility test. G = elementary education grade, Significant difference with boys group (* $p < 0.05$, ** $p < 0.01$).

The results obtained in this study did not show any very high or nearly perfect correlation ($r > 0.70$) between the different tests (i.e. the MABC-2 static and dynamic balance tests, the standing stork right and left leg tests, the MABC-2 catching and aiming tests and the MAT) in all participants or groups by gender (i.e. boys and girls). The results showed a significant moderate correlation between some static balance tests and CODA in all participants and in both, boys and girls groups ($r = -0.31$; ±0.08, 0/0/100, most likely to −0.47; ±0.06, 0/0/100 most likely, $p < 0.01$). However, moderate significant correlation between dynamic balance and catching skill was shown just in boys ($r = -0.33$; ±0.07, 0/0/100, most likely, $p < 0.01$). There was also found a moderate relationship between catching skill and CODA in all students ($r = -0.34$; ±0.07, 0/0/100, most likely, $p < 0.01$) and in boys ($r = -0.37$; ±0.07 0/0/100, most likely, $p < 0.01$). This correlation between catching skill and CODA was not found in girls. Finally, a moderate significant association was observed between catching and aiming skills for all students ($r = 0.37$; ±0.07 100/0/0, most likely, $p < 0.01$), boys ($r = 0.41$; ±0.07 100/0/0, most likely, $p < 0.01$) and girls ($r = 0.32$; ±0.07 100/0/0, most likely, $p < 0.01$).

Discussion

The main aims of the present study were to determine the gender differences on balance, catching, aiming and CODA of elementary education students and to analyse the relationship between these motor skills. The main contribution of this study is the analysis of the gender-based differences in children's motor skills to carefully consider possible differences when promoting children's motor skills development. Actually, to know if there are differences depending on the gender can provide relevant data to physical education professionals, enabling them to design more adequate programmes. The results of this study show that girls obtained better results than boys in all balance tests (i.e. the MABC-2 static and dynamic balance test and the standing stork right and left leg test). However, boys obtained better results in aiming skill and CODA.

The development of the motor skills is influenced by many factors, including gender (Barnett et al., 2016; Iivonen & Sääkslahti, 2014). Several studies have reported the potential gender differences in motor skills using the MABC (Junaid & Fellowes, 2006; Vedul-Kjelsås, Stensdotter, & Sigmundsson, 2012), other balance, aiming, throwing, (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2010; Butterfield, Angell, & Mason, 2012) or CODA tests (Meylan, Cronin, Oliver, & Rumpf, 2014; Yanci et al., 2014b). Even that, there is not currently sufficient clarity over the association of the gender and the motor competence and role that gender may play in the development of children's motor skills, so developing this topic is of fundamental educational importance (Flatters, Hill, Williams, Barber, & Mon-Williams, 2014). Some studies have shown males having better competence in many motor skills as aiming, catching (Barnett et al., 2016; Butterfield et al., 2012; Vedul-Kjelsås et al., 2012) or CODA (Amusa, Goon, & Amey, 2010; Meylan et al., 2014; Yanci et al., 2014b). Some other studies also showed that girls are more competent in balance tasks than boys in preschool (Iivonen & Sääk- slahti, 2014; Livesey, Coleman, & Piek, 2007) and in elementary school (Engel-Yeger et al., 2010;

Ruiz et al., 2003). Similarly, in the present study the boys group showed a significant better performance than girls in aiming skill and CODA. Even that, girls showed significant better performance in all balance tests (i.e. the MABC-2 static and dynamic balance test and the standing stork right and left leg test). Therefore, in some skills like balance, girls may have better results than boys in an early age. It appears that the type of motor skill analysed can influence gender differences. Usually boys receive greater encouragement and support in PA and sports than girls, so girls's opportunities to enhance their motor skills would be more limited, widening the gender gap (Hills & Croston, 2012). Additionally, different PA and sport preferences between girls and boys may also help to explain these gender differences (Barnett et al., 2016). Therefore, boys may perform better in aiming and CODA and girls in balancing, because each gender play more games that involve these elements (Mckenzie et al., 2002). As all motor skills are relevant, it might be interesting to implement specific programmes to improve all skills.

Besides the analysis of differences by gender in all participants, it may be also necessary to analyse the differences between boys and girls in each age group (Barnett et al., 2010). The results of our study reinforce the idea that gender can be a differentiating factor in the motor competence of elementary education students. In spite of this, previous studies have shown that the gender differences in CODA, flexibility, strength and speed, can be changed depending on the age of the students (Yanci et al., 2014b), so a gender difference analysis in each age is need also in other motor skills. The results of our study showed significant differences between boys and girls during early elementary education years. It seems that in an early age, girls obtain better results in balance, but we find a gender difference, in favour of boys in catching and CODA. Our results are in line with some other studies that found that girls have better competence in balance in an early age (3–6 yr) (Iivonen & Sääkslahti, 2014; Livesey et al., 2007) and between the ages of seven and eight (Ruiz et al., 2003). With regard to catching skills, similarly to the results obtained in our study, Logan et al. (2014) found that boys and girls performed similarly on each assessment of MABC-2 catching between the ages of six and seven. However, and as we found in the present study, differences in the aiming tests in favour of boys are supported by several studies in elementary education students (Butterfield et al., 2012; Junaid & Fellowes, 2006; Vedul-Kjelsås et al., 2012). Concerning CODA, Lam and Schiller (2001), in a study with 5 and 6 years old children in Hong Kong found significant differences according to gender. However, in most of the studies where CODA has been analysed, similar to the results found in our study, no significant differences were observed between boys and girls in young students (5–7 yr) (Mckenzie et al., 2002; Yanci, Los Arcos, Grande, Gil, & Cámara, 2014a). Moreover, and coinciding with our results, significant differences by gender were found in older students (Meylan et al., 2014; Yanci, Cámara, Vizcay, & Young, 2016). It seems that the differences between boys and girls in CODA do not appear until 8 years (Yanci et al., 2014a). Gender motor skills differences may be attributed to biological maturation (Butterfield et al., 2012; Mckenzie et al., 2002) or to structural differences in the developmental trajectories of the brain (Lenroot et al., 2007). This different development could have influenced the results obtained in each gender in the different ages and motor test. However, it appears that gender differences in motor skills at a young age are likely to be influenced by environmental rather than biological factors (Mckenzie et al., 2002), so in future studies it would be interesting to analyse how physical activity (i.e. type, characteristics, quantity ...) affect different motor skills at different ages. Therefore, we consider that further studies are required, especially with students at this early age (i.e. 6–8 yr).

The relationship between different motor skills has already been analysed in previous studies (Erkut, 2012). The direct correlation between different motor skills could be a very important finding, which could be useful for the planning physical programmes (Bigoni et al., 2017). To know if the improvement in one skill is potentially beneficial for another skill could be useful for physical education professionals to know which skills should be emphasized in each programme. As far as the authors are aware, this study is one of the first studies to investigate the relationship between balance, aiming, catching and CODA in 6–8 year old students. In the present study, the results show a significant moderate correlation between some static balance tests and CODA in all participants and in both, boys and girls group. Similarly to our results, some other studies have found relationship between static balance and CODA in soccer players (Little & Williams, 2005) and in young men athletes (Sekulic, Spasic, Mirkov, Cavar, & Sattler, 2013). However, and as in our study, Lockie, Callaghan, Jeffriess, and Luczo (2016), did not found relationship between dynamic stability and CODA. In our study, the relation between static balance and CODA was only moderate, possibly because balance is not the only variable that influences CODA. In fact, some studies with young and adults have shown that CODA is also related to speed (Sekulic et al., 2013), vertical (Brughelli, Cronin, Levin, & Chaouachi, 2008) and horizontal strength (Peterson, Alvar, & Rhea, 2006). The relationship between CODA and sprint, horizontal jump and vertical jump has also been shown in young athletes (Yanci et al., 2016). Therefore, CODA may be an ability influenced by various skills, static balance among them. Also, significant moderate correlation between dynamic balance and catching skill was shown in boys group. However, there was not found any other correlation between catching skill and another balance test, or with all students or girls group. As in our study, other studies found a moderate correlation between balance and ball skills in preschoolers (Ellinoudis et al., 2011), specially with dynamic balance (Kakebeeke et al., 2016). Actually, some other studies with elementary school students have found a correlation between balance and visio-motor tests, reaction time tests (Hatzataki, Zisi, Kollias, & Kioumourtzoglou, 2002) and two-hand coordination (Erkut, 2012), all of them skills and abilities that form part of the action of catching. Moreover, there was found a moderate correlation between catching and CODA for all students and in boys group. Related to our results, Ibrahim and Azeem (2010) found that some ball skills like dribbling were positively correlated with agility in teenage handball players. The association between these two skills can be due to the fact that in many sports initiation modalities, and also in didactic units in physical education, the tasks require a combined action between CODA and catch balls. Finally, a significant moderate association was observed between catching and aiming skills for all students, boys and girls group. In relation to our results, Dirksen, De Lussanet, Zentgraf, Slupinski, and Wagner (2016) found that an increased throwing accuracy is significantly correlated with an increased catching performance in secondary school students. This could happen because, even if aiming and catching skills have different elements, both skills used to be taught and learned simultaneously, so they are associated. Therefore, the moderate associations found among different skills show that despite being independent skills there is a certain association between them, possibly because are applied in combination in the teaching-learning process. It seems necessary to continue researching the relationship between the skills to better understand the relationships between different motor skills.

Conclusions

To sum up, it appears to be a gender difference in elementary education students' (6–8 years) motor skills. Girls have better competence in static and dynamic balance while boys obtained better results in aiming skill and CODA. It also seems that the age affects the gender difference. Actually, gender differences in favour of boys in CODA do not appear until older ages (>7 years). Therefore, the results obtained in this study reinforce the idea that gender and age can be differentiating factors in the motor competence of elementary education students, and as all motor skills are relevant, it might be interesting to implement specific programmes to improve all these skills. Moreover, the results showed a significant moderate correlation between some static balance tests and CODA, dynamic balance and catching skill, catching skill and CODA, and catching and aiming. The moderate associations found among different skills showed that, despite being independent skills, there is a certain association between them, possibly because they are applied in combination in the teaching-learning process.

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MOTOR SKILLS DIFFERENCES BY GENDER IN 9-TO 11-YEAR-OLD ELEMENTARY EDUCATION STUDENTS

A teacher affects eternity; he can never tell where his influence stops.

Henry B. Adams

Paper 2

Motor skills difference by gender in 9- to 11-year-old elementary education students

Josune Rodríguez-Negro and Javier Yanci

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Chapter 4. Paper 2

Motor skills difference by gender in 9- to 11-year-old elementary education students

Josune Rodríguez-Negro[1] and Javier Yanci[1]

[1]*Faculty of Education and Sport, University of the Basque Country, UPV/EHU, Vitoria-Gasteiz, Spain*

Abstract

The aim of the present study was to analyse the gender differences in balance, object-control skills and change of direction ability (CODA) in 9 to 11-year-old children. Static balance, dynamic balance, catching, aiming and CODA were assessed in 199 children (9-11 years, 38.05 ± 9.15 kg, 1.41 ± 0.07 m, 18.68 ± 3.12 kg/m^2). Girls obtained better results than their counterparts in static balance ($p < 0.05$, ES = 0.3, small), while boys obtained better results than girls in catching ($p < 0.01$, ES = -0.6, moderate) and in CODA ($p < 0.01$, ES = 0.6, moderate). Regarding each age group, even if there were no observed significant differences between boys and girls in the dynamic balance and in the aiming ability in any of the age groups ($p > 0.05$), significant differences were observed in static balance, catching and CODA in 9- and 10-year-old-children ($p < 0.05$ to 0.01, ES = 0.4 to 0.8, small to moderate) and in catching and aiming in 11-year-old children ($p < 0.05$, ES = -0.4 to 0.3, small). Gender could be a differentiating factor in the motor competence of children, specifically in static balance and catching ability.

Keywords: children; balance; aiming; catching; agility.

Introduction

Motor skills development is important not only for physical, psychological and social development in children (Lubans, Morgan, Cliff, Barnett, & Okely, 2010), but it is also related to a less accumulation of subcutaneous adipose tissue during childhood (Lopes, Maia, Rodriguez, & Malina, 2012). Fundamental motor skills consist of locomotor skills, stability skills (balance) and object-control skills (Brian, Goodway, Logan, & Sutherland, 2017). These skills are a key piece for achieving a lifelong active lifestyle (Fahimi, Aslankhani, Shojaee, Beni, & Gholhaki, 2013; Gabbard, 2011), so to enhance school-age children's motor skills performance is needed (Hardy, Reinten-Reynolds, Espinel, Zask & Okely, 2012).

Inside fundamental motor skills, balance is considered a prerequisite for learning complex motor skills (Mickle, Munro, & Steele, 2011), and it is subdivided into four types: static steady-state balance, dynamic steady-state balance, proactive balance and reactive balance (Shumway-Cook & Woollacott, 2017). Balance performance improves from early childhood onwards (Chester, Tingley, & Biden, 2006; Schedler, Kiss, & Muehlbauer, 2019) and it is not fully developed in 9- to 11-year-old children (Demura, Kitabayashi, Noda, & Aoki, 2008). On the other hand, object-control skills are improved through demanding and complex tasks (Howe et al., 2010), and the object-control proficiency is associated with future participation in physical activity in the adolescence (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009). Finally, change of direction ability (CODA) is a complex locomotor skill (Serpell, Ford, & Young, 2010), highly relevant for everyday practice (MacNamara et al., 2011), and for multitude of recreational activities (Goodway & Robinson, 2015) and sport modalities (Sassi et al., 2009; Sporis, Jukic, Milanovic, & Vucetic, 2010).

It has been observed that gender can be a differentiating factor for some motor skills in children (Rodríguez-Negro, Huertas-Delgado, & Yanci, 2019; Schedler, Kiss, & Muehlbauer, 2019). Regarding balance, Rodríguez-Negro and Yanci (2019), observed than 7- to 10-year-old girls have better performance that boys in some balance types. Schedler, Kiss and Muehlbauer (2019) also observed in 6 to 18 year old children, that girls have better static balance than boys of the same age. If we focus on object-control skills, Ruiz, Graupera, Gutiérrez and Miyahara (2003) and Engel-Yeger, Rosemblum and Josman (2010) reported that boys from 4 to 12 years old got better scores than girls in object-control skills. Similarly, Bravo, Rodríguez-Negro and Yanci (2017) also observed differences in favor of boys in the catching skill in 9- to 10-year-old children. Regarding locomotor skills, differences have been also observed between boys and girls in CODA (Meylan, Cronin, Oliver, & Rumpf, 2014; Yanci, Cámara, Vizcay, & Young, 2016). For example, Meylan, Cronin, Oliver and Rumpf (2014) found that in 11-year-olds, boys have better CODA than girls. Yanci, Cámara, Vizcay and Young (2016) observed the same in 12- to 16-year-old youngs.

These differences in motor performance in same-aged boys and girls has been attributed to the neuromuscular development (Eguchi & Takada, 2014), to the different sensory integration (Steindl, Kunz, Schrott-Fischer, & Scholtz, 2006) and in the case of balance, also to the postural control strategies (Smith, Ulmer, & Wong, 2012). However, the age to 9 to 11 seems to be critical. Although in other ages the differences in motor skills seems to be clearer (Barnett et al., 2016; Engel-Yeger, Rosenblum, & Josman, 2010), some studies have shown 9- to 11-year-old girls and boys performing equally well in terms of balance performance (Butz, Sweeney, Roberts, & Rauh, 2015; Libardoni et al., 2017; Schedler, Kiss, & Muehlbauer, 2019), some object-control skills (Bravo, Rodríguez-Negro, & Yanci, 2017), and CODA (Yanci, Los Arcos, Castillo, & Camara, 2017). Consequently, it is still questionable, if and to what extent gender related differences in fundamental motor skills performance in 9- to 11-year-old children exist.

Furthermore, there is not clear the gender differences in the above-mentioned motor skills in children of 9-11 years old, so an evidence-based results are still needed. Thus, the aim of the study was to determine the gender differences on 9- to 11-year-old children´s balances, object-control skills and locomotor skills.

Methods

Participants

A total of 199 children (10.04 ± 0.81 years) selected by convenience from a Spanish elementary education public school were enrolled in this study. Participants were divided into two groups attending to their gender (boys, n = 96, 10.15 ± 0.82 years, and girls, n = 103, 9.93 ± 0.79 years), and into six groups according to their age and gender (Table 1). Before participation in the present study, all children and parents were informed about the aim and the design of the study and signed an informed consent. The study was performed in accordance with the Helsinki Declaration (2013) and was approved by the Ethics Committee (CEISH, code PRE_2016_1_0171) of the University of the Basque country (UPV/EHU).

Table 1. Participants' descriptive characteristics.

		Age (years)	**Mass** (kg)	**Heigth** (m)	**BMI** (kg/m^2)
All	**All** (n = 199)	10.04 ± 0.81	38.05 ± 9.15	1.41 ± 0.07	18.68 ± 3.12
	Boys (n = 96)	10.15 ± 0.82	36.82 ± 7.83	1.41 ± 0.07	18.19 ± 2.49
	Girls (n = 103)	9.93 ± 0.79	39.17 ± 10.12	1.42 ± 0.08	19.14 ± 3.55
9 years	**All** (n = 64)		34.27 ± 7.21	1.36 ± 0.06	18.30 ± 2.58
	Boys (n = 29)		33.07 ± 4.78	1.35 ± 0.04	17.87 ± 1.74
	Girls (n = 35)		35.06 ± 8.41	1.36 ± 0.07	18.58 ± 2.99
10 years	**All** (n = 65)		37.62 ± 9.14	1.42 ± 0.06	18.40 ± 3.38
	Boys (n = 28)		35.43 ± 5.33	1.40 ± 0.05	17.87 ± 2.11
	Girls (n = 37)		39.22 ± 10.95	1.40 ± 0.05	17.87 ± 2.11
11 years	**All** (n = 70)		41.93 ± 9.32	1.46 ± 0.07	19.30 ± 3.28
	Boys (n = 39)		39.97 ± 9.33	1.45 ± 0.07	18.58 ± 3.03
	Girls (n = 31)		44.90 ± 8.63	1.48 ± 5.21	20.38 ± 3.41

BMI = Body Mass Index.

Procedure

In this study, balance (i.e., static balance and dynamic balance), object-control skills (i.e., aiming and catching) and locomotor skill (i.e., CODA) were examined in 9- to 11-year-old children. All tests were conducted during the children' physical education lesson at the school sports center. In the first session, basic anthropometric measurements and balance test were performed, and during the second session, 48 hours later, children performed aiming test, catching test and Modified Agility Test (MAT). In the weeks prior to conducting the tests, children received an oral explanation about the test procedure, and they completed a trial familiarization test to become familiar with them.

Measures

Anthropometric Measurement: The height (m) and body mass (kg) were measured in each participant. They were measured to the nearest 0.1 cm and 0.1 kg using a weighing scale with tallimeter (Seca™ 709, Hamburg, Germany). Body mass index (BMI) was calculated throw the formula kg/m^2.

Static and Dynamic Balance Tests: Balance was measured throw the Movement Assessment Battery for Children-2 (MABC-2), a formalised standardised test to identify motor competence in children (Rodríguez-Negro, Huertas-Delgado, & Yanci, 2019; Rodríguez-Negro, Falese, & Yanci, 2019). The MABC-2 has been found to have good reliability, with an intraclass correlation coefficient (ICC) of 0.75 for balance and 0.80 for total MABC-2 (Henderson, Sugden, & Barnett, 2007). In this study the test for the age band 2 (7 to 10 years) for 9- and 10-year-old children and age band 3 (11 to 16 years) for 11-year-old children were used. Specifically, the one-leg balance (MABC-2 static balance), the walking on a line balance (MABC-2 dynamic balance) and the jumping on the squares (MABC-2 jump dynamic balance) subtests were included (Rodríguez-Negro, Falese, & Yanci, 2019; Rodríguez-Negro, Huertas-Delgado, & Yanci, 2019). Every participant was made to perform two trials with each leg and the best of the three trials was recorded for data analysis.

Static Balance: The static balance was assessed with the standing stork balance test, which is used to monitor participants' ability to maintain a state of balance in a static position (Miller, 2013; Rodríguez-Negro & Yanci, 2019). To administer the Stork test, participants were made to stand comfortably on both feet with hands on the hip and instructed to lift one leg and place the toes of that foot against the knee of the other leg. Participants were then asked to raise the heel and stand on their toes. A stopwatch was used to time the period from when the heel was raised from the floor to time when (a) the hand(s) came off the hip(s), (b) the supporting foot swivelled or moved in any direction, (c) the non-supporting foot lost contact with the knee, or (d) the heel of the supporting foot touched the floor. Participants had three test trials for each test, and the best score was used for data analysis.

Object-Control Skills: Object-control skills were measured throw the aiming and catching subtests of the MABC-2 (Bravo, Rodríguez-Negro, & Yanci, 2017; Henderson, Sugden, & Barnett, 2007). These tests consist of throwing ten times a ball over a mat and catching ten times a ball. The number of successful trials over ten was measured and recorded. The MABC-2 has been found to have good reliability (ICC = 0.84) for aiming and catching tests (Henderson, Sugden, & Barnett, 2007).

Change of Direction Ability: CODA was measured with the Modified Agility Test (MAT) (Sassi et al. 2009), and the protocol for children of Yanci, Reina, Los Arcos and Cámara (2013) was used. The total distance covered was 20 m and a photocell (Microgate™ Polifemo Radio Light, Bolzano, Italy) was placed on the start/finish line to record the time taken for the test. The path done by the participants to complete the test is shown in the Figure 1. All participants performed the test 3 times with 2 min of rest between trials, and the best score was used for data analysis.

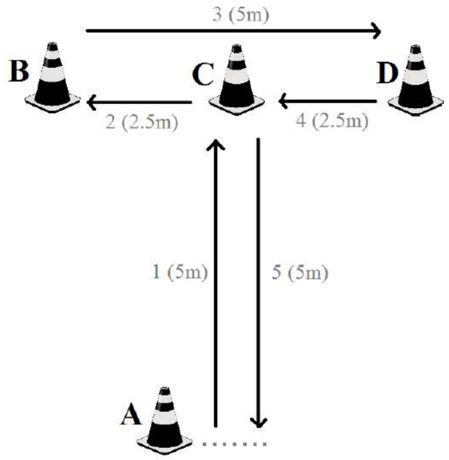

Figure 1. Modified Agility Test.

Data Analysis

The results are presented as mean ± standard deviation (SD). The normal distribution of results for the variables applied was tested using the Kolmogorov-Smirnov and homocedasticity with Levene test and statistical parametric techniques were applied. Independent paired t-tests were used to determine whether any significant differences existed between boys and girls groups in the total of the participants and in each age. The mean differences between boys and girls group in each case was calculated in percentage (Mean Dif. %): [(Mean girls-Mean boys)*100]/Mean boys. Furthermore, to allow a better interpretation of the results, practical significance was assessed by calculating Cohen's (2015) effect size. Effect sizes (ES) were classified as trivial (< 0.2), small (0.2 to 0.6), moderate (0.6 to 1.2), large (1.2 to 2.0), very large (2.0 to 4.0), and extremely large (>4.0) (Hopkins, Marshall, Batterham, & Hanin, 2009). Data analysis was performed using the Statistical Package for Social Sciences (SPSS, version 20.0 for Windows, Chicago, IL, USA). Statistical significance was set at $p < 0.05$.

Results

The static balance, dynamic balance, object-control skills and CODA results for total sample and for boys and girls are presented in Table 2. Girls group obtained better results than their counterparts in the static balance tests, concretely in the MABC-2 static balance test ($p < 0.05$, ES = 0.3, small) and in the standing stork right leg test ($p < 0.05$, ES = 0.3, small). However, boys obtained better results than girls in the MABC-2 catching test ($p < 0.01$, ES = -0.6, moderate) and in the MAT ($p < 0.01$, ES = 0.6, moderate). No significant differences between boys and girls groups were observed in the dynamic balance tests ($p > 0.05$, ES = 0.1, trivial) and in the aiming test ($p > 0.05$, ES = -0.1, trivial).

Table 2. The Movement Assessment Battery for Children-2 (MABC-2) and the modified agility test (MAT) results for boys and girls.

	Total sample	Boys	Girls	ES (Dif. %)
Static Balance				
MABC-2 static (s)	13.58 ± 10.33	12.33 ± 9.60	15.48 ± 10.72	0.3 (25.5)*
Standing right (s)	30.34 ± 20.11	27.74 ± 20.70	32.98 ± 19.46	0.3 (18.8)*
Standing left (s)	33.68 ± 21.18	32.62 ± 21.23	34.77 ± 21.24	0.1 (6.5)
Dynamic Balance				
MABC-2 dynamic (steps)	8.52 ± 5.07	8.15 ± 5.02	8.89 ± 5.13	0.1 (0.1)
MABC-2 jump right (jumps)	4.20 ± 1.10	4.28 ± 1.00	4.13 ± 1.19	0.1 (-3.5)
MABC-2 jump left (jumps)	4.08 ± 1.26	4.06 ± 1.26	4.11 ± 1.26	0.1 (1.2)
Object-control skills				
MABC-2 Catching (hits)	6.68 ± 2.78	7.51 ± 2.92	5.85 ± 2.65	-0.6 (-22.1)**
MABC-2 Aiming (hits)	6.08 ± 2.15	6.22 ± 2.19	5.94 ± 2.10	-0.1 (-4.5)
Change of direction ability				
MAT (s)	9.44 ± 1.37	8.99 ± 1.37	9.87 ± 1.37	0.6 (9.7)**

Mean Dif. = mean differences, ES = effect size. * $p < 0.05$, ** $p < 0.01$, significant difference between boys and girls.

The results of all the analyzed motor skills test attending to the gender for children of each age group are presented in Table 3. Significant differences in the static balance (i.e., MABC-2 Static Balance test and Standing Stork Right leg test) were observed between boys and girls in 9 years ($p < 0.01$, ES = 0.4 to 0.6, small to moderate) and 10 years ($p < 0.05$, ES = 0.3, small) age groups. However, in the dynamic balance tests, no significant differences were observed in any of the test or age groups ($p > 0.05$, ES = -0.2 to 0.2, trivial). If we focus in object-control skills, significant differences were found between boys and girls in the MABC-2 catching test in all the age groups ($p < 0.05$ or $p < 0.01$, ES = -0.4 to -0.7, small to moderate). However, no significant differences between boys and girls groups were observed in the MABC-2 aiming tests in any of the age groups ($p > 0.05$, ES = -0.2 to -0.1, trivial). Finally, related to the CODA, significant differences were observed between boys and girls in the MAT in all age groups ($p < 0.05$ or $p < 0.01$, ES = 0.3 to 0.8, small to large).

Table 3. The Movement Assessment Battery for Children-2 (MABC-2) and the modified agility test (MAT) results for boys and girls for all ages.

	9 years		**10 years**		**11 years**	
	Boys	Girls	Boys	Girls	Boys	Girls
MABC-2 static	8.87 ± 6.71	14.80 ± 10.57	14.34 ± 10.77	18.07 ± 11.43	13.80 ± 9.94	13.57 ± 10.56
ES (Dif. %)	0.6 (66.8)**		0.3 (26.0)*		-0.1 (-1.6)	
Standing right	20.19 ± 19.95	28.34 ± 18.78	34.28 ± 20.42	40.92 ± 20.96	28.77 ± 18.84	29.70 ± 17.03
ES (Dif. %)	0.4 (40.4)**		0.3 (19.4)*		0.1 (3.2)	
Standing left	25.63 ± 20.26	28.07 ± 18.92	36.80 ± 21.24	39.14 ± 19.00	35.41 ± 21.99	37.16 ± 20.44
ES (Dif. %)	0.1 (9.5)		0.1 (6.3)		0.1 (4.9)	
MABC-2 dynamic	7.63 ± 4.49	8.71 ± 5.20	10.03 ± 4.76	10.52 ± 5.39	6.80 ± 4.04	7.45 ± 4.86
ES (Dif. %)	0.2 (14.1)		0.1 (4.8)		0.1 (9.5)	
MABC-2 jump right	4.35 ± 0.93	4.36 ± 0.96	3.92 ± 1.29	3.58 ± 1.41	4.49 ± 0.75	4.54 ± 0.88
ES (Dif. %)	0.1 (0.2)		-0.2 (-8.6)		0.1 (1.1)	
MABC-2 jump left	4.42 ± 0.97	4.22 ± 1.26	3.65 ± 1.46	3.79 ± 1.40	4.10 ± 1.23	4.37 ± 0.97
ES (Dif. %)	-0.1 (-4.5)		0.1 (3.8)		0.2 (6.7)	
MABC-2 Catching	8.00 ± 1.80	6.15 ± 2.82	8.15 ± 2.16	6.34 ± 2.57	6.39 ± 2.89	5.08 ± 2.86
ES (Dif. %)	-0.6 (-23.1)*		-0.7 (-22.2)**		-0.4 (-20.5)*	
MABC-2 Aiming	6.65 ± 1.82	6.31 ± 2.23	7.52 ± 1.50	7.09 ± 1.47	4.51 ± 1.86	4.44 ± 2.00
ES (Dif. %)	-0.1 (-5.1)		-0.2 (-5.7)		-0.1 (-1.5)	
MAT	9.27 ± 1.13	10.36 ± 1.37	8.61 ± 1.11	9.62 ± 1.18	9.09 ± 1.22	9.63 ± 1.58
ES (Dif. %)	0.8 (11.7)**		0.8 (11.7)**		0.3 (5.9)*	

Mean Dif. = mean differences, ES = effect size. * $p < 0.05$, ** $p < 0.01$, significant difference between boys and girls.

Discussion

The main aim of the study was to determine the gender differences on 9- to 11-year-old children´s motor skills (i.e., balance, object-control skills and locomotor skills). The main contribution of this study is the analysis of the gender-based differences in 9- to 11-year-old children's motor skills to carefully consider possible differences when promoting children's motor skills development. The results of this study show that girls obtained better results than boys in static balance, and that boys obtained better results in catching skill and CODA. Furthermore, no differences between boys and girls were observed in dynamic balance and in aiming skill.

The development of the motor skills can be influenced by gender. Some studies have observed gender differences in balance (Rodríguez-Negro, Huertas-Delgado, & Yanci, 2019; Schedler, Kiss, & Muehlbauer, 2019), object-control skills (Bravo, Rodríguez-Negro, & Yanci, 2017; Barnett et al., 2016) and CODA (Meylan et al., 2014; Yanci et al., 2016). However, it has been described that gender differences with 9-11 years old are nor clear, and contradictory results have been found (Schedler, Kiss, & Muehlbauer, 2019). In the present study the boys group showed a significant better performance than girls in CODA and catching skills. However, girls showed significant better performance in some static balance tests (i.e., the MABC-2 static test and the standing stork right leg test). Therefore, the results of our study reinforce the idea that gender can be a differentiating factor in the motor competence of 9 to 11-year-old children, but that these differences depend on the analyzed skill, girls having more ability in some skills, and boys in others. Therefore, physical education professionals should take into consideration the differences according to gender that could be dependent of the analyzed skill.

Even that, there is not still clear the role that gender plays in children's motor skills development at each age, so besides the analysis of differences by gender in all participants, it may be also necessary to analyze the differences between boys and girls in each age group (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2010). Knowing the different motor skill development at each age is of fundamental educational importance (Flatters et al., 2014), as age is the predictor that best explains motor skills values in children of these age (Butz et al., 2015; Libardoni et al., 2018). The results of our study showed different development between boys and girls at some ages. According to static balance, it seems that in an early age (9-10 years) girls obtain better results, but in older ages (11 years) it has not been found a gender difference between boys and girls. Our results are in line with some other studies that found that girls have better performance in static balance till 10 years old (Rodríguez-Negro & Yanci, 2019; Ruiz, Graupera, Gutierrez, & Miyahara, 2003), but the differences between gender in static balance they start to disappear with 11 years old (Vedul-Kjelsås, Stensdotter, & Sigmundsson, 2012). Even that, when focusing on dynamic balance, there were not found any significant differences between boys and girls in any age group. As in the present study, the lack of differences in the dynamic balance according to the gender are supported by several studies in elementary education students (Rodríguez-Negro & Yanci, 2019; Ruiz et al., 2003). This result may support the assumptions of Pedersen, Sigmundsson, Whiting, and Ingvaldsen (2003), emphasizing the importance of task-specificity when investigating probable gender differences in motor competence. Furthermore, the differences between static and dynamic balance could be because in dynamic balance other skills may be involved, as coordination, strength or the trajectory calculation.

Concerning object control skills, several studies observed differences in favor of boys in object control skills in 4- to 12-year-old children (Engel-Yeger et al., 2010; Ruiz et al., 2003). In the present study, better catching skills in 9- to 11-year-old boys were found. Similarly, other studies have shown better results in the catching test in 9-, 10- (Bravo, Rodríguez-Negro, & Yanci, 2017) and 11-year-old boys (Vedul-Kjelsås, Stensdotter, & Sigmundsson, 2012). Even that, in the present study differences between boys and girls in aiming skill were not found at any age. Coinciding with our results, significant differences by gender were found in catching skills in favor of boys in 11-year-old children (Bravo, Rodríguez-Negro, & Yanci, 2017). Even if aiming and catching skills are moderate associated (Dirksen, De Lussanet, Zentgraf, Slupinski, & Wagner, 2016; Rodríguez-Negro, Huertas-Delgado, & Yanci, 2019) they have different elements, since aiming implies propelling movement while catching is the absorption of a mobile in movement (Ureña, Ureña, & Alarcón, 2008).

The differences according to the gender in the locomotor skills have been previously analyzed (Meylan et al., 2014; Yanci et al., 2016). Some previous studies have exposed that the differences according to the gender in the locomotor skill could be influenced by the age. With regard to CODA, the results obtained in our study showed that 9- to 11-year-old boys have better competence in CODA than same age girls. Similarly, Meylan et al. (2014) found that 11-year-old boys have better results in CODA than same age girls. Furthermore, it seems that this difference appears with 8-9 years old (Yanci et al. 2014), and it is maintained over the time, as Yanci et al. (2016) observed in 12- to 16-year-old youngs.

It appears that the type of motor skill analyzed can influence gender differences (Ruiz et al., 2003; Schedler, Kiss, & Muehlbauer, 2019). These differences may be attributed to biological maturation (Butterfield, Angell, & Mason, 2012; Eguchi & Takada, 2014), to improved sensory integration (Steindl et al., 2006), to structural differences in the developmental trajectories of the brain (Lenroot et al., 2007), or in the case of balance to the use of more adult-like postural control strategies (Smith, Ulmer, & Wong, 2012). Additionally, different physical activity and sport preferences between same-age girls and boys may contribute to gender differences in motor skills development (Barnett et al., 2010; Barnett et al., 2016; Wrotniak et al., 2006). Boys may perform better in catching and CODA and girls in balancing, because each gender seem to receive greater encouragement (Barnett et al., 2010) and have higher involvement in games that include these elements (Harrell et al., 2003; McKenzie et al., 2002).

Conclusion

To sum up, it appears that gender is a differentiating factor in some motor skills in 9- to 11-year-old children. Girls have better competence in static balance while boys obtained better results in catching skill and CODA. However, no gender differences were found between same-age boys and girls in dynamic balance and aiming skill. It also seems that the age affects the gender difference. Even if catching and CODA differences appear in all the analyzed ages, static balance differences disappeared with 11 years. Therefore, the results obtained in this study reinforce the idea that gender and age can be differentiating factors in the motor competence in 9- to 11-year-old-children.

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EFFECTS OF DIFFERENT BALANCE INTERVENTIONS FOR PRIMARY SCHOOL STUDENTS

A teacher takes a hand, opens a mind, and touches a heart.

Unknown Author

Paper 3

Effects of different balance interventions for primary school students

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Chapter 5. Paper 3

Effects of different balance interventions for primary school students

Josune Rodríguez-Negro[1], Lavinia Falese[2] and Javier Yanci[1]

[1]*Faculty of* Education and Sport*, University of the Basque Country, UPV/EHU, Vitoria-Gasteiz, Spain;* [2]*Laboratory of Epidemiology, Physical Activity and Lifestyles, Department of Human Sciences, Society and Health, University of Cassino and Southern Lazio, Cassino, Italy.*

Abstract

This study examines the effects of two different 8-week balance intervention programs for students of primary school age. Static and dynamic balance were assessed in 380 students (6-12 years) before and after an 8-week balance intervention program. Students were divided and assigned into a no intervention control group, a direct instructional model (DIM) or a tactical games model (TGM). Static and dynamic balance improved after both intervention programs, but results differed by grade (age). DIM was the most effective for G2 (7-8 years), and TGM was most effective for G4-G6 (9-12 years) students. Thus, at the youngest ages of primary school DIM balance programs in which skills are taught and practised in isolation and students work individually are more effective, but for improving balance. At more advanced ages (> 8 years), TGM balance programs may be more effective.

Key words: children; intervention programs; physical education; MABC-2.

Introduction

Balance is considered an important aspect of children's motor skill development, and it is a prerequisite for learning other complex motor skills (Mickle, Munro, & Steele, 2011). As balance improvements occur mainly from 2-18 years of age, they are not fully developed in primary school aged children (Demura et al., 2008). Although it is commonly believed that children automatically acquire balance as their bodies develop, environmental conditions are also vital for balance development (Fahimi et al., 2013). Educators often seek to assist motor skill development in childhood, and balance proficiency can be influenced by an appropriate intervention program (Fahimi et al., 2013). In fact, some researchers have recommended various balance intervention programs for children (Granacher et al., 2015).

Wälchli et al. (2017) reported improvements in balance after a 5-week balance intervention program in 6-15-year-old students. Similarly, Muehlbauer, Kuehnen, and Granacher (2013) observed balance improvements after a 4-week intervention program in 11-12 -year-old typically developing children. Moreover, Kováčiková et al. (2017) documented the effectiveness of a 4-week balance program for improving balance performance in 9-12-year-old children with asthma. Apart from targeted balance improvements, balance programs have been recommended to promote postural control (Granacher, Gollhofer, & Kriemler, 2010), conscious dynamic proprioception, defined as a specialized variation of the sensory modality and encompasses the sensations of joint movement and joint position (Emilio et al., 2014), and muscular strength (Wälchli et al., 2017).

Balance programs represent one response to the perceived need to help school-age children enhance their motor skill performance (Hardy et al., 2012), and these programs must be developmentally appropriate and purposely designed to improve fundamental movement skills in primary school children (Faigenbaum et al., 2015). Although quality programs should play a special role in developing this aspect of motor proficiency (Behringer et al., 2011), there is still controversy in the primary school context regarding whether or how best to teach fundamental movement skills (Hardy et al., 2011).

In physical education, two of the instructional models of interest are: (a) a direct instructional model (DIM) and (b) a tactical games model (TGM) (Metzler, 2011; Ishihara et al., 2017). Within the DIM, skills are taught in isolation using repetitive individual drill practices (Ishihara et al., 2017), teacher is the primary source for decisions and students tried to reproduce teacher's model of performance (Gurvitch & Metzler, 2010; Metzler, 2011).

Although DIM results in significant short-term improvement (Porter et al., 2007), researchers have found a lack of enjoyment with the experience among children undergoing this type of exercise (Wall & Côt, 2007). On the contrary, in the TGM teacher teaches through contextually-authentic tasks, based in teaching games for understanding approach (Metzler, 2011). Games are in their simpler format, and then they increase complexity (Metzler, 2011). The TGM within physical education addresses fundamental movement skills, cognitive development associated with learning to play games and the coordination of complex body movements (Trajković, Krističević, & Sporiš, 2017; Trajković et al., 2016). In TGM the teacher frames the learning task so that students can understand how the task is performed in game conditions (Gurvitch & Metzler, 2013), addressing the ability to adapt to continually changing task demands occurring within game situations (Miller, 2015; Trajković, Krističević, & Sporiš, 2017). An intervention program centered on TGM has been shown to be effective for improving explosive strength (Trajković et al., 2016), and, among adolescent volley ball players, improved speed and agility, setting, passing accuracy, spiking, and passing techniques (Gabbett et al., 2006).

To date, DIM and TGM have not been compared with regard to their benefits in improving balance among primary education students, and some authors have called for more longitudinal intervention studies to address children's static and dynamic balance (Granacher et al., 2011). Therefore, this study aimed to examine the effects of 8-week DIM and TGM balance intervention programs on the static balance and dynamic balance of primary school students. The hypotheses of this study were that balance intervention programs integrated into physical education lessons resulted in improved balance, but the age of the students and the instructional model used in the intervention program will condition the results.

Methods

Participants

Three-hundred and eighty typically developing students (6-12 years old) from a Spanish state primary school participated in this investigation. Participants were first divided into six groups according to their grade (G1-G6) and then, within each grade, classes were randomly divided into a no-intervention control group (CG; n = 124; 66 boys, 66 girls) or one of two intervention groups: (a) DIM (n = 125; 63 boys, 68 girls) and (b) TGM (n = 131; 66 boys, 66 girls). Table 1 summarizes these groups, including descriptive data regarding their age, height, body mass, and body mass index (BMI). Before participation, participants and parents were informed about the aim and the design of the study, and parents signed an informed consent. The management team of the primary school to which the students belonged approved the study. The study was performed in accordance with the Helsinki Declaration (2013) and was approved (CEISH, code PRE_2016_1_0171**)** by the Ethics Committee of the University of the Basque Country (UPV/EHU).

Table 1. Participants' characteristics.

		Age (yr)	**Mass** (kg)	**Height** (m)	**BMI** (kg/m^2)
All		8.60 ± 1.75	32.86 ± 9.46	1.34 ± 0.11	17.96 ± 2.99
DIM	**All**	8.64 ± 1.75	32.11 ± 8.61	1.33 ± 0.10	17.73 ± 2.91
(n=125)	**G1**	6.00 ± 0.00	24.60 ± 4.29	1.19 ± 0.06	17.10 ± 1.72
	G2	7.17 ± 0.38	26.46 ± 4.57	1.28 ± 0.03	16.05 ± 2.11
	G3	8.05 ± 0.21	32.03 ± 7.16	1.32 ± 0.04	18.14 ± 3.21
	G4	9.05 ± 0.21	31.97 ± 5.70	1.32 ± 0.05	18.07 ± 2.64
	G5	10.14 ± 0.35	37.19 ± 9.59	1.42 ± 0.07	18.06 ± 3.50
	G6	11.13 ± 0.34	40.28 ± 8.01	1.45 ± 0.05	17.73 ± 2.91
TGM	**All**	8.58 ± 1.74	32.64 ± 9.04	1.33 ± 0.11	18.00 ± 2.67
(n=126)	**G1**	6.00 ± 0.00	24.55 ± 5.17	1.18 ± 0.05	17.23 ± 2.52
	G2	7.04 ± 0.20	28.07 ± 4.82	1.25 ± 0.06	17.79 ± 2.17
	G3	8.20 ± 0.41	30.34 ± 6.18	1.31 ± 0.04	17.59 ± 2.88
	G4	9.00 ± 0.00	33.78 ± 6.56	1.36 ± 0.05	17.98 ± 2.48
	G5	10.00 ± 0.00	35.23 ± 4.33	1.41 ± 0.05	17.49 ± 1.59
	G6	11.04 ± 0.20	43.00 ± 11.18	1.46 ± 0.07	19.69 ± 3.47
CG	**All**	8.59 ± 1.78	33.85 ± 10.64	1.35 ± 0.11	18.16 ± 3.38
(n=129)	**G1**	6.05 ± 0.21	23.78 ± 5.00	1.19 ± 0.05	16.54 ± 2.62
	G2	7.08 ± 0.27	26.45 ± 5.58	1.27 ± 0.04	16.12 ± 0.02
	G3	8.05 ± 0.21	33.20 ± 8.39	1.31 ± 0.06	18.86 ± 3.06
	G4	9.14 ± 0.35	37.14 ± 8.46	1.39 ± 0.07	18.83 ± 2.64
	G5	10.05 ± 0.22	40.97 ± 12.04	1.42 ± 0.05	19.87 ± 4.39
	G6	11.17 ± 0.38	42.40 ± 8.46	1.48 ± 0.07	19.09 ± 3.27

BMI = Body mass index, G = Age group, DIM = Direct instructional model, TGM = Tactical games model, CG = Control group.

Measures

Anthropometric measurement: Height (in meters) and body mass (in kilograms) were measured for each participant, to the nearest 0.1 cm and kg, respectively. We used a weighing scale with tallimeter (Seca™ 709, Hamburg, Germany), and we calculated a BMI for each child, using the formula BMI = kg/m^2.

The Movement Assessment Battery for Children-2 Balance Tests: The Movement Assessment Battery for Children-2 (MABC-2; Henderson, Sugden, & Barnett, 2007) is a formalized and standardized test to identify motor competence in 4-16-year-old children. It contains eight sub-tests divided into these categories: (a) manual dexterity, (b) aiming, and (c) catching, and (d) static and dynamic balance. In this study, we included tests for one-leg balance and walking on a line, using length of time balanced in seconds and number of steps walked as respective measures. Every participant was asked to perform two attempts for each test, and we selected measures from the better of the two attempts to record for statistical analysis. The MABC-2 has been found to have good reliability (Intraclass correlation coefficient, ICC = 0.75) for balance (Henderson et al., 2007).

Standing stork tests: We measured static balance also through the standing stork balance test, as balance is a task depending skill (Sibley et al., 2015). Standing stork balance test is used to monitor participants' ability to maintain a state of balance in a static position (Miller, 2013). To administer the stork test, participants were asked to stand comfortably on both feet with hands on the hips and then lift one leg and place the toes of that foot against the knee of the other leg. Participants were then asked to raise the heel and stand on their toes. We used a stopwatch to time the period from when the heel was raised from the floor to time when (a) the hand(s) came off the hip(s), (b) the supporting foot swivelled or moved in any direction, (c) the non-supporting foot lost contact with the knee, or (d) the heel of the supporting foot touched the floor. Participants were given three trials with each leg, and we chose their best scores (time in s) for data analysis. The standing stork balance test has been found to have good test-retest reliability [typical error of measurement (TEM), 0.3 to 3.2%] (Chaouachi et al., 2014).

Intervention Programs

Each of the two intervention programs lasted eight weeks and were held during a 90-minute weekly physical education session. Lesson plans were designed by the researchers, and even if regular PE teacher led the activities, there was a researcher always observing the lessons. Each session started with a standardized warm-up period (10 minutes). In the main part of the lesson, students in the DIM intervention performed individual repetitive balance based tasks, in isolation from other skills (Ishihara et al., 2017) and trying to reproduce teacher's model of performance (Gurvitch & Metzler, 2010; Metzler, 2011); students in the TGM intervention practiced balance skills in groups and through contextually-authentic tasks, based in teaching games for understanding approach (Metzler, 2011; Trajković et al., 2017; Trajković et al., 2016). None of the tasks of the DIM or TGM intervention programs was similar to the test tasks. Students in the CG performed no balance based exercise; but, instead, they performed activities such as body expression and they heard discussions on the importance of physical activity with little or no motor involvement. Table 2 depicts the tasks for each intervention program.

Table 2. Task description of each intervention programme.

	DIM	TGM	CG
Week 1	Balance activities without equipment	Balance games without equipment in small groups	Drama activities individually and in pairs
Week 2	Balance activities with ropes and sticks	Balance games with ropes and sticks in small groups	Drama activities individually and in little groups
Week 3	Balance activities with benches	Balance games with benches in small groups	Drama activities in little groups + reflection on the importance of PA
Week 4	Balance activities with benches and balls	Balance games with benches and balls in big groups	Drama activities in little groups and big groups
Week 5	Balance activities with stilts	Balance games with stilts in small and big groups	Drama activities in big groups
Week 6	Balance activities with stilts and benches + slackline	Balance games with stilts and benches in big groups	Drama activities in big groups + reflection on the importance of PA
Week 7	Balance activities with a lot of equipment + slackline	Balance games with a lot of equipment in big groups	Drama activities individually, and in little and big groups
Week 8	Balance activities with a lot of equipment + slackline	Balance games with a lot of equipment in big groups	Theatre

DIM = Direct instructional model, TGM = Tactical games model, CG = Control group.

Procedure

Before (Pre) and after (Post) 8-week balance intervention programs, we tested participants with regard to their static balance and dynamic balance. All tests and the intervention programs were conducted during the students' physical education at the school sports center between January and March 2016. Children were tested during two specific sessions in the Pre- and again in the Post-testing, and tests were performed in the following order. In the first session, we gathered basic anthropometric measurements, and during the second session, 48 hours later, students performed all the balance tests. In the weeks prior to conducting the test, children received an oral explanation about the test procedure, and they completed a trial familiarization test.

Statistical Analysis

We present descriptive data as group means (*M*) and standard deviations (*SD*s). We tested the distribution of variable data for normality using the Kolmogorov-Smirnov test, and we applied parametric statistical techniques as necessary. We assessed between-group differences at baseline (Pre) using a one-way analysis of variance (ANOVA) with Bonferroni *post hoc* analyses as necessary. We calculated the between-group (DIM, TGM, and CG, or age groups) comparisons from Pre- to Post-testing with a two-way mixed ANOVA (group x time) with Bonferroni *post hoc* analyses as necessary. In addition, we used a Student *t* test for paired samples to analyse the differences between the Pre- and Post-testing scores independently for each group. The mean differences between Pre- and Post-testing in each case was calculated in percentages (Mean Dif. %): [(Mean2-Mean1)*100]/Mean1. Furthermore, to aid data interpretation, we described the practical significance of findings by calculating and classifying effect size. Effect sizes (ES) were classified as trivial (< 0.2), small (0.2 -0.6), moderate (0.6 - 1.2), large (1.2 -2.0), very large (2.0 -4.0), and extremely large (> 4.0) (Hopkins et al., 2009). For data analysis we used the Statistical Package for Social Sciences (SPSS, version 20.0 for Windows, Chicago, IL, USA), and we set statistical significance at $p < 0.05$.

Results

A significant improvement was evident between pre-testing and post-testing on all balance tests ($p < 0.01$, ES = 0.2 to 0.6, small to moderate) for all students who underwent a balance intervention program. Table 3 shows pre- and post-testing results of the MABC-2 static and dynamic balance tests and the standing stork right and left leg tests for each intervention program (i.e. DIM or TGM). Students of both the DIM ($p < 0.01$, ES = 0.4 to 0.9, small to moderate) and TGM ($p < 0.01$, ES = 0.3 to 1.1, small to moderate) showed a significant improvement on all balance tests, while no significant differences were found between pre- and post-testing for students in the CG on any balance test.

Table 3. The MABC-2 static and dynamic balance tests and the standing stork right and left leg tests results in the Pre-test (Pre) and Post-test (Post) for students of the direct instructional model (DIM), the tactical games model (TGM) and the control group (CG).

		MABC-2 static (s)	MABC-2 dynamic (steps)	Standing right (s)	Standing left (s)
DIM	Pre	11.50 ± 9.49	8.50 ± 5.07	24.80 ± 19.77	24.89 ± 20.89
	Post	16.98 ± 10.69**	11.71 ± 3.64**	33.28 ± 19.34**	34.61 ± 19.58**
	%Δ Pre-Post	47.65	37.76	34.19	39.05
	ES	0.5	0.9	0.4	0.5
TGM	Pre	12.52 ± 10.12	7.90 ± 5.43	26.17 ± 20.42	28.87 ± 20.56
	Post	15.47 ± 9.97**#	12.24 ± 3.76**##	32.25 ± 20.09**	37.86 ± 19.31**##
	%Δ Pre-Post	23.56	54.93	23.23	31.13
	ES	0.3	1.1	0.3	0.5
CG	Pre	11.58 ± 8.68	8.38 ± 4.47	24.56 ± 18.88	27.66 ± 20.21
	Post	11.69 ± 8.17	8.24 ± 4.28	24.37 ± 16.90	27.30 ± 19.33
	%Δ Pre-Post	0.94	-1.67	-0.77	-1.30
	ES	0.1	-0.1	-0.1	-0.1

DIM = Direct instructional model; TGM = Tactical games model; CG = Control group. ES = Effect size. * $p < 0.05$, ** $p < 0.01$, significant difference between Pre and Post. # $p < 0.05$, ## $p < 0.01$, significant difference between DIM and TGM.

Comparisons of pre- and post-testing mean difference scores for students in the two intervention groups on the MABC-2 static and dynamic balance tests and the standing stork right and left leg tests for each age group are presented in Table 4. Pre-post testing MABC-2 dynamic balance differences were not significant among G1 students who underwent DIM, while G1 students who underwent TGM improved their standing right leg balance test results ($p < 0.05$, ES = 0.6, moderate). Regarding G2, those with DIM improved their MABC-2 dynamic balance test scores ($p < 0.01$, ES = 3.8, very large), and balance scores on the Stork test for standing right leg ($p < 0.01$, ES = 0.7, moderate), and standing left leg ($p < 0.01$, ES = 0.9, moderate). However, G2 students who received TGM showed no significant pre- and post-test differences on any balance tests. G3 students with DIM improved their MABC-2 static balance test scores ($p < 0.01$, ES = 1.3, large), their MABC-2 dynamic balance test scores ($p < 0.01$, ES = 8.2, extremely large), and their standing right balance test scores ($p < 0.05$, ES = 0.6, moderate). G3 students with TGM showed no significant improvement in their MABC-2 static balance test scores but did significantly improve their MABC-2 dynamic balance test scores ($p < 0.01$, ES = 8.0, extremely large). Regarding G4 students, those who underwent DIM improved only their scores on the MABC-2 static balance test ($p < 0.05$, ES = 0.7, moderate), while those with TGM improved on the MABC-2 dynamic balance test ($p < 0.01$, ES = 0.8, moderate) and on the standing left leg balance test ($p < 0.01$, ES = 0.7, moderate). Similarly, G5 students with DIM improved only on the MABC-2 static balance test ($p < 0.01$, ES = 1.3, large), while those exposed to TGM improved on the MABC-2 dynamic balance test ($p < 0.05$, ES = 3.1, very large) and on the standing left leg balance test ($p < 0.01$, ES = 0.7, moderate). G6 students with DIM improved only on the standing left balance test ($p < 0.01$, ES = 1.0, moderate), while those with TGM improved on the MABC-2 dynamic balance test ($p < 0.01$, ES = 5.7, extremely large) and the MABC-2 static balance test ($p < 0.05$, ES = 0.5, small). Even when examining students in the CG group by separate age groups, there were no improvements in any age group on any of the balance variables.

Table 4. The MABC-2 static and dynamic balance tests and the standing stork right and left leg tests results in the Pre-test (Pre) and Post-test (Post) for students of the direct instructional model (DIM) and the tactical games model (TGM) at each age group.

	G1		G2		G3		G4		G5		G6	
	DIM	TGM	DIM	TGM	DIM	TGM	DIM	TGM	DIM	TGM	DIM	TGM
MABC-2 static (s)												
Pre	4.87 ± 2.80	9.87 ± 10.18	9.33 ± 9.10	9.58 ± 7.75	7.83 ± 4.98	11.50 ± 10.25	12.90 ± 10.88	12.77 ± 10.24	13.00 ± 9.62	18.74 ± 11.13	19.39 ± 9.30	13.06 ± 10.09
Post	6.56 ± 7.26	9.87 ± 6.81	13.09 ± 10.52	11.38 ± 8.76	18.44 ± 8.24**	19.24 ± 11.32#	21.00 ± 11.53*	13.88 ± 8.50	24.00 ± 8.31**	20.39 ± 10.39#	17.76 ± 9.22	18.05 ± 9.59*
%Δ Pre-Post	34.7	0	40.3	18.7	135.5	67.3	62.7	8.3	84.6	8.8	-8.4	38.2
ES	0.2	0	0.3	0.2	1.3	0.7	0.7	0.1	1.3	0.2	-0.2	0.5
MABC-2 dynamic (steps)												
Pre	11.19 ± 4.69	11.86 ± 3.90	5.17 ± 3.90	9.84 ± 5.37	5.35 ± 4.32	5.69 ± 4.52	10.14 ± 4.49	3.94 ± 3.60	10.00 ± 5.52	12.61 ± 4.16	9.62 ± 4.45	4.00 ± 2.97
Post	13.06 ± 2.11	12.07 ± 3.31	13.57 ± 2.19**	10.26 ± 3.60##	14.18 ± 1.07**	14.38 ± 1.08**##	10.14 ± 5.08	7.69 ± 4.75**	10.63 ± 2.96	14.72 ± 0.66*	9.19 ± 3.57	13.95 ± 1.73**##
%Δ Pre-Post	16.7	1.7	162.4	4.2	165.0	152.7	0	95.1	6.3	16.7	-4.4	248.7
ES	0.9	0.1	3.8	0.1	8.2	8.0	0	0.8	0.2	3.1	-0.1	5.7
Standing right (s)												
Pre	17.43 ± 17.23	11.35 ± 7.72	13.47 ± 16.07	18.87 ± 16.63	23.16 ± 15.69	34.25 ± 19.75	27.50 ± 19.67	23.29 ± 23.46	35.89 ± 20.42	40.00 ± 22.72	35.07 ± 20.78	27.72 ± 17.25
Post	22.38 ± 13.61	22.29 ± 18.68*	27.70 ± 19.11**	26.50 ± 20.79	34.44 ± 19.42*	40.44 ± 17.79	33.65 ± 17.28	23.60 ± 11.31	45.00 ± 17.72	41.53 ± 19.72	37.00 ± 22.86	36.82 ± 21.28
%Δ Pre-Post	28.3	96.3	105.6	40.4	48.7	18.0	22.3	1.3	25.3	3.8	5.5	32.8
ES	0.4	0.6	0.7	0.4	0.6	0.3	0.4	0.1	0.5	0.1	0.1	0.4
Standing left (s)												
Pre	15.75 ± 15.16	12.42 ± 9.60	13.91 ± 17.65	20.91 ± 15.50	21.77 ± 17.93	34.81 ± 18.30	35.10 ± 21.14	17.68 ± 18.18	38.36 ± 20.43	38.73 ± 21.72	24.50 ± 21.41	42.81 ± 18.71
Post	17.56 ± 8.24	23.43 ± 21.80	31.13 ± 18.39**	29.83 ± 19.77*	29.33 ± 19.65	42.81 ± 13.08	39.95 ± 16.59	30.87 ± 20.15	45.11 ± 18.99	50.16 ± 15.55**	44.71 ± 20.62**	46.36 ± 11.58#
%Δ Pre-Post	11.4	88.6	123.7	42.6	34.7	22.9	13.8	74.6	17.5	29.51	82.4	8.2
ES	0.2	0.5	0.9	0.5	0.4	0.6	0.3	0.7	0.4	0.7	1.0	0.3

MABC-2 = Movement Assessment Battery for Children-2. DIM = Direct instructional model; TGM = Tactical games model; ES = Effect size. * $p < 0.05$, ** $p < 0.01$, significant difference between Pre and Post. # $p < 0.05$, ## $p < 0.01$, significant difference calculated by a two-way mixed ANOVA (group x time)

Discussion

The aim of this study was to examine the effects of two different 8-week balance-intervention programs (i.e. direct instructional model DIM) and tactical games model (TGM)) on static and dynamic balance in primary school students. A large body of literature has been devoted to investigations of the effects of such interventions on balance-related test scores in adolescents (Granacher, Gollhofer, & Kriemler, 2010), university-aged students (Kibele & Behm, 2009) and children with disabilities (Gupta, Rao, & Kumaran, 2011), but such studies on typically developing children are scarce and, to date, no prior studies have compared balance intervention programs to improve static and dynamic balance in primary school students. Yet, this information could enable physical education professionals to assist children with the development of these skills through better designed intervention programs. Our most important finding was that both 8-week balance intervention programs, when integrated into primary school physical education lessons, significantly improved children's balance, relative to a no-intervention control group. Furthermore, our two methodological approaches (i.e. DIM and TGM) had different effects on children's balance learning, depending on the students' ages.

Since there are few dedicated hours of physical education in most schools (i.e. 1.40-2 hours/week in Spain), it is important to know what type of intervention program is optimal for improving static and dynamic balance. In the present study, while both DIM and TGM approaches led to balance improvements in this population, we found differences between our balance intervention programs. Others have also shown intervention differences in other populations or when training different motor development skills (Chaouachi et al., 2014; Trajković et al., 2017), and some have demonstrated improved balance-related test scores with balance intervention programs (Granacher, Gollhofer, & Kriemler, 2010; Granacher et al., 2011).

Apart from analyses of our participant sample as a whole, we analyzed data for these participants in separate age groups (i.e. G1-G6). We found few improvements among G1 students with either program. To our knowledge, only Granacher et al. (2011) specifically examined balance intervention program effects among 6-year-old children, and our results are in line with findings from this research team (who studied postural sway) in that both studies showed only improvement tendencies and no statistically significant improvements in this age group. This is likely because of incomplete and inhomogeneous neuromuscular maturation in children of this age (Granacher et al., 2011; Riach and Hayes 1987) and/or difficulty G1 children (age six years) encounter assimilating the intervention programs. Furthermore, it is also possible that the assessment tasks are relatively harder for children this young, such that the assessment was unable to detect as much change in this group. However, as Wälchli et al. (2017) found, children of more advanced ages do show beneficial effects of balance intervention programs. We found, that for most balance measures, G2 children benefitted most from DIM, G3 benefitted from both DIM and TGM, and among G4-G6 children TGM was most effective. Therefore, it seems that TGM tasks are less effective at early ages when students are not yet prepared, feel overwhelmed and tend to fatigue easily (Holmberg, 2009). In contrast, as the children mature and develop greater readiness, TGM intervention programs become more effective. Therefore, our findings suggest that physical education professionals should consider implementing DIM programs to younger primary school children and TGM to children in more advanced grades. It could be interesting to analyse in future researches the effects of difference frequency and length programmes in each age.

Among this study's limitations are that the distribution of classes in the school prohibited randomly assigning children to intervention groups. We relied on convenience sampling, since all students were from the same school, and we did not separately analyse boys and girls. Future studies should address these limitations with large, representative samples, random assignment to groups, gender analyses and longer intervention program.

Conclusions

Both our balance intervention programs improved static balance and dynamic balance in primary school students, relative to a no-intervention control group, suggesting that balance intervention programs suitable generally for this population. We also found that children in early stages of primary school benefitted most from a DIM balance program, in which skills were taught and practiced in isolation and in which students worked individually. Older children (>8 years) benefitted most from a TGM balance program, in which learning was embedded within game activities. This study has implications for physical education professionals who wish to design optimal programs for primary school children in that these two different intervention approaches each seem best suited for groups of different aged children.

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WHICH INSTRUCTIONAL MODELS INFLUENCE MORE ON PERCEIVED EXERTION, AFFECTIVE VALENCE, PHYSICAL ACTIVITY LEVEL AND CLASS TIME IN PHYSICAL EDUCATION?

The purpose of educational is to replace an empty mind with an open one.

Malcome S. Forbes

Paper 4

Which instructional models influence more on perceived exertion, affective valence, physical activity level and class time in physical education?

Josune Rodríguez-Negro and Javier Yanci

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Chapter 6. Paper 4

Which instructional models influence more on perceived exertion, affective valence, physical activity level and class time in physical education?

Josune Rodríguez-Negro[1] and Javier Yanci[1]

[1]*Faculty of Education and Sport, University of the Basque Country, UPV/EHU, Vitoria-Gasteiz, Spain*

Abstract

The aim of this study was to examine the effects of two different instructional models (i.e. direct instructional model (DIM) and tactical games model (TGM)) with primary education students. Perceived exertion, affective valence, physical activity (PA) level, instruction time, active learning time and relation of instruction/active learning time were measured with 256 primary education students during DIM and TGM 8 weeks intervention programs. Significant differences were found between the DIM and TGM in perceived exertion, PA level, instruction time and in the relation between instruction/active learning time ($p < 0.01$, ES = -0.4 to 1.1). By age group, the DIM had significantly higher PA level in students of 3rd grade of primary education (G3), 4th grade (G4) and 6th grade (G6) ($p < 0.05$ or $p < 0.01$, ES = -0.8 to -0.4). The instructional model used during physical education classes can affect perceived exertion, PA level, instruction time and the relation instruction/active learning time.

Key words*:* children; learning; student; pedagogy; skills.

Introduction

It has been widely documented how important it is for children to perform regular physical activity (PA) for achieving benefits in the health, psychological and social domains (Eime, Young, Harvey, Charity, & Payne, 2013). In this sense, school physical education (PE) is an ideal context to implement interventions for a large number of children (Boddy, Fairclough, Atkinson, & Stratton, 2012) and to positively impact on children's integral development (Fairclough et al., 2016; García et al., 2018). Despite this, weekly PE hours in many primary schools are scarce, and children often do not meet PA daily recommendations (World Health Organisation, WHO, 2010).

For this reason, it would be interesting to ascertain if the type of instructional model applied in PE classes can condition some effects (perceived exertion, affective valence, PA level, instruction time, active learning time and relation of instruction/active learning time) they have on students. Instructional models are comprehensive and coherent plans that promote the achievement of specific standards and learning outcomes within each content unit, and in PE classes there have been identified eight instructional models that are commonly used: direct instruction, personalized system for instruction, cooperative learning, sport education, peer teaching, inquiry, tactical games and teaching for personal and social responsibility model (Metzler, 2011). Between them, there are two dominant instructional models in primary education PE classes, direct instruction model (DIM) and tactical games model (TGM). With DIM, teacher is the primary source for content and decisions, and introduces repetitive individual drill practices. Teacher structures the learning by proceeding in small steps, and learners tried to reproduce teacher's model of performance (Gurvitch & Metzler, 2010; Metzler, 2011). With TGM, teacher teaches based in teaching games for understanding approach. Games are broken into their simples format, and then they increase complexity (Metzler, 2011). Strategy and tactics are essential in TGM and the teacher frames the learning task so that students can understand how the task is performed in game conditions (Gurvitch & Metzler, 2013). Knowing the effects of these instructional models in different dimensions could be especially relevant for improving the teaching-learning process.

Something we believe PE teachers should take into account when choosing one instructional model or another is the students' psychological responses, such as perceived exertion or affective valence. Several previous studies have measured primary school students' rating of perceived exertion (RPE) (Bendiksen et al., 2014), since it was observed that it is an adequate indicator of the work done during PA (Rodríguez, Zambrano, & Manterola, 2016). In the same way, the affective response to PA is the subjective experience of any valence (pleasant or unpleasant) state in response to acute PA (Schneider & Kwan, 2013) and it is one of the most significant components of mental activity (Panksepp, 2012). There is evidence that a positive affective response experienced during PA settings, such as PE classes, will lead to greater enjoyment of the session (Fairclough & Stratton, 2005), promote a positive memory of the experience (Parfitt, Rose, & Burgess, 2006), enhance motivation for PA (Edmunds, Ntoumanis, & Duda, 2008; Focht, 2009) and increase exercise adherence (Williams Dunsiger, Jennings, & Marcus, 2012). Therefore, it could be especially important to increase the affective valence of students in primary school. Nonetheless, different affective responses could be experienced depending on the instructional model (Raedeke, Fotch, & Scales, 2007; Rose & Parfitt, 2010). Even if it is traditionally considered that there is a lack of enjoyment with the DIM (Wall & Côté, 2007), there are few studies that have analysed this aspect in primary (Wall & Côté, 2007) and secondary school (Koka & Hagger, 2010), so it is necessary to carry out more research into how the instructional model used affects affective valence.

Another important aspect to take into account when choosing one instructional model or another during a PE class is the time students will have to perform the motor actions and the PA levels students are going to reach during the lesson (Harvey, Song, Baek, & Van der Mars, 2015), as PA during PE could make a significant contribution to total daily PA levels (Lonsdale et al., 2013). Currently, even if PA in childhood is associated with many health benefits (Collings et al., 2017), the majority of children fail to meet PA recommendations (Ekelund et al., 2012; Lu et al., 2017). Moreover, the time of theoretical practice in PE lessons does not correspond to the instruction time (time when students are on the sports track) or the active learning time for practice (time when students can perform motor actions) (Hernández-Álvarez, del-Campo-Vecino, Martínez-de-Haro, & Moya-Morales, 2010; Olmedo, 2000). It is important to have as much active learning time as possible during PE sessions, as students who spend more time doing good practices tend to learn more (Rink, 2003). Therefore, it would be interesting to know if the instructional model used conditions PA, instruction time or active learning time.

Thus the aims of this study were 1) to examine the effects of two different instructional models (i.e. DIM and TGM) on perceived exertion, affective valence, PA level, instruction time, active learning time and relation of instruction/active learning time in primary education students, and 2) to analyse the differences in the results according to the age of the students.

Materials and methods

Participants

A total of two hundred and fifty-six students (6-12 yr) from a Spanish primary education state school were enrolled in this investigation. Participants were divided into two groups according to the instructional model used in the PE lessons, namely, the direct instruction (DIM, n = 125, 61 boys and 64 girls), and tactical games model (TGM, n = 131, 63 boys and 68 girls). At the beginning of primary education the school randomly divides same age students in 2 groups, so we used those prior fixed classes. Before participation, participants and parents or legal guardians were informed about the aim and the design of the study and signed an informed consent. The management team of the primary education school to which the students belonged approved the study. The study was performed in accordance with the Helsinki Declaration (2013) and was approved by the Ethics Committee of the University of the Basque Country. The age, body height, body mass, and body mass index (BMI) of all participants and the groups according to the instructional model used, are summarised in Table 1.

Table 1. Participants' characteristics.

		Age (yr)	**Mass** (kg)	**Height** (m)	**BMI** (kg/m^2)
All		8.62 ± 1.84	32.24 ± 8.39	1.34 ± 0.11	17.71 ± 2.60
DIM	**All**	8.66 ± 1.77	32.49 ± 9.06	1.34 ± 0.11	17.73 ± 2.93
	G1	6.00 ± 0.00	24.60 ± 4.29	1.19 ± 0.06	17.10 ± 1.72
	G2	7.17 ± 0.38	26.46 ± 4.57	1.28 ± 0.03	16.05 ± 2.11
	G3	8.05 ± 0.21	32.02 ± 7.16	1.32 ± 0.04	18.14 ± 3.21
	G4	9.05 ± 0.21	31.97 ± 5.70	1.32 ± 0.05	18.07 ± 2.64
	G5	10.14 ± 0.35	37.19 ± 9.59	1.42 ± 0.07	18.06 ± 3.50
	G6	11.17 ± 0.38	40.40 ± 8.46	1.48 ± 0.07	19.09 ± 3.27
TGM	**All**	8.58 ± 1.74	32.64 ± 9.04	1.33 ± 0.11	18.00 ± 2.67
	G1	6.00 ± 0.00	24.55 ± 5.17	1.18 ± 0.05	17.23 ± 2.52
	G2	7.04 ± 0.20	28.07 ± 4.82	1.25 ± 0.06	17.79 ± 2.17
	G3	8.20 ± 0.41	30.34 ± 6.18	1.31 ± 0.04	17.59 ± 2.88
	G4	9.00 ± 0.00	33.78 ± 6.56	1.36 ± 0.05	17.98 ± 2.48
	G5	10.00 ± 0.00	35.23 ± 4.33	1.41 ± 0.05	17.49 ± 1.59
	G6	11.04 ± 0.20	43.00 ± 11.18	1.46 ± 0.07	19.69 ± 3.47

BMI = Body mass index. DIM = Direct instruction model, TGM = Tactical games model, G = Age group

Procedure

In this study, we examined the effects of two different instruction models on perceived exertion, affective valence, PA level, instruction time, active learning time and relation of instruction/active learning time in primary education students. Measures were carried out during 8 weeks, and students had a 90 min PE class each week. The PE classes with the selected instructional model and all assessments were carried out during PE classes at the school sports centre from January to March 2016. The children received an oral explanation about the assessment procedure and they completed a two-week-trial assessment to become familiar with it. Students of each age-group were divided into two groups, according to the instructional model used in the PE lessons (i.e. DIM, TGM).

Measures

Perceived Exertion: Perceived exertion was assessed using the Children's OMNI Scale of Perceived Exertion (OMNI Scale) (Robertson et al., 2000). The OMNI Scale has a category range of 0-10 and mode-specific pictorial descriptors in addition to child-friendly verbal descriptors to assist them in rating their perceived exertion. The scale was posted around the gym so students could always clearly see the scale when rating. The OMNI Scale has been validated with children over a range of ages from 6 to 15 years old (Rice, Gammon, Pfieffer, & Trost, 2015).

Affective valence: The valence (pleasure/displeasure, good/bad) component of affect was measured using the Feeling Scale (FS) (Hardy & Rejeski, 1989). At the end of the session participants rated their feelings on an 11-point bipolar scale ranging from +5 to -5, with verbal anchors of very good (+5), good (+3), fairly good (+1), neutral (0), fairly bad (-1), bad (-3), and very bad (-5). The FS has been validated for using in the PA context (Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000).

Physical activity (PA) level: The number of steps taken per PE lesson was counted by means of an electronic pedometer (Yamax Digiwalker SW-650, Yamax Corporation, Toyko, Japan), as pedometry measurement has been found to be a relative indicator of PA (McNamara, Hudson, & Taylor 2010). Pedometer accuracy studies have found that the Yamax Digi-Walker step-counters accurately record steps at various speeds and conditions (Coffman, Reeve, Butle, Keeling, & Talbot, 2016). An explanation about how to use the pedometer was given to the participants, and they were provided with a sheet to record the number of steps they took in each PE lesson. Participants were asked to wear the pedometer clipped to their waistband on the right hip from the moment they started the lesson to the moment they went back to the locker room.

Instruction time, active learning time and relation of instruction/active learning time: Instruction time was recorded taking into account the time from the moment that students left the locker room to the moment they went back to the locker room again, thus considering the time students were on the multi-sports track in the sports centre where the PE sessions were held (Olmedo, 2000). The recording of the active learning time for PE class only considered the time in which the students could perform some motor action within the PE lesson (Olmedo, 2000). This excluded commuting times to the sports hall, the time in the locker room and the time spent on various explanations and interruptions by the teacher when they could not practise motor skills. The ratio instruction time/active learning time was calculated by dividing the instruction time by the active learning class time for each PE session.

Intervention programme description.

The 8-week balance-intervention programmes were carried out in a 90 min weekly session and were held during PE classes. Each session started with a standardised warm-up (10 minutes). In this study, fidelity of treatment was assessed by collecting data on the instructional models' characteristics and tasks done, using an ad hoc system for observing instructional models. Moreover, the teacher was trained to deliver PE using these instructional models. The DIM included class sessions where teacher introduced repetitive individual drill practices and structured the learning by proceeding in small steps. Learners tried to reproduce teacher's model of performance and the teacher provided feedback and corrections (Metzler, 2011). The learning domain priority was the psychomotor learning (Gurvitch & Metzler, 2010) focusing in developing balance patterns, and the teacher was the primary source for content and decisions, giving detailed and repeated instructions and explanations. During class sessions where TGM instructional model was scheduled, teacher was directed to teach the balance unit through contextually-authentic tasks, based in teaching games for understanding approach. Games were broken into their simples format, and then they increased complexity, and strategy and tactics were essential (Metzler, 2011). The learning domain priority was the cognitive (Gurvitch & Metzler, 2010) and the teacher frames the learning task so that students can understand how the task is performed in game conditions (Gurvitch & Metzler, 2013).

Statistical analysis

The results are presented as mean ± standard deviation (SD). Independent paired t-tests were used to determine whether any significant differences existed between the DIM and TGM groups in perceived exertion, valence of affect, PA level, instruction time, active learning time and relation of instruction/active learning time in all participants and in each age range (i.e. G1-G6). The mean differences were calculated in percentage (Mean Dif. %): [(Mean2-Mean1)*100]/Mean1. Furthermore, to allow a better interpretation of the results, practical significance was assessed by calculating effect size (ES) = (Mean2-Mean1)/SD2. ES were classified as trivial (< 0.2), small (0.2 to 0.6), moderate (0.6 to 1.2), large (1.2 to 2.0), very large (2.0 to 4.0) and extremely large (> 4.0) (Hopkins, Marshall, Batterham, & Hanin, 2009). The inter-session coefficient of variation (CV = SD/Mean) was calculated for each instructional model (i.e. DIM and TGM) and for each instructional model in each age group (i.e. G1-G6). Data analysis was performed using the Statistical Package for Social Sciences (SPSS, version 20.0 for Windows, Chicago, IL, USA). Statistical significance was set at $p < 0.05$.

Results

Perceived exertion, affective valence, PA level, instruction time, active learning time and relation of instruction/active learning time results for students of all groups in each instructional model (i.e. DIM or TGM) are presented in Table 2. Significant differences were found between the DIM and TGM in perceived exertion ($p < 0.01$, ES = -0.5), PA level ($p < 0.01$, ES = -0.4), instruction time ($p < 0.01$, ES = 0.4) and in the relation between instructional/active learning time ($p < 0.01$, ES = 1.1). However, no significant differences were found between the DIM and TGM in affective valence and active learning time ($p > 0.05$, ES = -0.1 to 0.1). Moreover, in both instructional models the inter session CV was less than 0.25%.

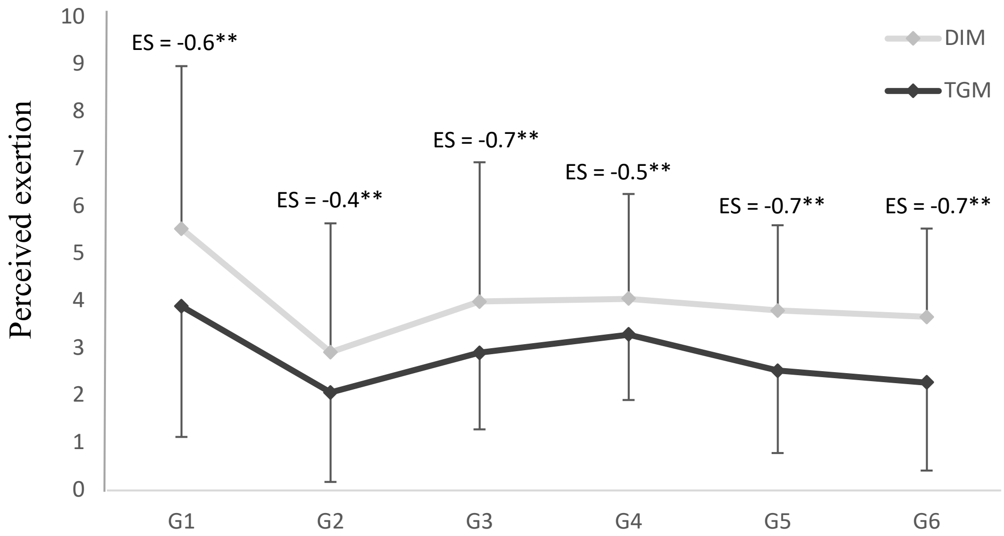
Table 2. The perceived exertion, affective valence, PA level, instruction time, active learning time and relation of instruction/active learning time results during the intervention program for all students of the direct instruction model (DIM) and the tactical games model (TGM).

	DIM	**TGM**	**DI-TGM** ES, (Dif. %)
Perceived exertion	3.89 ± 2.62	2.74 ± 2.03	-0.5** (-29.56)
Inter session CV (%)	0.11	0.17	
Affective valence	3.57 ± 2.31	3.72 ± 2.09	0.1 (4.20)
Inter session CV (%)	0.06	0.05	
PA level (steps/session)	2981.45 ± 1597.74	2607.46 ± 936.24	-0.4** (-12.54)
Inter session CV (%)	0.12	0.05	
Instruction time (min/session)	51.35 ± 8.47	54.22 ± 6.53	0.4** (5.6)
Inter session CV (%)	0.05	0.19	
Active learning time (min/session)	30.16 ± 6.55	29.51 ± 7.55	-0.1 (-2.15)
Inter session CV (%)	0.14	0.25	
Relation instruction time /active learning time	1.45 ± 0.29	1.89 ± 0.38	1.15** (30.34)
Inter session CV (%)	0.06	0.08	

ES = effect size, Dif. % = mean differences in percentage, CV = coefficient of variation, PA = physical activity.
** $p < 0.01$, significant difference between instructional models (i.e. DIM and TGM).

Figure 1 shows the perceived exertion and affective valence results for students from both instructional models in each school year (i.e. G1-G6). Students of the DIM had significantly higher values than those of the TGM in perceived exertion in all the age groups ($p < 0.01$, ES = -0.4 to -0.7), but in affective valence differences were just found between instructional models in G6 ($p < 0.01$, ES = 0.7).

1A)



1B)

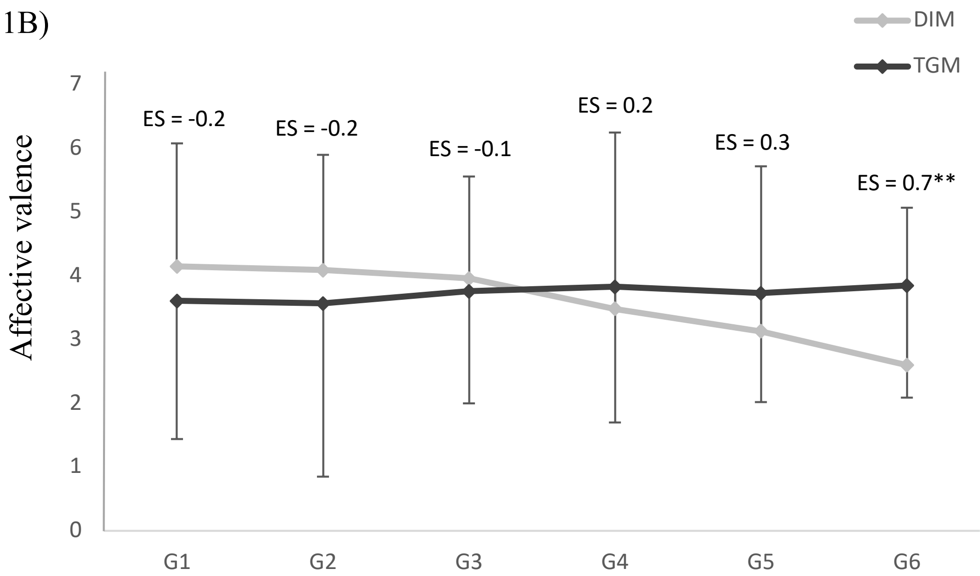


Figure 1. The perceived exertion (1A) and affective valence (1B) results for students of the direct instruction model (DIM) and the tactical games model (TGM) in each age group.
ES = effect size between DIM and TGM. G = age group. ** $p < 0.01$, significant difference between instructional models (i.e. DIM and TGM).

The PA level results for students of each instructional model (i.e. DIM or TGM) in each school year (i.e. G1-G6) are presented in Figure 2. Students of the DIM had a significantly higher PA level during PE sessions than those of the TGM in G3 ($p < 0.05$, ES = -0.8), G4 ($p < 0.05$, ES = -0.4) and G6 ($p < 0.01$, ES = -0.8). However, significant differences were not found between the PA level of the instructional models in G1, G2 and G5 ($p > 0.05$, ES = -0.1 to -0.2).

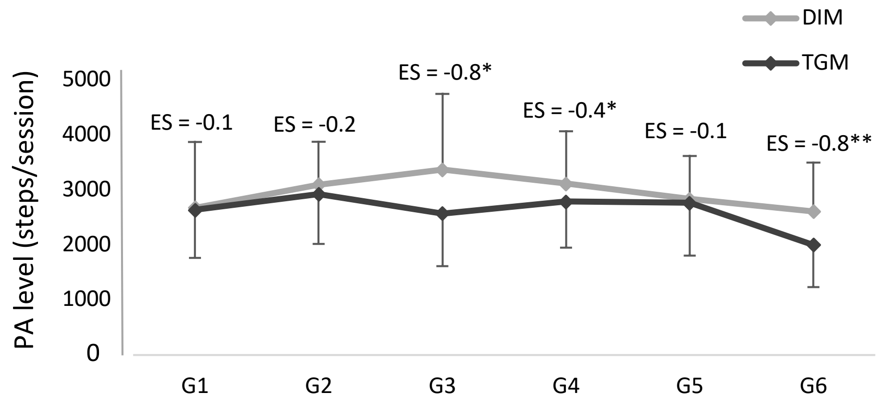
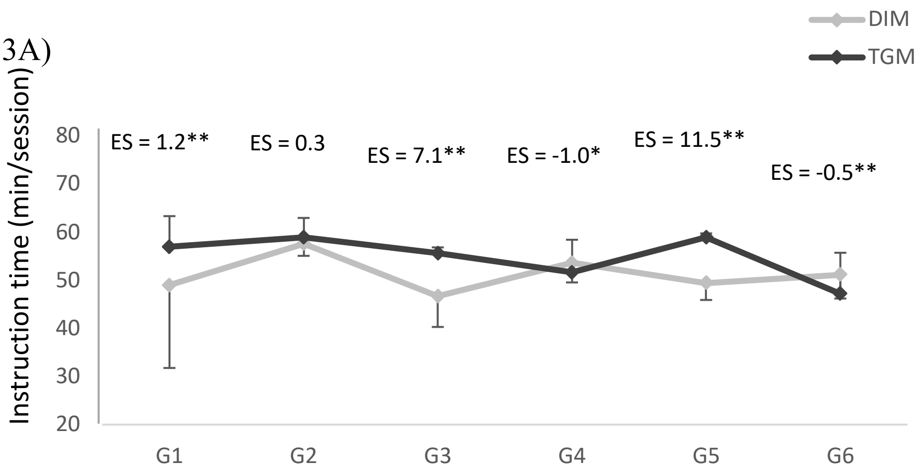
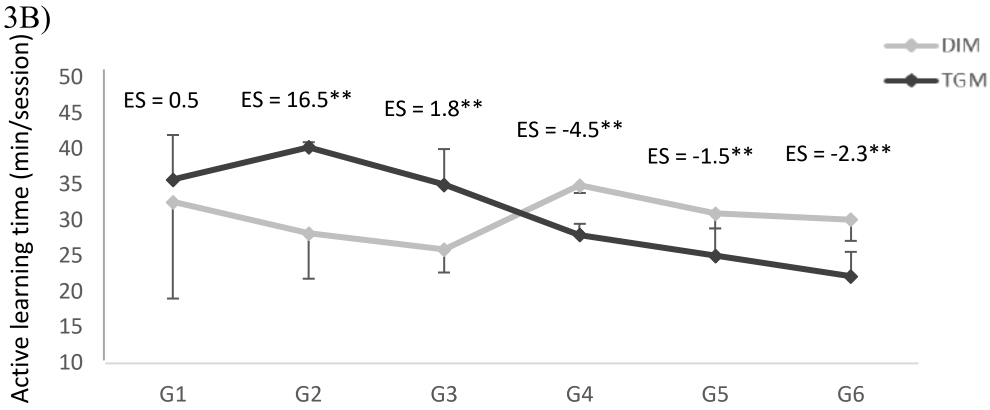


Figure 2. The physical activity (PA) level results for students of the direct instruction model (DIM) and the tactical games model (TGM) in each age group (i.e. G1-G6).
ES = effect size between DIM and TGM. G = age group. * $p < 0.05$, ** $p < 0.01$, significant difference between instructional models (i.e. DIM and TGM).

Figure 3 shows the instruction time, the active learning time and the relation between instruction/active learning time results for students from both instructional models in each school year (i.e. G1-G6). Significant differences were shown between the instruction time of the DIM and TGM in G1 ($p < 0.01$, ES = 1.2), G3 ($p < 0.01$, ES = 7.8), G4 ($p < 0.05$, ES = -1.0), G5 ($p < 0.01$, ES = 11.5) and G6 ($p < 0.01$, ES = -0.5). Regarding active learning time, in G1, G2 and G3 the highest values were found in the TGM ($p < 0.01$ or $p > 0.05$, ES = 0.5 to 16.5), while in G4, G5 and G6 the highest values were found in the DIM ($p < 0.01$, ES = -1.5 to -4.5). In the relation between instruction/active learning time, in G2 and G3 the smallest ratio was found in the TGM ($p < 0.01$, ES = -0.7 to -9.4). However, in G4, G5 and G6 the biggest ratio was found in the TGM ($p < 0.01$, ES = 2.0 to 3.1). Moreover, the inter session CV for all the variables in each age group (i.e. G1-G6) was 0.03-0.57% in the TIM, and 0.01-0.47% in the TGM.

3A)





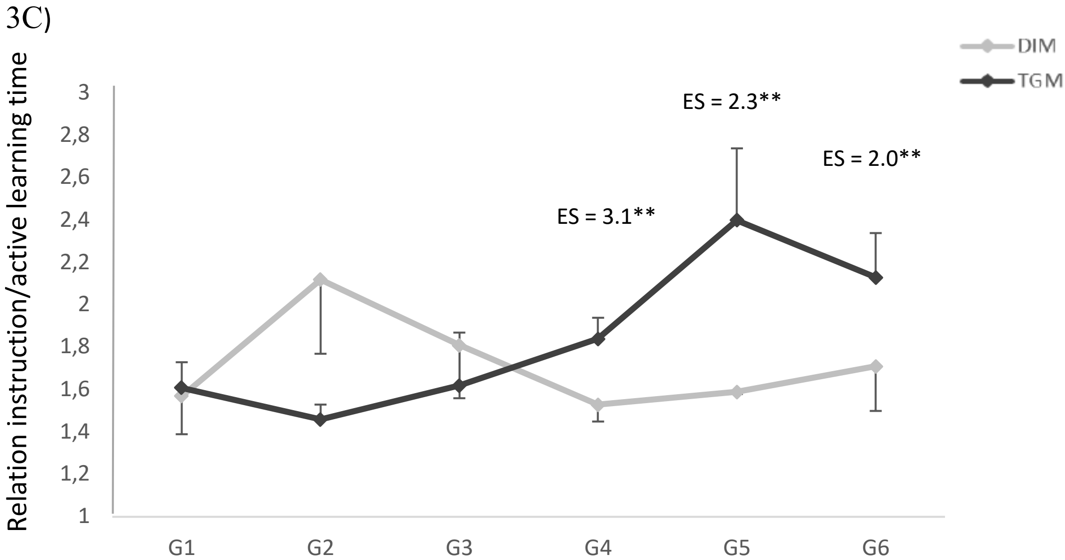


Figure 3. The instruction time (3A), active learning time (3B) and relation between instruction/active learning time (3C) results for students of the direct instruction (DIM) and the tactical games model (TGM) in each age group.
ES = effect size between DIM and TGM. G = age group. * p < 0.05, ** p < 0.01, significant difference between instructional models (i.e. DIM and TGM).

Discussion

The aim of this study was to examine the effects of two different instructional models (i.e. DIM and TGM) on perceived exertion, affective valence, PA level, instruction time, active learning time and relation of instruction/active learning time in primary education students. As far as we know, this is the first study to compare the effects of these two instructional models on the aforementioned variables in primary school students. For the whole group without age distinction, a significantly higher perceived exertion and PA level was observed with the DIM, while more instruction time and relation instruction/active learning time were recorded in the

TGM. Therefore, the instructional model used during the PE sessions can affect perceived exertion, PA level, instruction time and the relation instruction /active learning time.

There is controversy about whether the same content applied with two different instructional models can affect what happens during PE sessions. In the present study, we have observed significant differences between the DIM and TGM in perceived exertion, PA level, and instruction time and in the relation between instruction/active learning time for all the students. A significantly higher perceived exertion and PA level were observed with the DIM, even if more instruction time and a higher instruction/active learning time relation were recorded in the TGM. However, in this study no significant differences were found between the DIM and TGM in affective valence and active learning time. Our results are in line with several studies that have found differences in perceived exertion (Vallabhajosula, Holder, & Bailey, 2016), PA level (Fairclough et al., 2016; McClain, Yun, & Van der Mars, 2014) and session times (Chinchilla & López, 2010), between two different instructional models in school age children. Probably, students achieved higher levels of PA during the DIM because the characteristics of DIM tasks make students spend less time waiting and more time in action. In addition, an increase in the level of PA may have caused an increase in the students' perceived exertion. Although the instruction time and the relation instruction/active learning time were greater in the TGM, instruction time could not be an indication of the type of activity, as staying longer in the sport facility does not ensure effective practice time and does not indicate the intensity of the exercise. Therefore, as indicated by the results obtained in this study, if the main objective of PE teachers is to increase the PA level, it might be advisable to use the DIM in their PE sessions.

Besides the analysis of all participants, it may be also necessary to analyse all the selected variables in each instructional model (i.e. DIM or TGM) according to the students' age group (i.e. G1-G6). In the present study, although a greater level of PA was observed only in G3, G4 and G6 with the DIM than with the TGM, greater perceived exertion with the DIM was found in all groups (G1-G6). A previous research concluded that TGM can accumulate recommended PA goals for PE (Harvey, Song, Baek, & van der Mars, 2015), but they did not make the comparison with the PA level in DI. Our results are in line with the investigation of Fairclough et al. (2016), and with the findings presented in the systematic review by Lonsdale et al. (2013) that concluded that there are differences in PA levels according to the intervention carried out in PE sessions. Moreover, as in the present study, some previous studies have also observed differences in perceived exertion between two instructional models in primary school age children (Vallabhajosula, Holder, & Bailey, 2016). Taking into account that in G1, G2 and G5 there were no differences between instructional models in the PA level but the perceived exertion was greater with the DIM in all school years, it seems that regardless of having done or not more PA, students perceive a lower exertion in the TGM. Possibly, due to the nature of the tasks, the sessions based on games decrease the perceived exertion of the students.

Regarding affective valence, the results show only differences in G6, presenting a greater affective valence with the TGM than with the DIM. Some previous research has observed different affective responses to two instructional models in children from 10 years old (Fairclough et al., 2016) and younger (Edmunds et al., 2008; Raedeke, Fotch, & Scales, 2007). These results lead us to think that despite the fact that at an early age (<10 years) the affective valence is similar regardless of applying a DIM or TGM instructional model, from 10 years onward, games may be more suitable to ensure greater affective valence. Having a greater affective valence in PE sessions could be beneficial to maintain the practice of PA (Williams et al., 2012). Based on these results, PE teachers should bear in mind that in the first years of primary school it may make no difference to use one instructional model or another (DIM or TGM) in order to increase affective valence in the students. However, with students in the last courses, the use of the TGM may be much more suitable to improve affective valence.

On the other hand, most research studies find that PE instruction and active learning class time could change depending on the characteristics of the session (Pieron, 2005; Silverman, 2005) and that a large amount of time is dedicated to administrative and organisational procedures (Waring, Warburton, & Martin, 2009). Due to the short time available for PE sessions (in many cases less than the recommended 150 min per week) (Pate et al., 2006) optimising the instruction and especially the active learning time may be relevant. In the present study, we have observed that at early ages (G2-G3) there is more active learning time with the TGM than with the DIM, but from 9 years old (G4-G6) students have more active learning time with the DIM than with the TGM. It seems that age can affect the active learning time and that the application of different instructional models at different ages can produce different active learning time. Our results partially differ from those of Chinchilla and López (2010), because even if they obtained the same results as us in active learning time in G1-G2 with two different instructional models, they observed more active learning time in G5 and G6 with the TGM. The results of both studies seem to indicate that in higher courses the TGM can cause more active learning time so its use at these ages could be interesting. However, at initial ages the results are unclear. While Chinchilla and López (2010) did not obtain differences, the results of our study indicate that the DIM was more effective in the increase of active learning time. Therefore, more studies are needed to investigate this aspect in greater depth and to understand which factors affect active learning time at each age or school year and especially in the first years of primary school.

The findings of the present pilot study may have implications for PE teachers. Coinciding with many studies on the same topic of interest, these results lead us to think that the instructional model used during the PE sessions can affect perceived exertion, PA level, instruction time and the relation instruction/active learning time, and that the effect is different according to the students' ages. Therefore, PE teachers should take into account what they want to give priority to during their PE sessions (i.e. increase PA level, increase students' valence of affect, increase perceived exertion, increase the instruction or active learning time…) in order to choose the instructional model that is most appropriate for achieving it.

Some limitations that should be noted in this study. Due to the distribution of the classes by the school, the intervention groups could not be randomised and students groups were of small size. Furthermore, the type of tasks done by each group and the personal characteristics of the students and teachers may have been able to influence the results obtained. Moreover, the study used convenience sampling since all the students were from the same school, so it could be interesting to expand the sample to make it more representative of different socio-educational contexts.

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EFFECTS OF TWO DIFFERENT INSTRUCTIONAL MODELS ON CREATIVITY, ATTENTION, AND IMPULSE CONTROL AMONG PRIMARY SCHOOL STUDENTS

We don't stop playing because we grow; we grow old because we stop playing.

George Bernard Shaw

Paper 5

Effects of two different instructional models on creativity, attention and impulse control among primary school students

Josune Rodríguez-Negro and Javier Yanci

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Chapter 7. Paper 5

Effects of two different instructional models on creativity, attention and impulse control among primary school students.

Josune Rodríguez-Negro[1], and Javier Yanci[1]

[1]*Faculty of Physical Education and Sport, University of the Basque Country, UPV/EHU, Vitoria-Gasteiz, Spain*

Abstract

The aim of this study was to investigate the effects of two different physical education intervention programmes on cognitive functions (i.e. creativity, attention and impulse control) in primary education students. These dimensions were measured in 168 children (8-12 years) before and after two 8-week intervention programmes with different methodological approaches [i.e. direct instructional model (DIM) and tactical games model (TGM)]. The results show an improvement in creativity ($p < 0.01$, ES = 0.6, moderate) and attention ($p < 0.01$, ES = 1.0, moderate) in all students after the TGM programme. Older students (grade 6) also improved impulse control after TGM ($p < 0.01$, ES = 1.5, large). No significant differences were observed after the DIM in any of the analysed cognitive functions ($p > 0.05$). These results lead us to think that TGM could be an effective tool for improving children's cognitive functions.

Key words: physical education; cognitive functions; children; game, intervention programme.

Introduction

In recent decades, physical exercise has been promoted as a valuable tool for achieving benefits in health (Schwarzfischer et al., 2017), social domains (Eime et al., 2013) and academic performance (Álvarez-Bueno et al., 2017). Moreover, there is an increasing body of literature that has reported positive effects of physical exercise on cognitive functions in primary school students (Kulinna et al., 2018; Vanhelst et al., 2016), and physical fitness seems to be a predictor of cognitive functions (Latorre et al., 2017). Specifically, physical exercise may enhance creativity (Bollimbala, James, & Ganguli, 2019; Colzato et al., 2013), attention (Gallotta et al., 2015; Kulinna et al., 2018) and impulse control (Den Heijer et al., 2017). These cognitive functions play a significant role in school settings, since creativity, attention and impulse control are key elements in comprehension and learning processes (Diamond, 2006; Pesce et al., 2009), thereby contributing to learning and academic performance (Latzman et al., 2010; Stevens & Bavelier, 2012).

The positive effects of exercise on the above-mentioned cognitive functions could be due to the changes in the cerebellum, frontal or prefrontal cortex and motor cortices (Diamond, 2000; Dietrich, 2006; Schenider et al., 2009). Actually, some studies have shown that physical exercise increases grey matter volume (Erickson et al., 2011), and reduces damage in the grey matter (Chaddock-Heyman et al., 2014). Furthermore, there is a decrease in cortical brain activity (Schneider et al., 2013; Wollseiffen et al., 2018) and an increase of blood flow (Mandolesi et al., 2017) after an exercise session, and this may cause an improvement in the cognitive functions. Besides, a relocation of attention could also be caused by the joy of exercise (Schenider et al., 2009; Schneider et al., 2013), as satisfaction regarding physical activity and exercise preferences are linked to cortical activation in frontal cortex areas and to an improvement in cognitive functions (Schneider et al., 2009; Shibata et al., 1997). It seems that there is a cognitive function development slump beginning especially from the fourth grade of primary education (Claxton et al., 2005; Kim, 2011), so it is essential to research how to stimulate cognitive functions in school-age children. For this purpose, school physical education (PE) seems to be an ideal context to improve students' creativity, attention capacity and impulse control (Doron, 2016; Gallotta et al., 2015; Vanhelst, 2016).

Although there has been growing interest in physical exercise due to its positive effects on cognitive functions in people of different ages (Mandolesi et al., 2018; Weinberg & Gould, 2015), less attention has been drawn to the qualitative characteristics of physical exercise for children's cognitive development (Diamond, 2015; Tomporowski et al., 2015). In this respect, it has been stated that the effects of physical exercise on cognitive functions are influenced by some characteristics of the physical exercise performed, such as type, duration and intensity (Budde et al., 2010; Iuliano, et al., 2015; Pesce et al., 2009). Furthermore, the methodological approach used in PE lessons could also affect school-age children's cognitive functions (Pesce et al., 2016). When teaching PE in the school setting, two fundamental methodological approaches for teaching appear: the traditional instructional model (DIM) and the tactical games model (TGM) (Miller, 2015; Ishihara et al., 2017; Rodríguez-Negro & Yanci, In press). DIM for teaching PE offers a method based on students individually performing repetitive exercises under fixed conditions (Ishihara et al., 2017; Rodríguez-Negro, Falese, & Yanci, 2019). TGM, in contrast, situates learning within game activities, so students need to coordinate complex body movements and to adapt to continually changing task demands (Trajković et al. 2016; Trajković, Krističević, & Sporiš 2017). Some research has analysed the effects on children's motor skills after participating in a TGM (Pesce et al., 2016; Rodríguez-Negro & Yanci, In press; Silverman, 2016) or DIM intervention programme (Rodríguez-Negro, Falese, & Yanci, 2019), but no research has compared the effects of each methodological approach on creativity, attention and impulse control in primary school students. It would be interesting to know the effects of these two instructional models, widely used in PE, specifically on cognitive functions of primary school students, since cognitive functions are relevant for learning and academic performance (Latzman et al., 2010; Stevens & Bavelier, 2012).

Additionally, an essential point to contemplate when exploring the effects of intervention programmes on cognitive functions is to avoid laboratory settings (Schneider et al., 2013), and to interfere as little as possible with the students' natural environment to achieve contextually relevant ecological validity (Kulinna et al., 2018). Following all these ideas, the aim of this study was to investigate the effects of two different 8-week intervention programmes imparted by teachers during real PE lessons with different methodological approaches (i.e. DIM and TGM) on cognitive functions (i.e. creativity, attention and impulse control) in primary education students.

Methods

Participants

A total of one-hundred and sixty-eight elementary education students (8-12 yr.) from a Spanish elementary state school were enrolled in this investigation. Students were divided into two groups and each group was randomly assigned to an intervention programme, namely, DIM (n = 83) and TGM (n = 85). Students were also divided into 4 groups according to age (i.e. G3 to G6). The age, body height, body mass, and body mass index (BMI) of all participants and groups according to the intervention programme administered, are summarised in Table 1. Before participation, participants and parents were informed about the aim and the design of the study, and the parents signed an informed consent. The management team of the elementary school to which the students belonged approved the study. The study was performed in accordance with the Helsinki Declaration (2013) and was approved (CEISH, code 2015/147) by the Ethics Committee of University of the Basque Country.

Table 1. Participants' characteristics.

		Age (yr)	**Mass** (kg)	**Height** (m)	**BMI** (kg/m^2)
DIM	**All**	9.59 ± 1.07	35.37 ± 8.53	1.38 ± 0.07	18.01 ± 2.96
(n=83)	**G3**	8.05 ± 0.21	32.02 ± 7.16	1.32 ± 0.04	18.14 ± 3.21
	G4	9.05 ± 0.21	31.97 ± 5.70	1.32 ± 0.05	18.07 ± 2.64
	G5	10.14 ± 0.35	37.19 ± 9.59	1.42 ± 0.07	18.06 ± 3.50
	G6	11.17 ± 0.38	42.40 ± 8.46	1.48 ± 7.24	19.09 ± 3.27
TGM	**All**	9.56 ± 1.02	35.59 ± 9.09	1.39 ± 0.06	18.18 ± 2.78
(n=85)	**G3**	8.20 ± 0.41	30.34 ± 6.18	1.31 ± 0.04	17.59 ± 2.88
	G4	9.00 ± 0.00	33.78 ± 6.56	1.36 ± 0.05	17.98 ± 2.48
	G5	10.00 ± 0.00	35.23 ± 4.33	1.41 ± 0.05	17.49 ± 1.59
	G6	11.04 ± 0.20	43.00 ± 11.18	1.46 ± 0.07	19.69 ± 3.47

BMI = Body mass index, DIM = Direct instructional model, TGM = Tactical games model.

Procedure

In this study, we examined the effects of two different intervention programmes (i.e. DIM and TGM) on creativity, attention and impulse control in elementary school students. Tests were carried out before (Pre) and after (Post) the 8-week intervention programmes to analyse their effects. The children had a 90 min PE class each week. The intervention programme and all assessments were carried out during PE classes at the school sports centre, and the tests were performed in the order they were named.

Measures

Creativity: The CREA test (Corbalán et al., 2003) was used to measure creativity. The CREA test measures individual creativity according to the question generation indicator, and the test consisted of asking as many questions as possible in 4 min about a given image. The CREA test has been found to have good reliability (ICC = 0.87) (Corbalán et al., 2003).

Attention and impulse control: Selective attention and impulse control were assessed with the CARAS-R test (Thurstone & Yela, 2012). CARAS-R assesses the ability of the students to perceive similarities and differences in 60 graphic elements; each of them formed by three schematic drawings of faces. Two of the faces are the same and the task consist in determining which face is different and crossing it out. The test lasts 4 min and has been found to have good reliability values (Cronbach's Alpha = 0.91) (Thurstone & Yela, 2012).

Intervention Programme Description

The intervention programmes were administered during PE sessions and lasted for 8 weeks with a weekly 90 min session. Sessions were held without changing the structure of the school day and during a regular school PE lesson, to achieve contextually relevant ecological validity (Kulinna et al., 2018). Each session started with a standardised warm-up (10 min). In the main part of the session (see Table 2), students of the DIM performed repetitive balance-based tasks in isolation from other skills, individually and under fixed conditions (Ishihara et al. 2017). Students of the TGM, however, practised balance by situating this skill within group game activities (Trajković et al. 2016; Trajković, Krističević, & Sporiš 2017).

Table 2. Task description of each intervention programme.

	DIM	TGM
Week 1	Balance activities without equipment	Balance games without equipment in small groups
Week 2	Balance activities with ropes and sticks	Balance games with ropes and sticks in small groups
Week 3	Balance activities with benches	Balance games with benches in small groups
Week 4	Balance activities with benches and balls	Balance games with benches and balls in big groups
Week 5	Balance activities with stilts	Balance games with stilts in small and big groups
Week 6	Balance activities with stilts and benches + slackline	Balance games with stilts and benches in big groups
Week 7	Balance activities with a lot of equipment + slackline	Balance games with a lot of equipment in big groups
Week 8	Balance activities with a lot of equipment + slackline	Balance games with a lot of equipment in big groups

DIM = Direct instructional model, TGM = Tactical games model.

Statistical Analysis

The results are presented as mean ± standard deviation (SD). The between-group (DIM and TGM) comparison from Pre to Post was calculated using a student *t* test for paired samples. The mean differences in each group between Pre and Post were calculated in percentage (Dif. %): [(MeanPost-MeanPre)*100]/MeanPre. Furthermore, to allow a better interpretation of the results, practical significance was assessed by calculating effect size. Effect sizes (ES) were classified as trivial (< 0.2), small (0.2 to 0.6), moderate (0.6 to 1.2), large (1.2 to 2.0), very large (2.0 to 4.0), and extremely large (> 4.0) (Hopkins et al., 2009). Data analysis was performed using the Statistical Package for Social Sciences (SPSS, version 23.0 for Windows, Chicago, IL, USA). Statistical significance was set at $p < 0.05$.

Results

Table 3 shows the creativity, attention and impulse control test results in the Pre and Post for the students in each intervention programme (i.e. DIM and TGM). After the intervention programme (Pre-Post) students from the DIM did not improve any of the analysed cognitive functions ($p > 0.05$, ES = -0.1 to 0.2, trivial). However, students of the TGM significantly improved their creativity (p < 0.01, ES = 0.6, moderate) and attention (p < 0.01, ES = 0.6, moderate).

Table 3. Creativity, attention and impulse control test results in the Pre-test (Pre) and Post-test (Post) students from the direct instructional model (DIM) and tactical games model (TGM).

		Pre	Post	Pre-Post ES (Dif. %)
Creativity	DIM	8.96 ± 3.18	10.03 ± 4.73	0.2 (11.9)
	TGM	7.90 ± 3.07	10.58 ± 4.51	0.6 (32.3)**
Attention	DIM	32.66 ± 9.52	34.86 ± 12.81	0.2 (6.7)
	TGM	32.50 ± 9.48	41.07 ± 8.89	1.0 (26.3)**
Impulse control	DIM	89.82 ± 12.51	88.61 ± 19.63	-0.1 (-1.3)
	TGM	93.72 ± 7.71	94.40 ± 9.22	0.1 (0.7)

ES = effect size, Dif. % = mean differences in percentage, ** p < 0.01, significant difference between Pre-Post.

The creativity, attention and impulse control test results in the Pre and Post for the students of each intervention programme according to the age group (i.e. G3 to G6) are presented in Table 4. After the intervention programme (Pre-Post), students of the TGM from all age groups significantly improved creativity (p < 0.05 or 0.01, ES = 0.5 to 1.3, small to large) and attention (p < 0.01, ES = 0.9 to 1.1, moderate) test results. Furthermore, students from the G6 age group of the TGM also improved impulse control test results (p < 0.01, ES = 1.5, large). However, creativity, attention and impulse control test results did not improve (p > 0.05) in any age group in the students from the DIM.

Table 4. Creativity, attention and impulse control test results in the Pre-test (Pre) and Post-test (Post) for students of each age group.

		DIM			TGM		
	Age group	Pre	Post	Pre-Post ES (Dif. %)	Pre	Post	Pre-Post ES (Dif. %)
Creativity	**G3**	7.35 ± 2.91	8.94 ± 3.78	0.4 (21.6)	5.28 ± 2.44	7.61 ± 3.64	0.6 (44.1)**
	G4	8.40 ±3.77	9.94 ± 7.33	0.2 (18.3)	7.01 ± 2.88	7.95 ± 2.03	0.5 (13.4)*
	G5	8.75 ± 2.31	9.33 ± 2.83	0.2 (6.6)	9.05 ± 2.54	11.16 ± 3.67	0.6 (23.3)**
	G6	10.83 ± 2.72	11.59 ± 4.19	0.2 (7.0)	9.77 ± 2.52	14.70 ± 3.83	1.3 (50.4)**
Attention	**G3**	27.00 ± 8.36	28.32 ± 9.81	0.1 (4.8)	25.72 ± 8.02	35.41 ± 9.17	1.0 (37.6)**
	G4	30.24 ± 9.07	32.24 ± 15.05	0.1 (6.6)	33.10 ± 7.86	40.83 ± 8.55	0.9 (23.3)**
	G5	33.70 ± 7.76	36.55 ± 13.39	0.2 (7.3)	33.71 ± 8.48	42.68 ± 8.16	1.1 (26.6)**
	G6	38.65 ± 9.07	41.17 ± 9.19	0.3 (6.5)	36.17 ± 10.43	43.79 ± 8.24	0.9 (21.0)**
Impulse control	**G3**	90.79 ± 16.09	88.03 ± 14.84	-0.1 (-3.0)	93.52 ± 7.94	93.86 ± 7.25	0.1 (0.3)
	G4	86.13 ± 15.36	87.88 ± 27.98	0.1 (2.0)	94.49 ± 5.26	90.09 ± 15.35	-0.2 (-4.6)
	G5	88.78 ± 10.98	85.17 ± 21.59	-0.1 (-4.0)	93.28 ± 8.09	94.40 ± 7.27	0.1 (1.2)
	G6	93.30 ± 5.04	92.76 ± 10.57	-0.1 (-0.5)	93.61 ± 9.27	98.01 ± 2.89	1.5 (4.7)**

ES = effect size, Dif. % = mean differences in percentage, * $p < 0.05$, ** $p < 0.01$, significant difference between Pre-Post.

Discussion

The aim of this study was to analyse the effects of two intervention programmes with different instructional models (i.e. DIM and TGM) on cognitive functions in primary education students. A large body of literature has been devoted to investigating the effects of physical exercise on cognitive functions in children (Kulinna et al., 2018; Vanhelst et al., 2016), but studies that focus on the qualitative characteristics of physical exercise for children's cognitive development are scarce (Diamond, 2015; Tomporowski et al., 2015). In addition, there is a shortage of papers that analyse the effects of different physical exercise programmes according to the age of the practitioners. The most important finding of the present study was that TGM was successful in improving students' creativity and attention. Furthermore, TGM also helped to improve impulse control in the oldest children (G6, 11-year-old students). However, the DIM programme did not cause any improvement in creativity, attention or impulse control at any age. This information could provide relevant data to teachers, so they could know which is the most appropriate instructional model if they want to boost students' creativity, attention or impulse control. TGM seem to be the most effective analysed instructional model for groups of different aged children to improve cognitive functions.

In the last decades, much attention has been focused on creativity, since it has been described as one of the aspects that are pursued in teaching processes (Diamond, 2006; Pesce et al., 2009). Possibly because of the importance that creativity has in an adequate education and development of students (Diamond, 2006; Latzman et al., 2010), many countries have adopted educational policies to promote creativity (Konstantinidou et al., 2014) and the idea that school needs to help to improve the creativity of the students seems to be wide-spread (Craft, 2002). However, although the importance of improving students' creativity since primary school has been described (Diamond, 2006; Latzman et al., 2010), few studies have analysed the effects of different intervention programmes on students' creativity. In addition, specifically in PE sessions, it is unknown whether the type of programme or instructional model used can have different effects on students' creativity. In the present study, the TGM approach during PE lessons led to creativity improvements in primary education students, both in total students and students grouped by year (G3-G6). However, DIM did not cause significant improvements in creativity in primary education students, either in the total students or at different ages. According to a previous study by Bollimbala, James, and Ganguli (2019), the creativity of students from grade 6 and 7 (G6-G7) in primary school can be improved after physical exercise, in their particular case, after a dance session. Some other studies also demonstrated that physical exercise is an effective tool for improving creativity in children (Colzato et al, 2013). However, the results of this study go deeper into the findings obtained in previous studies since the results show that the type of approach can cause different effects. In the present study, no improvement in student’s creativity was found with the DIM at any age, as all instructional models are not effective for this purpose. However, TGM had a positive effect on the creativity of the students in G3-G6. TGM is a type of exercise that could promote neurological changes in the cerebellum, frontal or prefrontal cortex and motor cortices (Diamond, 2000; Dietrich, 2006; Schenider et al., 2009), and this may cause an improvement in some cognitive functions, such as creativity. Nevertheless, because of the characteristics of exercise during the DIM programme, it does not trigger an improvement in cognitive function as there are less decisions to make. Furthermore, satisfaction from physical exercise is linked to cortical activation in the frontal cortex areas (Schneider et al., 2009), and as TGM is a model where students experiment higher levels of satisfaction (Rodríguez-Negro & Yanci, In press), this can lead to an improvement of cognitive functions (Schneider et al., 2013; Shibata et al., 1997). Therefore, TGM seems to be a model that could be considered by PE professionals if they want to boost students’ creativity.

Besides creativity, it has been found that during school lessons, primary education children are required to be receptive to the content taught and maintain their attention in order to learn (Pesce et al., 2009). Adequate attention by students seems to improve the teaching-learning process (Stevens & Bavelier, 2012). For this reason, it may be especially relevant to know if the type of approach used in PE lessons has different effects on student attention. The present study has shown that TGM during PE lessons could be an effective tool for improving student's attention at all analysed ages. Kulinna et al. (2018) also found an improvement in selective attention after PE lessons based on dance and fitness, in 4th and 5th grade (G4-G5) primary education students. Our results are also partially in line with results reported by Gallotta, Emerenziani, Franciosi, Meucci, Guidetti and Baldari (2015), who found an improvement in attention after a coordinative PE lesson in primary education students from grade 3 to 5 (G3-G5). In spite of this, as occurred with creativity, in the present study no improvement in student's attention was found with the DIM at any age. This proves the determinant importance of the qualitative characteristics of physical exercise and the instructional model used during the session, for children's attention development (Diamond, 2015). The results obtained in the present study seem to show that not every approach is valid for the improvement of attention in primary education students and that TGM may be more effective for this aspect in students of this age. In TGM students need to make more decisions, respond to the actions of the other students and to the demands of the game (Miller et al., 2015), and due to these characteristics, it seems that it can provoke an improvement in the students' attention. It would be interesting in future research to analyse if the improvement in attention found in this study could be associated with an improvement in attention in other educational areas.

Another objective of the current educational system is to improve students' impulse control, as it is related with better academic performance and a higher quality of life for the students (Rose et al., 2018). Some previous studies have concluded that exercise in children can help to improve their impulse control (Den Heijer et al., 2017; Lufi & Parish-Plass, 2011). In this respect, Lufi and Parish-Plass (2011), found an improvement in impulse control after 20 weekly exercise sessions for 1 academic year in 8 to 13-year-old children. Nonetheless, in the present study, an improvement in impulse control was found only in G6 children receiving the TGM instructional model, but no significant differences were found at any other age or in the DIM groups after the intervention programme. These results are different from those obtained by Jensen and Jenny (2004) who found an improvement in impulse control after a 20-week game-based intervention programme, in 8 to 13-year-old boys with impulse control problems. According to their results, it seems that a game-based intervention could be effective to improve impulse control in children with impulsivity problems. However, the results obtained in this study seem to indicate that TGM does not provoke positive effects on impulsivity in students with normal impulse control levels, except in G6. It may be necessary to delve more deeply into what tasks and approaches are the most appropriate for improving impulsiveness in primary school children.

Even though this study used rigorous methodology, a battery of tests, data analysis and an ecological setup in real school lessons, it nevertheless has some limitations that should be addressed in future research. It was a convenience sample, and due to the policy of the school there was no control group. Moreover, all the children were from the same school, so they represent a specific socio-economic and cultural structure. However, there were good reference groups with different intervention contents.

Conclusions

The findings of the present study showed that TGM was a successful instructional model to improve creativity and attention at all analysed ages (i.e. G3-G6) and impulse control in G6 children. Nonetheless, none of the analysed cognitive functions (i.e. creativity, attention and impulse control) were improved at any age through the DIM programme. This study has implications for PE professionals who wish to design optimal programmes for primary school children for improving the above-mentioned cognitive functions, as TGM seem to be the most effective analysed instructional model for groups of different aged children.

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ZORTZIGARREN KAPITULUA

ONDORIO OROKORRAK

When you learn, teach. When you get, give.

Maya Angelou

Zortzigarren kapitulua. Ondorio orokorrak

Laburbilduz, doktorego tesi honetan lortutako emaitzek sexua eta adina Lehen Hezkuntzako ikasleen gaitasun motorretan faktore bereizgarriak izan daitezkeela indartzen dute, baita irakaskuntza metodologia ezberdinek ikasleen garapen integralean eragin desberdinak dituztela ere. Gaitasun motorretan, neskek mutilak baino oreka estatiko eta dinamiko hobea erakutsi zuten. Dena den, oreka estatikoaren kasuan desberdintasun horiek desagertu egin ziren 11 urterekin, eta oreka dinamikoaren kasutan 9 urterekin. Objektuak kontrolatzeko trebetasunari dagokionez, mutilek neskek baino gaitasun hobea erakutsi zuten. Adinaren arabera, ordea, zenbait adinetan ez ziren aurkitu desberdintasunak mutilen eta nesken artean objektuak harrapatzeko trebetasunean (6-8 urte), ezta punterian ere (9-11 urte). Azkenik, CODAri dagokionez, doktorego tesiaren emaitzek erakusten dute nesken eta mutilen arteko desberdintasunak CODAn 7 urte arte ez direla agertzen, eta 7 urtetik aurrera mutilek neskek baino trebetasun handiagoa dutela CODAn. Horretaz gain, emaitzek korrelazio nabarmena erakutsi zuten oreka estatikoaren emaitzen eta CODA emaitzen artean, oreka dinamiko eta harrapatzeko trebetasunaren artean, harrapatzeko trebetasuna eta CODAren artean, eta harrapatzeko trebetasuna eta punteriaren artean. Gaitasun desberdinen arteko korrelazioak moderatuak izan ziren. Alderdi honek erakusten du trebetasun independenteak izan arren, haien arteko nolabaiteko erlazioa dagoela, agian irakaskuntza-ikaskuntza prozesuan konbinatuta irakasten direlako.

Bestalde, bi irakaskuntza metodologiek haurren garapen integralean izan zituzten eraginak konparatu ziren. Ikasle batzuk 8 asteko esku-hartzea egin zuten DIMen oinarrituta. Bertan trebetasunak modu isolatuan irakasten eta praktikatzen ziren eta ikasleek banan-banan lan egiten zuten. Beste ikasle batzuek TGM esku-hartzea egin zuten, ikaskuntza joko-jardueren barruan txertatuta zegoena. Bi esku-hartzeek hobekuntza eragin zuten ikasleen oreka estatiko eta dinamikoan. Inolako esku-hartzerik gabeko kontrol talde bat ere bazegoen, eta hauek ez zuten hobekuntzarik izan orekan. Ikasleen adinaren arabera, Lehen Hezkuntzako lehen urteeko haurrek gehiago hobetu zuten oreka DIM programarekin, eta haur nagusienek (> 8 urte) TGM programarekin hobetu zuten gehiago.

Bi irakaskuntza metodologien ondorioak ere aztertu ziren ikasleen eremu psikologikoan, ariketa fisiko mailan eta instrukzio eta aktiboki ikasteko denboran. Adin guztietako ikasleek DIMekin aztertutako gorputz hezkuntzako saioetan ahalegin handiagoa (RPE) hautematen zuten, eta gogobetetasun altuagoa erregistratu zen 11 urteko ikasleetan TGMekin. Gainera, 8 urte baino gehiago zituzten ikasleetan, DIM izan zen metodologia egokiena ariketa fisiko maila handiagoa izateko gorputz hezkuntzako saioetan. Instrukzio eta aktiboki ikasteko denboran jartzen badugu arreta, ordea, ikasle gazteenek (6-8 urte) instrukzio denbora gehiago izan zuten TGMekin, eta ikasle helduenak instrukzio denbora gehiago DIMekin (9-11 urte). Doktorego tesi honen emaitzek erakusten dute gorputz hezkuntzako saioetan erabilitako metodologiak RPEan, ariketa fisiko mailan, instrukzio denboran eta irakaskuntza/aktiboki ikasteko erlazio denboran eragina duela. Baita ikasleen adinaren arabera, ondorioak desberdinak direla ere.

Amaitzeko, metodologien eragina ikasleen garapen integralean ikusteko, sormenean, arretan eta oldarkortasunaren kontrolean duten eragina aztertu zen. Doktorego tesi honen aurkikuntzek erakusten dute TGMk irakaskuntza metodologia efektu positiboak izan zituela sormena eta arreta hobetzeko aztertutako adin guztietan, eta oldarkortasuna kontrolatzeko 11 urteko haurretan. DIM irakaskuntza metodologiarekin, ordea, Lehen Hezkuntzako ikasleek ez zuten funtzio kongnitibo bat ere hobetu.

BEDERATZIGARREN KAPITULUA

PROPOSAMEN PRAKTIKOAK

What a teacher is, is more important than what he teaches.

Karl Menninger

Bederatzigarren kapitulua. Proposamen praktikoak

Doktorego tesi honen ondorioek gorputz hezkuntzako irakaslegoan eraginak eduki ditzakete. Doktorego tesi honetan lortutako emaitzek Lehen Hezkuntzako ikasleen gaitasun motorretan sexua eta adina faktore bereizgarriak izan daitezkeela adierazten dute, eta gaitasun motor guztiak garrantzitsuak direnez, interesgarria izan liteke Lehen Hezkuntzako ikasleen gaitasun motorrak hobetzeko programa espezifikoak ezartzea. Gainera, emaitza hauek gorputz hezkuntzako saioetan erabilitako irakaskuntza metodologiak Lehen Hezkuntzako ikasleen garapen integralean eragina izan dezakeela erakusten dute eta, zehazki, oreka estatiko eta dinamikoan, RPEn, ariketa fisiko mailan, irakaskuntza denboran, erlazioa irakaskuntza/aktiboki ikasteko denboran, sormenean, arretan eta oldarkortasunaren kontrolean. Hori dela eta, gorputz hezkuntzako irakasleek kontuan hartu beharko lukete zeri eman nahi dioten lehentasuna haien saioetan (hau da, ikasleen gogobetetasuna handitzea, ikasleen arreta hobetzea, ikasleen sormena garatzea...), eta hori lortzeko irakaskuntza metodologia egokiena aukeratu. Bestalde, emaitzek irakaskuntza metodologien eraginak aipatutako aldagaietan ikasleen adinaren arabera desberdinak direla erakusten dute. Hori dela eta, gorputz hezkuntzako irakasleek metodologia desberdinetako esku-hartzeak garatu beharko lituzkete garatu nahi duten aldagaiaren eta ikasleen adinaren arabera. Amaitzeko, gorputz hezkuntzan aplikatutako esku-hartzeek ikasleen garapen integralari baita ikasleen ariketa fisikoko mailari ere lagundu diezaieketela kontuan hartuta, gorputz hezkuntzako irakasgaiaren karga didaktikoa handitzea aproposa izango litzateke.

HAMARGARREN KAPITULUA

MUGAK

Don´t struggle to be a better teacher than everybody else. Simply be a better teacher than you ever thought you could be.

Robert John Meehan

Hamargarren kapitulua. Mugak

Doktorego tesi honek diseinua, metodologia, emaitzen analisia eta eztabaida zorrotzak ditu, eta eskola erreal batean garatu da. Hala ere, zenbait muga izan ditu, etorkizunean egingo diren ikerketetan kontuan hartu behar direnak. Eskolan klaseak banatuta zeuden moduagatik eta ikastetxearen politika dela eta, haurrak ez ziren ausaz banatu esku-hartze taldeetan. Gainera, doktorego tesi honek nahitako laginketa erabili zuen ikasle guztiak eskola berekoak zirelako, beraz, egitura sozioekonomiko eta kultural zehatza adierazten du. Hori dela eta, interesgarria izan liteke lagina zabaltzea testuinguru sozioekonomiko desberdinetan, lagina adierazgarriagoa izan dadin. Hala ere, esku-hartzeetan, metodologia desberdinak zituzten erreferentzia-talde handiak zeuden. Etorkizuneko ikerketek lagin adierazgarriagoak eta ausazko taldeak osatu beharko lituzkete.

HAMAIKAGARREN KAPITULUA

ETORKIZUNEKO IKERKETA ILDOAK

Education is not a problema. Education is an opportunity.

Lyndon B. Johnson

Hamaikagarren kapitulua. Etorkizuneko ikerketa bidea

Doktorego tesi honetan aurkezten diren ezagutzak sakontzeko, lehentasunezkoak dira ondorengo etorkizuneko ikerketa ildoak:

- Lehen Hezkuntzako neska eta mutilen arteko gaitasun motorren mailen ezberdintasunen arrazoiak aztertzea.
- Beste gaitasun motorretan neska eta mutilen arteko desberdintasunak badauden aztertzea.
- Beste irakaskuntza metodologien eragina ikustea Lehen Hezkuntzako umeen garapen integralean.
- Esku-hartzeen atxikipena aztertzea, jarduera gelditu ondoren zer eragin izan duten jakiteko.
- Oldarkortasunaren kontrola hobetzeko egokiagoa den esku-hartzea bilatzea.

HAMABIGARREN KAPITULUA

ERANSKINAK

Never forget to remain a student while you teach others.

Jerry Corsten

12.1 Aldizkarietako argitalapenen portadak

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Motor skills differences by gender in early elementary education students

Josune Rodríguez-Negro, Francisco Javier Huertas-Delgado & Javier Yanci

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Chapter

Motor Skills Difference by Gender in 9- to 11-Year-Old Elementary Education Students

Josune Rodríguez-Negro and Javier Yanci*
Department of Physical Education and Sport,
Faculty of Education and Sport, University of the Baque Country,
UPV/EHU, Vitoria-Gasteiz, Spain

Abstract

The aim of the present study was to analyse the gender differences in balance, object-control skills and change of direction ability (CODA) in 9 to 11-year-old children. Static balance, dynamic balance, catching, aiming and CODA were assessed in 199 children (9-11 years, 38.05 ± 9.15 kg, 1.41 ± 0.07 m, 18.68 ± 3.12 kg/m2). Girls obtained better results than their counterparts in static balance ($p < 0.05$, ES = 0.3, small), while boys obtained better results than girls in catching ($p < 0.01$, ES = -0.6, moderate) and in CODA ($p < 0.01$, ES = 0.6, moderate). Regarding each age group, even if there were no observed significant differences

* Corresponding Author Email: josune.rodriguez@ehu.eus.

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Effects of different balance interventions for primary school students

Josune Rodríguez-Negro[a], Lavinia Falese[b], and Javier Yanci[a]

[a]Department of Physical Education and Sport, Faculty of Education and Sport, University of the Basque Country, UPV/EHU, Vitoria-Gasteiz, Spain; [b]Laboratory of Epidemiology, Physical Activity and Lifestyles, Department of Human Sciences, Society and Health, University of Cassino and Southern Lazio, Cassino, Italy

ABSTRACT

This study examines the effects of two different 8-week balance intervention programs for students of primary school age. Static and dynamic balance were assessed in 380 students (6–12 years) before and after an 8-week balance intervention program. Students were divided and assigned into a no intervention control group, a direct instructional model (DIM) or a tactical games model (TGM). Static and dynamic balance improved after both intervention programs, but results differed by grade (age). DIM was the most effective for G2 (7–8 years), and TGM was most effective for G4-G6 (9–12 years) students. Thus, at the youngest ages of primary school DIM balance programs in which skills are taught and practised in isolation and students work individually are more effective, but for improving balance. At more advanced ages (>8 years), TGM balance programs may be more effective.

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Children; intervention programs; MABC-2; physical education

Introduction

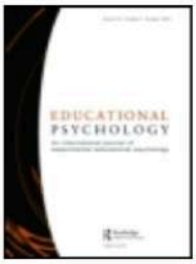
Balance is considered an important aspect of children's motor skill development, and it is a prerequisite for learning other complex motor skills (Mickle, Munro, & Steele, 2011). As balance improvements occur mainly from 2 to 18 years of age, they are not fully developed in primary school aged children (Demura, Kitabayashi, Noda, & Aoki, 2008). Although it is commonly believed that children automatically acquire balance as their bodies develop, environmental conditions are also vital for balance development (Fahimi, Aslankhani, Shojaee, Beni, & Gholhaki, 2013). Educators often seek to assist motor skill development in childhood, and balance proficiency can be influenced by an appropriate intervention program (Fahimi et al., 2013). In fact, some researchers have recommended various balance intervention programs for children (Granacher, Prieske, Majewski, Büsch, & Muehlbauer, 2015).

Wälchli, Ruffieux, Mouthon, Keller, and Taube (2017) reported improvements in balance after a 5-week balance intervention program in 6–15-year-old students. Similarly, Muehlbauer, Kuehnen, and Granacher (2013) observed balance improvements after a 4-week intervention program in 11–12-year-old typically developing children. Moreover, Kováčiková, Neumannova, Rydlova, Bizovská, and Janura (2017) documented the effectiveness of a 4-week balance program for improving balance performance in 9–12-year-old children with asthma. Apart from targeted balance improvements, balance programs have been recommended to promote postural control (Granacher, Gollhofer, & Kriemler, 2010), conscious dynamic proprioception, defined as a specialized variation of the sensory modality and encompasses the sensations of joint movement and joint position (Emilio, Hita-Contreras, Jimenez-Lara, Latorre-Román, & Martínez-Amat, 2014), and muscular strength (Wälchli et al., 2017).

Balance programs represent one response to the perceived need to help school-age children enhance their motor skill performance (Hardy, Reinten-Reynolds, Espinel, Zask, & Okely, 2012), and these programs must be developmentally appropriate and purposely designed to improve fundamental movement skills in primary school children (Faigenbaum et al., 2015). Although quality programs should play a special role in developing this aspect of motor proficiency (Behringer, Vom Heede, Matthew, & Mester, 2011), there is still controversy in the primary school context regarding whether or how best to teach fundamental movement skills (Hardy, King, Espinel, Cosgrove, & Bauman, 2011).

In physical education, two of the instructional models of interest are: (a) a direct instructional model (DIM) and (b) a tactical games model (TGM) (Metzler, 2011; Ishihara, Sugasawa, Matsuda, & Mizuno, 2017). Within the DIM, skills are taught in isolation using repetitive individual drill practices (Ishihara et al., 2017), teacher is the primary source for decisions and students tried to reproduce teacher's model of performance (Gurvitch & Metzler, 2010; Metzler, 2011). Although DIM results in significant short-term improvement (Porter, Landin, Hebert, & Baum, 2007), researchers have found a lack of enjoyment with the experience among children undergoing this type of exercise (Wall & Cót, 2007). On the contrary, in the TGM teacher teaches through contextually-authentic tasks, based in teaching

CONTACT Josune Rodríguez-Negro josune.rodriguez.negro@gmail.com Department of Physical Education and Sport, Faculty of Education and Sport, University of the Basque Country, UPV/EHU, Lasarte 71, 01007, Vitoria-Gasteiz, Spain.



Educational Psychology

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Which instructional models influence more on perceived exertion, affective valence, physical activity level, and class time in physical education?

Josune Rodríguez-Negro & Javier Yanci

To cite this article: Josune Rodríguez-Negro & Javier Yanci (2019): Which instructional models influence more on perceived exertion, affective valence, physical activity level, and class time in physical education?, Educational Psychology, DOI: 10.1080/01443410.2019.1613516

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12.2 Argitalpenen kalitate adierazleak

Aldizkaria	ISSN/ISBN	Herrialdea	Kategoria	Impaktua	Koartila
Early Child Development and Care	0300-4430	Estatu Batuak	Pediatria	IF = 0,713	4
NOVA Publishers	978-1-53617-439-7	Estatu Batuak	Orokorra/Hezkuntza	ICE = 33.000	
Journal of Educational Research	0022-0671	Estatu Batuak	Hezkuntza	IF = 1,155	3
Educational Psychology	0144-3410	Ingalaterra	Hezkuntza	IF = 1,254	3
European Physical Education Review	1741-2749	Norbegia	Hezkuntza	IF = 2,000	2

ISSN = International Standard Serial Number. IF = Inpaktu faktorea. ICEE = Argitaletxeen kalitatearen adierazlea adituen arabera (SPI Ranking).

12.3 Argitalapenen betetze maila artikuluen bildumaren bidezko tesi araudiarekin

Jarduera Fisiko eta Kirolean doktorego tesiaren programa arautzen duen bezala eta UPV/EHUn indarrean dagoen legeriarekin (2013ko ekainaren 27ko EHAA, EHAA) bat eginez, doktoregaia tesia artikuluen bildumaren bidez aurkezteko baldintzak betetzen ditu:

- Gizarte Zientzietan doktoregaiak gutxienez hiru argitalpen izan behar ditu lehen egile gisa.
- Aurkeztutako argitalapenak guztira bi puntu egin behar dituzte.

Publikazioa	Publikazio mota	Publikazioaren egoera	Puntuazio kualitatiboa
Early Child Development and Care	JCR Q4	In press	1
NOVA Publishers	Liburua	Publikatuta	0.5
Journal of Educational Research	JCR Q3	Publikatuta	1
Educational Psychology	JCR Q3	In press	1
European Physical Education Review	JCR Q2	Berrikuspenean	0

Totala = 3.50

12.4 Alderdi etikoak

Datu pertsonaleko fitxategia

Fitxategiaren izena: INB DATOS TESIS JOSUNE RODRIGUEZ
Fitxategiari aplikatutako segurtasun maila: Oinarrizkoa
Mota: Mistoa
Fitxategiaren barne arduraduna: Javier Yanci Irigoyen
Erregistro zenbakia: 2080310018-INA0047
Agentzia: AVPD
Baimenaren data: 16/07/2015

Euskal Herriko Unibertsitateko (UPV/EHU) Gizakiekin lotutako Ikerketetarako Etika Batzordeko onespena (GIEB: 2015/147).

Universidad del País Vasco Euskal Herriko Unibertsitatea | NAZIOARTEKO BIKAINTASUN CAMPUSA CAMPUS DE EXCELENCIA INTERNACIONAL

IKERKETAREN ARLOKO ERREKTOREORDETZA
VICERRECTORADO DE INVESTIGACIÓN

GIZAKIEKIN ETA HAUEN LAGIN ETA DATUEKIN EGINDAKO IKERKETETARAKO UPV/EHUKO ETIKA BATZORDEAREN TXOSTENA

Nik, **Mª Jesús Marcos Muñoz** andreak, Universidad del País Vasco/Euskal Herriko Unibertsitateko Ikerketa eta Irakaskuntzako Etika Batzordeko (IIEB) idazkariak, honako hau

ZIURTATZEN DUT:

Gizakiekin Egindako Ikerketetarako Etika Batzordeak (GIEB), 2014ko otsailaren 17an EHAAn argitaratutako arautegian[1] ezarritako baldintzak betetzen dituenak, aztertu egin du **Josune Rodríguez Negro** ikaslearen Doktorego tesiaren proiektua: *"Metodología global vs analítica: efecto de distintos tipos de programas de intervención en las habilidades motoras en estudiantes de educación primaria"*.

Kontuan hartu dira honako hauek:

- Doktorego tesiaren n proiektuaren tutorearen oniritzia aurkeztu da (tutorea: Javier Yanci Irigoyen jn.).
- Doktorego tesiaren proiektuaren diseinua, xedea eta helburu zientifikoak egokiak dira eta ikasleak lana egiteko besteko gaitasuna dauka.
- Bete egiten dira laginaren aukeraketarako baldintzak, informazioa emateko prozedura eta baimena eskuratzekoa, datu pertsonalen babesa eta Doktorego tesiaren proiektua egiteko indarrean dauden legezko baldintzak.

GIEBek, bai osaeran, bai Lanerako Prozedura Arautuari dagokionean, UPV/EHUk 2014ko otsailaren 17an emandako erabakia betetzen du, bai eta Praktika Onei buruzko Araudia ere.

Horrela, bada, GIEBek, 2015ko abenduaren 17anegindako bileran, aipatutako Doktorego tesiaren proiektuaren **ALDEKO TXOSTENA** eman du (71/2015aktan jasota dago) proiektu hori ikasleak **Josune Rodríguez Negro** egin dezan Javier Yanci Irigoyen jaunaren gidaritzapean.

Eta hala sinatu dut Leioan, 2016ko otsailaren 15ean

INFORME DEL COMITÉ DE ÉTICA PARA LAS INVESTIGACIONES CON SERES HUMANOS, SUS MUESTRAS Y SUS DATOS (CEISH) DE LA UPV/EHU

Mª Jesús Marcos Muñoz, Secretaria de la Comisión de Ética en la Investigación y la Docencia de la Universidad del País Vasco/Euskal Herriko Unibertsitatea (CEID)

CERTIFICA QUE:

Que este Comité de Ética para la Investigación con Seres Humanos (CEISH), que reúne los requisitos establecidos en el BOPV de 17 de febrero de 2014[2], ha evaluado el proyecto de Tesis Doctoral de la investigadora: **Dña. Josune Rodríguez Negro**:*"Metodología global vs analítica: efecto de distintos tipos de programas de intervención en las habilidades motoras en estudiantes de educación primaria"*

Considerando que,

- Se ha presentado el Visto Bueno del tutor del proyecto de Tesis Doctoral: D. Javier Yanci Irigoyen.
- El proyecto de Tesis Doctoral propone un diseño, finalidad, objetivos científicos adecuados, y una cualificación del alumno suficiente para su realización.
- La selección de la muestra, el procedimiento de información y obtención del consentimiento, la protección de los datos personales y los requisitos normativos vigentes necesarios para llevar a cabo el proyecto de Tesis Doctoral, se cumplen.

El CEISH, tanto en su composición, como en su Procedimiento Normalizado de Trabajo, cumple con el Acuerdo de la UPV/EHU de 17 de febrero de 2014 y con las Normas de Buenas Prácticas.

Ha emitido **INFORME FAVORABLE** en la sesión del CEISH celebrada el 17 de diciembre de 2015 (recogido en su acta 71/2015), a que dicho proyecto de Tesis Doctoral sea realizado, por la alumna **Josune Rodríguez Negro**, bajo la tutela de D. Javier Yanci Irigoyen.

Lo que firmo en Leioa, a 15 de febrero de 2016

IIEB
EUSKAL HERRIKO UNIBERTSITATEA UNIVERSIDAD DEL PAÍS VASCO

Mª Jesús Marcos Muñoz
Ikerketaren Etikako teknikaria/ Técnica de Ética en la Investigación
IIEBeko Idazkaria/ Secretaria CEID/IIEB

[1] UPV/EHUren ikerkuntza eta irakaskuntzaren arloan etikako organoak arautzeko arautegia.

[2] Reglamento por el que se regulan los órganos de ética en la investigación y la práctica docente.

BIZKAIKO CAMPUSA
CAMPUS DE BIZKAIA
Sarriena Auzoa, z/g
48940 LEIOA

susi.marcos@ehu.es

12.5 Tesiarekin erlazionatutako beste argitalapenak

Bravo, I., Rodríguez-Negro, J., & Yanci, J. (2017). Diferencias en función del género en la puntería y atrape en niños/as de Educación Primaria. *Retos, 32, 3*5-38.

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12.6 Tesiarekin erlazionatuko beste libru-kapituluak

Rodríguez-Negro, J., Castillo, D., Redin, S., & Yanci, J. (2016). *Análisis de la actividad física extraescolar realizada por adolescentes con discapacidad intelectual.* En Avances en actividad física y deportiva inclusiva (130-139). Almería: Universidad de Almería.

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12.7 Ekitaldi zientifikoetan aurkeztutako tesiarekin erlazionatutako ponentziak

Rodríguez-Negro, J. (2018). Metodologías en educación física para el desarrollo integral de los estudiantes. *Jornadas de Intercambio de experiencias de investigación* de la universidad del País Vasco (UPV-EHU). Vitoria-Gasteiz, 2018.

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12.8 Kongresuetan aurkeztutako tesiarekin erlazionatutako komunikazioak

Pesola, A. J., Rodríguez-Negro, J., Hantunen, T., Muhonen, H., Lietzen, E., Vaheristo, J., Uhlgre, V.V., … Kumpulainen, S. (2019). Voiko istumisa vähentää edistämällä tiettyjä liikuntamotivaation osa-alueita? *Finnish Sports Science Days.* Finlandia, 2019.

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Congreso Internacional de Educación e Innovación: Inclusión, Tecnología y Sociedad. Granada, 18-20 2019.

Rodríguez-Negro, J., Romaratezabala, E., & Yanci, J. (2018). Evolución de la capacidad de cambio de dirección en función de la edad en niños y niñas de edad escolar. *III Congreso Internacional en Investigación y Didáctica de la Educación Física.* Granada, 2018.

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Romaratezabala, E., Rodríguez-Negro, J., Aritzeta, I., & Yanci, J. (2019). Percepción sobre la práctica de actividad física actual y pasada de deportistas con discapacidad. *Congreso Internacional de Educación e Innovación: Inclusión, Tecnología y Sociedad*. Granada, 2019.

12.9 Ikerketa egonaldiak

Otsaila-Maiatza 2017: Ikerketa egonaldia Università di Cassino e del Lazio Meridionale-ko Science umane, social e della salute departamentuan (Frosinone, Italia).

UNIVERSITÀ DEGLI STUDI
DI CASSINO E DEL LAZIO MERIDIONALE

To whom who may concern

This is to certify that Josune Rodriguez Negro has been in the University of Cassino and Southern Lazio from the 1st of February to the 31st of May of 2017 doing work related to her doctoral thesis.

Loriana Castellani
Director of the department of Human Sciences, Society and Health
University of Cassino and Southern Lazio

UNIVERSITÀ DEGLI STUDI DI CASSINO E DEL LAZIO MERIDIONALE - 1979 - Dipartimento di Scienze Umane, Sociali e della Salute

IL DIRETTORE DEL DIPARTIMENTO
(Prof. Loriana CASTELLANI)

Cassino, June 7th 2017

Otsaila-Maiatza 2019: Ikerketa egonaldia University of Applied Sciences of Mikkeli-ko ActiveLife laboratorie-n (Finlandia).

XAMK
Active Life Lab

XAMK
South-Eastern Finland
University of Applied Sciences

Arto Pesola
Active Life Lab
South-Eastern Finland University of Applied Sciences
P.O Box 68 (Patteristonkatu 3 D)
50101, Mikkeli, Finland

Mr. Dr. Arto Pesola, research manager of the Active Life Lab of the South-Eastern Finland University of Applied Sciences of Mikkeli, and as a person in charge of the applicant at host institution,

CERTIFY that:

Josune Rodríguez Negro, 78945285Q, from the University of the Basque Country (UPV/EHU) has been doing a temporary research stay in the following dates: 18-02-2019 to 20-05-2019.

20th May 2019
Date

Arto Pesola
Stamp and Signature

12.10 Tesiarekin lotura daukaten bestelako merituak

African Educational Research Journal (SJR 0.76) eta Journal of Clinical and Diagnostic Research (SJR 0.35) nazioarteko aldizkarietako kanpoko ebaluatzailea.

Journal of International Education and Practice eta African Journal of Education and Teaching aldizkarien editorial taldeko kidea.

eman ta zabal zazu

Universidad del País Vasco

Euskal Herriko Unibertsitatea

Effects of instructional models in physical education for integral development in elementary education students