The Influence of Teaching Styles in Physical Education for a Healthy Lifestyle: Physical Activity and Physical Condition

"La Influencia de los Estilos de Enseñanza en Educación Física para un Estilo de Vida Saludable:
Actividad Física y Condición Física"

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Autorización de los Directores de la Tesis para su presentación

El Dr. José Luis Chinchilla Minguet y el Dr. Elvis Álvarez Carnero como Directores de la Tesis Doctoral titulada: "The Influence of Teaching Styles in Physical Education for a Healthy Lifestyle: PA and PC" por Dña. Norma Teresa Martin Sanz el en Departamento de Didáctica de las Lenguas, las Artes y el Deporte, autorizan su presentación a trámite dado que reúne las condiciones necesarias para su defensa.

En Málaga, a 09 de Noviembre del 2015

Dr. José Luis Chinchilla Minguet

Dr. Elvis Álvarez Carnero

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ABSTRACT

Introduction

Increased Moderate-Vigorous Physical Activity (MVPA) and reduced Sedentary Time (ST) are key factors for a healthy lifestyle during childhood and adolescence. Studies have suggested that schools may be effective resources to promote healthy habits (McKenzie, & Lounsbery, 2013). Therefore, in Physical Education (PE), is important to assess how teachers use strategies and provide students tools to engage in Physical Activity (PA) (Lonsdale,. et al., 2013). Many factors may be involved in the successful PE class to promote healthy out-school behaviors, as Teaching Styles (TS), learning time, motivation and so on (Kulinna, & Cothran, 2003). Regarding TS, there is a lack of knowledge about influence of the TS in the promotion of daily PA.

Purpose

The first purpose was review the state of the art on pedagogical assessment tools to evaluate TS in PE. The second purpose was to observe the differences of total daily PA and Physical Condition (PC) variables between two groups of adolescents who were taught during two whole academic years using different TS and contents.

Method

Review: Several databases were used to identify literature that appeared to be relates to the use of TS in PE in elementary and secondary schools. We reviewed publications between 1st of January 1970 up to and including 31th of July 2015.

Sample: 176 adolescents wore an Accelerometer (ACL) to record one week of total daily PA at the beginning and at end of course. Four groups of PE classes were taught with two different strategies: Reproduction of Knowledge (RK) and Production of Knowledge (PK), following the classical Spectrum (Mosston, & Ashworth, 2002) and comparing them with a control group that not used a precise TS, Mixed Knowledge (MK). After analyzing ACL data, 91 adolescents (49 boys and 42 girls) obtained valid records (attrition rate = 48,3%).

Physical activity assessment: PA was recorded using ACLs (Actigraph GT3X). The inclusion criteria to considerer a complete day would be if it contained ≥ 10 hours for weekdays and ≥ 8 hours for weekend days (Yildirim, 2011). Only participants with ≥ 4 complete days, including one weekend day were included (Holman, Carson, & Jansson, 2011). Repeated measures analysis was carried out in order to compare differences between groups and time effect.

Body composition: Height and weight were assessed. Anthropometry was used to estimate body composition (Alvero-Cruz, 2014). Fat Mass Percent (%FM) was calculated with Slaughter equations (Slaughter, 1988), and Fat Free Mass was calculated as [(FFM = Weight - (%FM · Weight))]. Skeletal Muscle Mass (SMM) (Poortmans, 2005; Lee, 2000).

Physical Fitness: Strength on Right and Left Hands (RGS and LGS) was measured using a digital handgrip dynamometer (T.K.K.5401, Takei). Lower Limbs Strength (LLS) was measured with an isometric back-leg lift dynamometer (TKK-5002, Psymtec).

Results and discussion

Review: 526 potentially relevant publications and 373 references related to TS and PE.

Physical activity, Body Compositon (BC) and Physical Fitness (PF) assessment: Significant differences were found between RK and MK for MVPA, Fat Mass (FM) and FFM ($P < 0.05$). Significant differences were found between and MK for Maximum Oxygen Uptake ($VO_{2A}Max$), RGS, LGS, LLS and ($P < 0.01$). There were significant differences between 3rd and 1st content in ST, Light Physical Activity (LPA), Moderate Physical Activity (MPA), MVPA and Steps ($P < 0.05$).

Conclusions

1. Five specific instruments in regard with TS using during PE lessons were found.
2. Our main finding related with PA was that PA patterns (minutes per day at specific intensities) were affected by change in TS. The PA volume and intensity levels varied based on different content and TS. Specifically, PK group raised significantly all PA daily patterns except sedentary time after one-academic year. Regarding to RK and MK, there were significant differences between these TS for VPA, MVPA and steps.

INDEX

INDEX OF TABLES

INDEX OF FIGURES

ABBREVIATURES

%FM	Fat mass percent
ACL	Accelerometer
ALT-PE	Academic learning time in physical education
BC	Body composition
BMI	Body mass index
BOC	Beginning of the physical education course
CAD	Cadence
CAFIAS	Cheffers' adaptation of Flanders' interaction analysis system
CE	Corporal expression
EOC	End of the physical education course
FFM	Fat free mass
FFMI	Fat free mass index
FFT	Framework for teaching evaluation instrument
FIAS	Flanders interaction analysis system
FM	Fat mass
FMI	Fat mass index
GLM	General lineal model
HGS	Hand grip strength
IFITS	Instrument for identifying teaching styles
IITLB	Instrument for identifying teaching and learning behaviors
ITT	Intention to treat analysis
LGS	Left hand-grip strength
LLS	Lower limb strength
LPA	Light physical activity
MASTS	Mosston and Ashworth spectrum of teaching styles
MAX	Maximus
MC	Muscle circumference
MIN	Minimum
MK	Mixed knowledge
MPA	Moderate physical activity

MVPA	Moderate-Vigorous physical activity
NR	Non-responders
OA	Outdor activities
OSCD-PE	Observation system for content development in physical education
PA	Physical activity
PC	Physical condition
PE	Physical education
PELOT	Physical education and lesson observation tool
PET	Physical education teacher
PETAI	Physical education teacher assessment instrument
PF	Physical fitness
PFH	Physical fitness and health
PI	Physical inactivity
PK	Production of knowledge
QMTPS	Qualitative measures of teaching performance scale
R	Responders
RGS	Right hand-grip strength
RK	Reproduction of knowledge
RQ	Research questions
SD	Standard deviation
SG	Sports and games
SMM	Skeletal muscle mass
SMMI	Skeletal muscle mass index
SPSS	Statistical Package for the Social Sciences
ST	Sedentary time
TS	Teaching style
TU	Teaching units
$VO_{2\ max}$	Maximum oxygen uptake
VPA	Vigorous physical activity
WC	Waist circumference
WHO	World Health Organization

I. Introduction

There is evidence that regular PA improves many health outcomes such as body composition, cardiorespiratory and muscular fitness, bone health and metabolic health biomarkers among children and adolescents (Committee, 2008; Dencker & Andersen, 2008; Malina, 2014), moreover these healthy adaptations would have a carryover effect into adulthood (Boreham & Riddoch, 2001). Consequently, scientific literature has suggested that the best primary strategy for improving the long-term health is to promote PA during childhood and adolescence (Hallal, 2006; McKenzie, 2013; Rowland, 1994; Telama, 2005). However, the prevalence of PA participation has been dramatically reduced during the last decades around the world and particularly Southern Europe (European Commission, 2014). Institutions make call for schools as the main setting to include an educational policy in order to develop a health-centered curriculum and qualified physical education teachers to promote healthy lifestyles (WHO, 2004a, 2004b).

Following scenario previously described a large body of research has been conducted in order to explore the efficacy of school-based interventions focused in improving PA-related health outcomes and PA per se (Dobbins, Husson, DeCorby, & LaRocca, 2013; Lai et al., 2014; Lonsdale et al., 2013; Sun et al., 2013). However, less is known about the efficacy of didactic interventions based in the manipulation of qualitative characteristics of PE classes and its consequences on after school schedule PA and physical fitness.

In this manuscript we have firstly reported comprehensive review, which offers an update of valid tools for TS assessment in physical education classes. The second part describes and reports results and discussion from a randomized intervention of one

academic year in the scholar context. The main novelty of this work is that related with the methodology in the didactic intervention program, which was absolutely based on the Mosston and Ashworth Spectrum of Teaching Styles (MASTS) (Mosston & Ashworth, 2002), with all contents and activities distributed evenly between two teaching groups every academic level along the compulsory secondary education. Moreover, the PE teacher was always the same for all intervention groups, in this way we could establish an acceptable control of variability of teaching-learning processes during PE classes in order to isolated the effect of TS. In our knowledge, this is the first study of the literature, which tries analyzed the effect of TS on PA-related health outcomes (PA, BC and PF) and with a quasi-experimental design. Furthermore, this research involved the difficulty of record in public schools a higher number of PE lessons (a total of 128 lessons). All of them, designed based on detailed RK and PK TS (Mosston & Ashworth, 2002) and taught in daily classes according with the four main contents based on The National Curriculum. Finally, studies usually have used between 1 and 13 sessions to analyze PA patterns in relation with PE contents (Fairclough & Stratton, 2005), we have performed and intervention, where every single session has been controlled and supervised and 128 of them were recorded. Considering, there is a clear lack of research studies that used the complete MASTS to analyze the efficacy of TS in PE our results should give a relevant contribution to the body of knowledge in the PE didactics research.

In addition, this study has the exclusive characteristic to combine the use of broad MASTS in PE classes to analyze the influence of teaching strategies regarding on PA daily patterns, BC and PF. Consequently, this study may constitute a bridge between

the school PE and PA for health, which has been traditionally studied as non-related areas so far. This new research approach focused on the influence of school methodologies to engage students in PA in PE classes and also during their leisure time after school schedule would fill a gap of knowledge related with actual importance and efficacy of school learning to improve socialization, healthy lifestyle and lifelong learning. This dissertation combine pedagogical and physiological in two main chapters:

- *Chapter 1. Teaching Styles in Physical Education: Pedagogy Assessment Tools Review.*
- *Chapter 2. Impact of Teaching Styles on Physical Activity Patterns, Body Composition and Physical Condition during Physical Education Classes.*

II. Background

II. 1. Physical Activity, Body Composition and Physical Fitness

II.1.1. Physical Activity

There is large evidence that support PA promotes health outcomes and prevents the deleterious consequences produced by sedentary habits (Bailey, 2006; Belcher et al., 2015; Hancox, 2006; Physical Activity Guidelines Advisory Committee, 2008; Thyfault, Du, Kraus, Levine, & Booth, 2015). The World Health Organization (WHO) estimates that 1.9 million deaths in the world are attributable to Physical Inactivity (PI) (WHO, 2004a). Recently, unhealthy lifestyle habits have increased in children and youth and this situation contributes to the development of different disorders (WHO, 2004a). The shortage of PA produces metabolic and cardiovascular diseases during childhood and adolescence (Andersen, 2006; Belcher et al., 2015; Janssen, & LeBlanc, 2010; Janssen, Wong, Colley, & Tremblay, 2013; Strong, 2005; WHO, 2004a). Currently, overweight and obesity is one of the most important PA-related disorders (Donnelly, 2009; Janssen, Katzmarzyk, Boyce, Vereecken, Mulvihill, Roberts, ... & Pickett, 2005) and have reached epidemic proportions in Western countries (Ells et al., 2015; Ogden, Carroll, Kit, & Flegal, 2014; Pigeot et al., 2009) and particularly in Spain (Grijota, Robles , Munoz, & Maynar, 2015; Martin et al., 2008; Miqueleiz et al., 2014; Rios, Flores, Ruiz, & Martinez, 2013; Pizarro & Royo-Bordonada, 2012). Nowadays, children and youth spend less time playing outdoors and are involved more time in new passive technologies, which have specific health consequences (Ekelund et al., 2006; Gao, Chen, Pasco, & Pope, 2015) and requires new social approaches.

PA not only improves aspects in relation with adult and physical health, but also contributes to obtain better results in the cognitive function and academic capacities (Dudley, 2012), so school stage is considered the best moment to engage youth people in PA (Andersen, 2006; Strong, 2005); the educational system and specifically Physical Education Teachers (PET) should contribute in this regard (Siedentop, 2009). For these reasons, different researches have been focused in the multiple benefits of active and healthy life in children and youth (Janssen, & LeBlanc, 2010; Janssen, Wong, Colley, & Tremblay, 2013; Strong, 2005). There is evidence that regular PA improves body composition, cardiorespiratory and muscular fitness (Dencker et al., 2006), bone health (Fulkerson et al., 2004) and metabolic health biomarkers among children and adolescents (Physical Activity Guidelines Advisory Committee, 2008; Simons-Morton, Parcel, O'Hara, Blair, & Pate, 1988). The most prevalent morphological consequence associated with PI and reduction of PA may be the changes in BC associated with enlargement of the adipose tissue or excessive adiposity (Guerra et al., 2006), which has two well defined categories such as overweight and obesity (Bray, 1985). Although, the prevalence of excessive thinness associated with eating disorders (for example anorexia) is a current concern during adolescence also (Hoek, 2006).

II.1.2. Body Composition

Childhood and adolescent overweight and obesity are highly prevalent in Spain (Lehingue, 1999; Martin et al., 2008; Pigeot et al., 2009). Although, there are several epidemiological and cross-sectional studies that have studied the main determinants of childhood obesity (Farajian et al., 2013; Pigeot et al., 2009), there are several questions, which remain to analyze from qualitative or quantitative point of view. There are studies

in the literature that have addressed the analysis of this problem from a global point of view (Haug et al., 2008, Singh et al., 2008b, Pigeot et al., 2009), socio-economic and demographic (Farajian et al., 2013) or as specifically as breack school time (Winterfeld, 2005) and its associations with obesity (Stratton et al., 2007, Fernandes and Sturm, 2010), the extracurricular physical activity (Martinez Vizcaino et al., 2008), travel to school (Chillon et al., 2010), leisure activities (Foley and Maddison, 2010, Salcedo Aguilar et al., 2010), hours of sleep and leisure time activity (Ortega et al., 2010), or even the sport (Quiterio et al., 2009). Therefore, it is important to know the reasons why children and adolescents have become sendentary and non-active, which may have lead to increase the rate of overweight and obesity. These reasons are not entirely clear, although there is some related to the social changes in family organization and new social habits (Farajian et al., 2013; Pigeot et al., 2009) (Anderson and Butcher, 2006, Martin-Matillas et al., 2010, Martin-Matillas et al., 2011). Some authors have been mainly focused in interventions for changing family habits (Braden, Strong, Crow, & Boutelle, 2015) and the place where the children live (Elder et al., 2014), rather than those associated with the general community policies (Covic et al., 2007, Singh et al., 2008a). Currently, there is strong evidence that school-based interventions have a significant impact for reducing weight loss and obesity, and its associated metabolic risk factors (Amini, Djazayery, Majdzadeh, Taghdisi, & Jazayeri, 2015; Sun et al., 2013), however this intervention had an exercise-training profile more than educative or PE class-based intervention, and less is know about the maintenaince of the results in a follow-up perspective.

II.1.3. Physical Fitness

Health-related PF has been widely studied in adults (Haskell, Blair, & Hill, 2009) and during the last decades in children and adolescents (Oja, 1997; Ortega, Ruiz, Castillo, & Sjostrom, 2008; Simons-Morton et al., 1988). The association between PA and PF has been a classical research topic in sport and PA sciences and there is strong evidence about their relationship (Blair & Church, 2004; Dencker et al., 2006; Oja, 2001; Sallis, 1993). Although, a controversy remains to establish which is more important for health status (Blair, Cheng, & Holder, 2001, Malina, 2001) although this may be related with the variable defining PF. In a health perspective PF has been defined by several components: Morphologic (BC); muscular (strength); cardiorespiratory (VO_{2max}); motor (balance and coordination) and metabolic (energy expenditure and blood markers, Blair et al., 2001).

The VO_{2max} has been the most important and studied health-related variable of the physical fitness (Levine, 2008). It has a strong association with survival (Barons et al., 2015; Shah et al., 2015), cardiovascular disease (Eaton, 1992) and all causes of mortality (Kodama et al., 2009). Moreover, it has been shown a connection between VO_{2max} in youth and cardiovascular disease risk in the adulthood (Twisk, Kemper, & van Mechelen, 2002). Although VO_{2max} is strongly determined by genetic influence and maturation (Bouchard & Malina, 1983), PA still has the potentially of improving cardiorespiratory fitness and obtain health benefits during childhood and adolescence (Baranowski et al., 1992; Malina, 1996). School-based intervention have proved to be effective to increase VO_{2max} (Dobbins, De Corby, Robeson, Husson, & Tirilis, 2009; Dobbins, Husson, DeCorby, & LaRocca, 2013) and particularly those that are

conducted by teachers, who are specialist in PE (Sallis et al., 1997). Nevertheless, VO_{2max} is not the only variable related with health that has been studied in children. The muscular component (strength) has been associated a several health outcomes among which the most important are bone mass, muscle mass (Peterson et al., 1991), functionality (Harris, 1997) and recently mortality (Volaklis, Halle, & Meisinger, 2015). Muscle mass and bone health (Tan et al., 2014) must be most important benefits among children and adolescents and school based interventions have confirmed efficacy in order to improve strength and functionality (Dobbins et al., 2013; Sallis et al., 1997); conversely, sedentary time such as playing video games has been reported a reduced bone mineral density (Shao et al., 2015) and strength (Fulkerson et al., 2004). So, strength exercises must have more risk and learning necessities than those designed for improving cardiorespiratory fitness (Barbieri & Zaccagni, 2013), which makes the pedagogic intervention of PE teacher much more important. Moreover, strength or resistances exercise have been popularly banned from the regular practice of children and adolescents due to a misunderstanding of they risk, however it has been described that this kind of exercise can be practice since 6-years old (Faigenbaum, 2000), which would permit an early education in this type of exercise.

Considering this previous evidence appears to be children and adolescents have potentially to improve their cardiorespiratory fitness and strength when involved in supervised PA interventions. However, different doses PA from interventions may result in different time responses (adaptations). Moreover, total daily PA is not single construct and it is a compound of several dimensions such as: sleeping time, ST, LPA, MPA and Vigorous Physical Activity (VPA) (Thompson, Peacock, Western, &

Batterham, 2015). The volume of MVPA has been suggested to be essential to achieve these improvements related with a healthy lifestyle (Andersen, 2006; Physical Activity Guidelines Advisory Committee, 2008). Although, there is not ad definitive agreement, several organizations and studies suggested that children and adolescents, in elementary and secondary stages, should accrue at least 60 minutes of PA with moderate-vigorous intensity during five days per week as general guideline (Janssen, Wong, Colley, & Tremblay, 2013; Strong, 2005; Tremblay, 2011; WHO, 2004b, 2010).

The prevalence of PA published in international studies from North America and Europe have shown that children and adolescents do not meet the latter recommendation of an hour a day of MVPA o average (Aznar, 2011; Dumith, Gigante, Domingues, & Kohl, 2011; Griffiths et al., 2013; Hallal, Andersen Bull, Guthold, Haskell, & Ekelund, 2012; Riddoch et al., 2007). Conversely, other researches confirmed that young people from Europe and Spain tend to accrue 51-58 min/day of MVPA (Aibar, 2013a; Janssen, Katzmarzyk, Boyce, Vereecken, Mulvihill, Roberts,... & Pickett, 2005). This discrepancy could be related with the fact that PA levels decline with age especially in secondary school and girls more than boys (Dumith et al., 2011; Sallis, 2000) and suggest a decrease up to 9% in people between 10 and 17 years old (Aznar, 2011; Baptista, 2012; Laguna Nieto, 2011; López-Fernández, 2015). European and specifically young Spaniards are below these recommendations on this range of age (Aibar, 2013a; Janssen, Katzmarzyk, Boyce, Vereecken, Mulvihill, Roberts,... & Pickett, 2005). Since adolescents expend a significant time of the day at school and a lifelong learning must be a main goal of the educative system, PE should play a role in

order to modify this deleterious behavior further than the potentiality of school-based interventions for improving MVPA (Lonsdale et al., 2013; Naylor et al., 2015).

II.2. Physical Activity and Physical Education

During academic course 2014-15, the general non-university education regimen enrollment approached to 8.09 million students in Spain. A total of 2.9 million were elementary students, 1.84 million were secondary students and 637 thousand were bachelor students (MECD, 2015). On average students spend approximately 1,050 hours per year in the high school and around 70 hours enrolled in PE classes (two hours per week in secondary education). Although, PE is a part of the national curriculum, the frequency and amount of MVPA to provide directly from PE classes is not enough to meet healthy recommendations (Kremer, 2012; McKenzie, Feldman, Woods, Romero, Dahlstrom, Stone, ... & Harsha, 1995). Moreover, students are often relatively inactive in PE classes (Blair, 2009; Simons-Morton, 1990, 1994). Regarding PA dimensions, intensities and volumes during PE classes there are still controversy (Torres-Luque, 2014), some authors have observed that the total amount of MVPA was between 8% - 10% (Martínez Martínez, 2012), while others indicated that MVPA in PE classes not exceed 30% of the total time (Kremer, 2012; Van Cauwenberghe & Bourdeaudhuij, 2008) but some researches have reported values as high as 30% - 37% (Kremer, 2012; Meyer, 2013) or even 54% in high school PE (Smith, Lounsbery, & McKenzie, 2014). Data from Portugal and Spain measured that youth people between 10-19 years old accumulated around 30%-36% of MVPA during PE classes (Baptista, 2012; López-Fernández, 2015).

Overall, these previous studies indicated that PA during PE classes contribute between 12%-16 % of a total daily PA during the week (Meyer, 2013) and that could be represent a rationale to increase the practice time during PE and the amount of weekly hours allocated to the PE subject. Consequently, new researches focused on the influence of methodologies to engage students in PA in PE classes and also during their leisure time outside of school may represent a main goal in order to correct the current behavior of adolescents (Atkin, Gorely, Biddle, Cavill, & Foster, 2011; Busch, de Leeuw, de Harder, & Schrijvers, 2013; Chillon, Evenson, Vaughn, & Ward, 2011; Lai et al., 2014). In 2004 WHO referred specifically to schools as the main setting to include an educational policy in relation with a health-centered development curriculum and qualified PET to promote healthy lifestyles (WHO, 2004a). Research studies have suggested that the best primary strategy for improving the long-term health is promote PA during childhood and adolescence creating healthy lifestyles that persist when they will be adult (Hallal, Victora, Azevedo, & Wells, 2006; McKenzie, & Lounsbery, 2013; Rowland, 1994; Telama, 2005), which is known as lifelong learning.

Although these factors have a great importance, children behaviors are strongly determined by the learning they receive in schools (Behets, 1997, Byra & Jenkins, 1998; Cothran, Kulinna, Banville, Choi, Amade-Escot, MacPhail,… Kirk, 2005) and, in particular, those related to PA and healthy behaviors should be transmitted in PE class (Byra, Sanchez, Wallhead; 2013; Rosenkranz, 2012). Studies in relation with TS used in PE and the influence of these learning strategegies in BC variables are scarce in the literature. This kind of studies could represent a big progress in the creation of a real strategy to solve the problem of PI in young people and its consequences.

II.3. Teaching Styles

Based on pedagogy, the first principle of teaching is facilitating learning, however, the teaching learning process can be complex (Guilbert, 1998). Therefore, the study of teacher effectiveness in relation with PA remains an important field of analysis. Students have different characteristics that influence in their learning, so teachers should develop skills to use different teaching methods to improve this process (Jaakkola, 2011).

Over the time, teachers have used different theories about multiples instructional approaches (Cothran, 2006). Joyce and Weil in 2004 describe over 20 different approaches to teaching divided in social interaction, information processing, focus on the individual and behavior modification (Joyce, 2004). Within the area of PE, Kulinna and Cothran suggested that an effective approach to pedagogical practice is to use a variety of TS (Kulinna, 2003) and the oldest and most widely known formal system of instructional frameworks is Mosston's Spectrum of Teaching Styles (Mosston, 1966a).

Mosston in 1966 proposed a continuum of TS based in the decision making process, a set of decisions made by the teacher and learner (Mosston, 1966a). The multiple options of interaction between TS establish *The Spectrum of Teaching styles*. According to Spectrum theory, TS can be classified in two main clusters: Reproduction of Knowledge (RK) and Production of Knowledge (PK). Mosston and Ashworth in 2002 continue identifying two clusters of TS, but these authors introduced an update adding three more TS (Mosston & Ashworth, 2002, 2008). The RK cluster consists of the first five styles: Command (A), Practice (B), Reciprocal (C), Self-Check (D) and

Inclusion (E), these styles reinforce the recreation of known information. Therefore, the next PK cluster consists of six styles: Guided Discovery (F), Convergent Discovery (G), Divergent Discovery (H), Learner-Designed Individual Program (I), Learner-Initiated and (J), Self-Teaching (K). These styles promote discovery of new information and the learner is involved at a higher level of cognition. The eleven landmark TS represent different teaching and learning experiences, but located between each concrete TS there are many pedagogical situations that are similar, but not the same, these variations are designed as a canopy (Mosston & Ashworth, 2002). The Spectrum begins with the Command TS where the teacher makes all decisions. As we move across the spectrum additional decisions are given to the learner ending with Self-Teaching and the learner makes all decisions.

Early studies of MASTS focused on the study of two or more TS from the RK cluster (often to determine fitness or motor skill outcomes from classes taught using different TS) (Camberlain, 1979; Dougherty, 1970; Mariani, 1970), with the Self-Check Style not studied (Hewitt, 2015). These seminal studies also investigated different developmental channels such as physical, social, emotional and cognitive (Boschee, 1974; Camberlain, 1979; Virgilio, 1979). The RK cluster had many effectiveness studies beginning in eighties (Chatoupis, 2010), followed by RK based in Practice Style (B) (Chatoupis, 2005, 2008; Chatoupis, & Emmanuel, 2003b; Sanchez, Byra, & Wallhead, 2012; Zeng, 2009) and Reciprocal Style (C) (Byra, 2004; Ernst, 1998; Hennings, 2010). Likewise researchers have been also focused in several educational factors inside RK TS that affected the teaching-learning process such as feedback (Byra, & Marks, 1993; Byra, Sanchez, & Wallhead, 2013), behaviors (Byra, & Jenkins, 1998;

Byra, Sanchez, & Wallhead, 2013), motivation (Goudas, 1995) and promoting motor skill acquisition (Chatoupis, 2005).

Regarding PK, there have been few studies from 1980 onwards concerning with the PK cluster (Hewitt, 2015). Several researchers have compared different TS in both clusters RK and PK (Cleland, 1994) and other studies have looked at only the PK (Maina, 1997). Thus, there is a lack of clear research studies that used the complete MASTS, and in our knowledge there has not been any study aimed to analyze the influence of PK and RK on total daily PA, PF and BC.

II.4. Contents in Physical Education

The content used in PE classes was the most studied of three factors, and it has been usually analyzed in relation with sex and age (Kulinna, 2003; Fairclough & Stratton, 2005b), class structure and the lesson goals. Most of the studies reviewed have categorized the contents in five groups: team sports, individual sports, PF, skills and mixed sessions (Fairclough & Stratton, 2003b; Stratton, 1997; Yuste et al., 2013). Each type of session was developed based on different parameters (interaction, skills requirement, goals), which were associated to different levels of motor behavior or physiological variables (the most commonly used in PE classes to characterize the internal load has been heart rate).

Stratton found seventeen research studies that analyzed physiological variables in PE classes (Stratton, 1996a). These studies observed a wide range variability in MVPA related to heart rate response depending on the content. Additionally, material resources or meteorology influenced the associations of these results with different TS.

Thus, they conclude that is difficult to ensure which content is more effective to promote MVPA in PE. A second review by Fairclough & Stratton (2005b) included forty studies relative to PA participation, which was assessed by systematic assessment tools, accelerometers (ACLs) and heart rate during, in relation to PE contents. These authors concluded that sports and PF contents produced the highest percentage of MVPA.

In order to promote adherence to PA behavior by PE intervention, it is important to know the educational success criteria that may be involved in PE classes such as time on learning (Berkey, 1986; Hastie, 1994; LaMaster, 1993; Metzler, 1983; Shute, 1982; Silverman, 1991), motivation (Chatoupis, & Emmanuel, C., 2003b; Chatzipanteli, 2015; Ferrer-Caja, 2002; Rosenkranz et al., 2012), TS (Ashworth, 2007; Curtner-Smith, 2001; Hasty, 1997; Mosston, 1966a; Parker, 2012), student and teacher perception of TS (Kulinna, 2003; SueSee, 2015) and others. TS management influences diverse learning conditions and experiences in PE, so should influence the autonomy to learn. However, there are not enough experimental or quasi-experimental studies related to efficacy of TS for promotion of after-school PA. As consequence, there is a lack of knowledge about influence of the TS in the promotion of daily PA. So, the main purpose in this dissertation was analyze the relation between TS used in PE and their influence on total PA daily patterns and PF variables related with health, such as cardiorespiratory variables, strength and BC**.**

III. Research Questions, Aims and Hypothesis

III.I Research Questions (RQ)

Chapter 1. Teaching Styles in Physical Education: Pedagogy Assessment Tools Review

(RQ1) What TS pedagogical assessments tools have been used in PE in the international literature?

(RQ2) What validation studies have been published about these TS pedagogical assessments tools?

(RQ3) What assessment tools have been used in PE related to teaching-learning effectiveness in the international literature?

(RQ4) What validation studies have been published about these assessments tools related to teaching-learning process?

Chapter 2. Impact of Teaching Styles on Physical Activity Patterns, Body Composition and Physical Condition during Physical Education Classes

(RQ5) Have adolescents taught in PE with reproductive or productive TS similar total daily (24 hour) PA patterns after and along an academic year?

(RQ6) Are adolescents taught in PE with reproductive or productive TS similar in their BC components after an academic year?

(RQ7) Are there differences in cardiorespiratory fitness variables between adolescents that were taught with RK or PK?

(RQ8) Are there differences in strength variables between adolescents that were taught with RK or PK?

III.2 Aims

Chapter 1. Teaching Styles in Physical Education: Pedagogy Assessment Tools Review

The main aims were considered in this research study:

1. To review the state of the art on pedagogical assessment tools, which have been commonly used to determine TS of PE classes.

Specifics goals:

1. To review the validation studies of these pedagogical assessment tools.

To review the literature and collect the teaching assessment tools related to other factors that influence the effectiveness of PE classes (e.g time on task, feedback and so on).

Chapter 2. Impact of Teaching Styles on Physical Activity Patterns, Body Composition and Physical Condition during Physical Education Classes

The main aims were considered in this research study:

1. To observe the differences on total daily PA behavior and in health-related PC variables between two groups of adolescents who were taught during a one academic year by using RK or PK TS following the classical Spectrum of Teaching Styles (MASTS) (Mosston & Ashworth, 2002) and compare them with a control group that not used a precise TS, mixed knowledge (MK).

Specifics goals:

1. To implement an ecological teaching research trial to analyze the influence of two TS in PE classes.
2. To analyze the differences on total daily PA behavior (ST, LPA, MPA, VPA, MVPA and Steps), after one academic year using RK or PK TS.
3. To analyze the differences in health-related PC variables such as cardiorespiratory fitness (VO2 Max), strength (RGS, LGS, LLS) and BC (FM, FFM, SMM, Waist Circumference (WC), Fat Mass Index (FMI), Fat Free Mass Index (FFMI), Skeletal Muscle Mass index (SMMI) and Body Mass Index (BMI)) after one academic year using RK or PK TS.

To explore differences on total daily PA behavior across three different contents (PF, Sports and Games (SG) and corporal expression) during PE lessons along one academic year.

III.3. Hypothesis

Hypothesis 1. There are not worldwide reognized TS pedagogical assessment tools used in PE and also teaching assessment instruments related to other factors that influence the effectiveness of PE classes.

Hypothesis 2. There are not significant differences on total daily PA behavior and in heath-related PC variables such as cardiorespiratory fitness, strength and BC using different TS (RK or PK) in PE.

Hypothesis 3. There are not significant differences on total daily PA behavior across different contents taught in PE lessons.

IV. Methodology

IV.1. Chapter 1: Teaching Styles in Physical Education: Pedagogy Assessment Tools Review

IV.1.1. Methods

Several databases were used (WOK, PubMed, SCOPUS, Thesaurus, ERIC, Sport Discus, ProQuest, DICE and Dialnet), to identify literature that appeared to be related to the use of TS in PE classes. The search strategy focused on different terms and concepts. Keywords that were used for the search were based on terms in different fields such as pediatrics (children, adolescents, youth), physical education (PE, PA), and pedagogy (learning styles, learning strategies, approaches to learning, TS, pedagogical assessment tools, behavioral assessment tools, motivational styles, learning orientations, teaching methods).

IV.1.2. Inclusion criteria

Identified studies suggested that some researchers produced models and instruments to assess TS used for different purposes. Therefore in this article the main inclusion criteria were to include pedagogical tools that were concerned with TS in relation with PE in elementary and secondary schools. We reviewed all identified that were published between 1st of January 1970 up to and including 31th of July 2015. Also, all papers that had been written in English or Spanish were selected.

On the other hand the exclusion criteria of pedagogical tools included, papers that had been published in a language other than English or Spanish. Second, papers with pedagogical tools about sports outside school were also excluded. Finally, studies about

TS in PE that did not include an original assessment tool. Conference proceedings and other unpublished papers were not included in the study.

IV.2. Chapter 2: Impact of Teaching Styles on Physical Activity Patterns, Body Composition and Physical Condition during Physical Education Classes

IV.2.1. Methods

IV.2.1.1. Participants

Young from thirteen to twenty years provided data on their BC, PF and ACLs. These young attended two different public high schools in the south of Spain. The socio-economic and cultural context is medium and equal in both educative centers. The ethnic distribution of participants in the first high school was: 83% European, 9% Asian, 6% South and Central American and 2% African. In the second high school, the ethnic distribution of participants was: 85% European, 5% Asian, 9% South and Central American and 1% African.

From the first high school, a total of 138 accepted to participate in the study (boys = 74 and girls = 64), the recruitment rate was 85% and the attrition rate was 45.83%. A subsample of students also participated by wearing an ACL during PE and daily during each of the weeks of data collection. For the purpose of the study a total of 82 adolescents agreed to wear ACL and complete data were obtained from 58 adolescents (boys = 26 and girls = 32), the recruitment rate was 59.42% and the attrition

rate was 29.26%. From the second high school, a subsample of 38 students was selected as a control group (boys = 20 and girls = 18 girls). Complete ACL data were obtained from 33 adolescents (boys = 20 and girls = 13 girls), the attrition rate was 13.16% (Figure 2).

IV.2.1.2. Design

IV.2.1.2.1. Setting

The first high school had a total of 306 students and was located in an urban community. Students had PE classes twice per week for a 60-minute lesson across the academic years. The high school does not offer sports activities outside school hours but students can participate in extracurricular activities offered at the nearby sports hall. The PE teacher promotes sports activities during the break. There is 30 minutes break each day at noon when students can also be active and participate in one of the following activities: soccer, basketball and volleyball competitions.

The second high school had a total of 398 students and was located in the same urban community. Students had PE classes twice per week for a 60-minute lesson across the academic years. This high school does not offer sports activities outside school hours but students can participate in extracurricular activities offered at the nearby sports hall. The PE teacher promotes sports activities during the break. There is 30 minutes break each day at noon when students can also be active and participate in one of the following activities: soccer and basketball competitions.

IV.2.2. Intervention

IV.2.2.1. Curriculum

In the first high school, this study was a two-year ecological intervention during PE where two different TS were utilized in two randomly attributed groups (there were 2 groups of students by academic level). Teacher selected the TS following the classical Spectrum of Mosston: Production Knowledge (PK) and Reproduction Knowledge (RK) (Mosston & Ashworth, 2002). Every year of intervention was based on The National curriculum (RD 1631/2006. RD 1467/2007. D 231/2007. D 416/2008). The existing curriculum included four required content areas: Physical Fitness and Health (PFH), Corporal Expression (CE), Outdoors Activities (OA), Sports and Games (SG). During academic courses there are six didactic units in the intervention: two of PFH (18 lessons), one of CE (12 lessons), one of OA (12 lessons) and two of SG (18 lessons). The study took place during the students' regularly scheduled PA classes (ecological perspective). Each year of the study involved 40 weeks and a total of 74 classes (60 lessons using specific TS). The same female teacher conducted all PE both years of the project. She had nine years of teaching experience in public high school students by the time of the study.

In the second high school, the control group was one group of students by academic level. The BC, PF and ACLs assessments were only at the beginning of the academic course and during the first year. PE lessons were based on The National Curriculum (RD 1631/2006. RD 1467/2007. D 231/2007. D 416/2008). The existing curriculum included four required content areas but the participants were assessed only during PF content. The male teacher did not select any concrete TS; he used mixed

knowledge (MK) TS. He had fifteen years of teaching experience in public high school students by the time of the study.

Before the intervention, permission for the study was granted for the schools authorities and students' parents by signed informed consent documents for being involved in the PA and biological assessments. Briefly, two weeks at the beginning of the course were used to organize explanatory meetings with the school administrative committee, parents and students. Then signed administrative authorizations (Appendix III) and informed consents (Appendix V) from school administration, parents and students were collected from those who accepted to participated in the study. PA, PC and BC assessments were carried out the next four weeks (see below) and during the two last weeks of the end of the academic year. After pretesting, the intervention started throughout the academic year with one intervention group using the RK and the other using PK.

During the first year of study, there were three groups that participated in the intervention RK (one per grade 9^{th}, 10^{th} and 11^{th}) (60 lessons) and the other three groups (one per grade 9^{th}, 10^{th} and 11^{th}) were taught with PK (60 lessons). The second year of the intervention two classes (one per grade 10^{th} and 11^{th}) were taught with PK (60 lessons) and the other two classes (one per grade 10^{th} and 11^{th}) were taught with RK (60 lessons). In the second high school, the control group was one group by level, two classes (one per grade 10^{th} and 11^{th}) (Table 14).

IV.2.2.2. Teaching Styles study protocol

In the first high school, the teacher used all TS of RK cluster (A-E) and the five first TS of PK cluster (F-J). It was decided not to use style K because this TS is not widely applied in PE schools context (Doherty, 2010). The teacher designed the methodology following a progression, first she used TS where the teachers made more decisions than the learner and gradually the student took over more of the decisions. As described previously, there were four main contents across the year: PFH, CE, OA, SG, were planned to be taught in relation to the context at the school (schedule, weather, personal characteristics of students or academic level), but always at same period time in each TS. A total of six Teaching Units (TU) were developed and taught during every academic course in both RK and PK as follow (a similar plan was followed the second year): two PFH units had eleven and seven lessons respectively (TU1-TU2), one CE unit had twelve lessons (TU3), one OA unit had twelve lessons (TU4) two SG units had nine lessons both of them (TU5-TU6). See below (Tables 1-8).

Table 1. *Physical Fitness and Health (PFH) contents planned in 9th grade every academic year: reproduction knowledge (RK) teaching styles (TS) based on Mosston and Ashworth Spectrum of Teaching Styles (MASTS).*

RK				
TU1. PFH: FITNESS GAMES, STRENGH AND ENDURANCE				
LESSON 1 - 4	**Content**	**Warm-up**	**Fitness games**	**Closure**
	TS	(A)	(B)	(A)
LESSON 5 -7	**Content**	**Warm-up**	**Strength**	**Closure**
	TS	(A)	(D)	(A)
LESSON 8 - 10	**Content**	**Warm-up**	**Endurance**	**Closure**
	TS	(B)	(C)	(B)
TU2. PFH: SPEED, FLEXIBILITY AND FITNESS CIRCUIT				
LESSON 1 - 2	**Content**	**Warm-up**	**Speed**	**Closure**
	TS	(B)	(B)	(B)
LESSON 3 - 5	**Content**	**Warm-up**	**Flexibility**	**Closure**
	TS	(B)	(B)	(B)
LESSON 6 - 7	**Content**	**Warm-up**	**Fitness circuit**	**Closure**
	TS	(D)	(E)	(D)

PFH, Physical Fitness and Health; UT, Teaching Unit; TS, Teaching Style; (A) Command TS; (B) Practice TS; (C) Reciprocal TS; (D) Self-check TS; (E) Inclusion.

Table 2. *Corporal Expression (CE) contents planned in 9th grade every academic year: reproduction knowledge (RK) teaching styles (TS) based on Mosston and Ashworth Spectrum of teaching styles (MASTS).*

RK				
TU3. CE: RHYTHM, MOVEMENT AND DANCE				
LESSON 1 - 2	**Content**	**Warm-up**	**Music and Rhythm**	**Closure**
	TS	(A)	(A)	(A)
LESSON 3 - 5	**Content**	**Warm-up**	**Musical Games**	**Closure**
	TS	(A)	(B)	(A)
LESSON 6 - 7	**Content**	**Warm-up**	**Rhythm and Movement**	**Closure**
	TS	(C)	(D)	(C)
LESSON 8-10 / 11-12	**Content**	**Warm-up**	**Choreography**	**Closure**
	TS	(B)	(E)	(B)

CE, Corporal Expression; UT, Teaching unit; TS, Teaching style; (A) Command TS; (B) Practice TS; (C) Reciprocal TS; (D) Self-check TS; (E) Inclusion.

Table 3. *Outdoors Activities (OA) contents planned in 9th grade every academic year: reproduction knowledge (RK) teaching styles (TS) based on Mosston and Ashworth Spectrum of teaching styles (MASTS).*

RK				
TU4. OA: ORIENTATION				
LESSON 1 - 2	**Content**	**Warm-up**	**Map**	**Closure**
	TS	(A)	(A)	(A)
LESSON 3 - 5	**Content**	**Warm-up**	**Compass**	**Closure**
	TS	(A)	(B)	(A)
LESSON 6 - 7	**Content**	**Warm-up**	**Orientation in the school**	**Closure**
	TS	(B)	(C)	(B)
LESSON 8 - 10	**Content**	**Warm-up**	**Orientation in the park**	**Closure**
	TS	(B)	(D)	(B)
LESSON 11 - 12	**Content**	**Warm-up**	**Orientation in the field**	**Closure**
	TS	(B)	(E)	(B)

CE, Corporal Expression; UT, Teaching unit; TS, Teaching style; (A) Command TS; (B) Practice TS; (C) Reciprocal TS; (D) Self-check TS; (E) Inclusion.

Table 4. *Sports and Games (SG) contents planned in 9th grade every academic year: reproduction knowledge (RK) teaching styles (TS) based on Mosston and Ashworth Spectrum of teaching styles (MASTS).*

RK				
TU5. SG: BASKETBALL I				
LESSON 1 - 3	**Content**	**Warm-up**	**Pre-Games**	**Closure**
	TS	(A)	(B)	(A)
LESSON 4 - 6	**Content**	**Warm-up**	**Motor Skills**	**Closure**
	TS	(B)	Reciprocal (C)	(B)
LESSON 7 - 9	**Content**	**Warm-up**	**Strategy**	**Closure**
	TS	(D)	(E)	(D)
TU6. SG: SOCCER II				
LESSON 1 – 3	**Content**	**Warm-up**	**Pre-Games**	**Closure**
	TS	(B)	(B)	(B)
LESSON 4 - 6	**Content**	**Warm-up**	**Motor skills II**	**Closure**
	TS	(B)	(C)	(B)
LESSON 7 - 9	**Content**	**Warm-up**	**Strategy II**	**Closure**
	TS	(D)	(E)	(D)

SG, Sports and games; UT, Teaching unit; TS, Teaching style; (A) Command TS; (B) Practice TS; (C) Reciprocal TS; (D) Self-check TS; (E) Inclusion.

Table 5. *Physical Fitness and Health (PFH) contents planned in 9th grade every academic year: production knowledge (PK) teaching styles (TS) based on Mosston and Ashworth Spectrum of teaching styles (MASTS).*

PK				
TU1. PFH: FITNESS GAMES, STRENGH AND ENDURANCE				
LESSON	**Content**	**Warm-up**	**Fitness games**	**Closure**
1 - 4	TS	(F)	(G)	(F)
LESSON	**Content**	**Warm-up**	**Strength**	**Closure**
5 - 7	TS	(F)	(G)	(F)
LESSON	**Content**	**Warm-up**	**Endurance**	**Closure**
8 - 10	TS	(F)	(H)	(F)
TU2. PFH: SPEED, FLEXIBILITY AND FITNESS CIRCUIT				
LESSON	**Content**	**Warm-up**	**Speed**	**Closure**
1 - 2	TS	(H)	(H)	(H)
LESSON	**Content**	**Warm-up**	**Flexibility**	**Closure**
3 - 5	TS	(I)	(I)	(I)
LESSON	**Content**	**Warm-up**	**Fitness circuit**	**Closure**
6 - 7	TS	(J)	(J)	(J)

PHF, Physical fitness and health; UT, Teaching unit; TS, Teaching style; (F) Guided Discovery; (G) Convergent Discovery; (H) Divergent Discovery; (I) Learner-Designed individual program; (J) Learner-Initiated.

Table 6. *Corporal Expression (CE) contents planned in 9th grade every academic year: production knowledge (PK) teaching styles (TS) based on Mosston and Ashworth Spectrum of teaching styles (MASTS).*

PK				
TU3. CE: RHYTHM, MOVEMENT AND DANCE				
LESSON 1 - 2	**Content**	**Warm-up**	**Music and Rhythm**	**Closure**
	TS	(F)	(F)	(F)
LESSON 3 - 5	**Content**	**Warm-up**	**Musical Games**	**Closure**
	TS	(G)	(H)	(G)
LESSON 6 - 7	**Content**	**Warm-up**	**Rhythm and Movement**	**Closure**
	TS	(I)	(I)	(I)
LESSON 8 - 12	**Content**	**Warm-up**	**Coreograhy**	**Closure**
	TS	(J)	(J)	(J)

CE, Corporal expression; UT, Teaching unit; TS, Teaching style; (F) Guided Discovery; (G) Convergent Discovery; (H) Divergent Discovery; (I) Learner-Designed individual program; (J) Learner-Initiated.

Table 7. *Outdoors Activities (OA) contents planned in 9th grade every academic year: production knowledge (PK) teaching styles (TS) based on Mosston and Ashworth Spectrum of teaching styles (MASTS).*

PK				
TU4. OA: ORIENTATION				
LESSON 1 - 2	**Content**	**Warm-up**	**Map**	**Closure**
	TS	(F)	(F)	(F)
LESSON 3 - 5	**Content**	**Warm-up**	**Compass**	**Closure**
	TS	(G)	(G)	(G)
LESSON 6 - 7	**Content**	**Warm-up**	**Orientation in the school**	**Closure**
	TS	(J)	(J)	(J)
LESSON 8 - 10	**Content**	**Warm-up**	**Orientation in the park**	**Closure**
	TS	(I)	(I)	(I)
LESSON 11 - 12	**Content**	**Warm-up**	**Orientation in the field**	**Closure**
	TS	(H)	(H)	(H)

OA, Outdoors activities; UT, Teaching unit; TS, Teaching style; (F) Guided Discovery; (G) Convergent Discovery; (H) Divergent Discovery; (I) Learner-Designed individual program; (J) Learner-Initiated.

Table 8. *Sports and Games (SG) contents planned in 9th grade every academic year: production knowledge (PK) teaching styles (TS) based on Mosston and Ashworth Spectrum of teaching styles (MASTS).*

PK				
TU5. SG: BASKETBALL I				
LESSON 1 - 3	**Content**	**Warm-up**	**Pre-Games**	**Closure**
	TS	(F)	(F)	(F)
LESSON 4 - 6	**Content**	**Warm-up**	**Motor Skills**	**Closure**
	TS	(G)	(G)	(G)
LESSON 7 - 9	**Content**	**Warm-up**	**Strategy**	**Closure**
	TS	(F)	(H)	(F)
TU6. SG: SOCCER II				
LESSON 1 - 3	**Content**	**Warm-up**	**Pre-Games**	**Closure**
	TS	(H)	(H)	(H)
LESSON 4 - 6	**Content**	**Warm-up**	**Motor skills II**	**Closure**
	TS	(I)	(I)	(I)
LESSON 7 - 9	**Content**	**Warm-up**	**Strategy II**	**Closure**
	TS	(J)	(J)	(J)

SG, Sports and Games; UT, Teaching unit; TS, Teaching style; (F) Guided Discovery; (G) Convergent Discovery; (H) Divergent Discovery; (I) Learner-Designed individual program; (J) Learner-Initiated.

IV.2.2.3. Description of lessons

In both high schools PE lessons were designed following The National curriculum (RD 1631/2006. RD 1467/2007. D 231/2007. D 416/2008). Each lesson over the year of the study lasted 60 minutes, which were divided into warm up (10-15 min), lesson (35-40 min) and closure (10-15 min). In the first high school the lessons in RK and PK styles had the same content and the same number of class sessions. Teacher role and student role were determined by the TS used. The main aim of the lessons was the same in both TS but the learning intentions (physical, social, emotional, cognitive, moral) varied depending on the TS used. Learning intentions were equivalent with the five "developmental channels" described by Mosston in 1966. These channels represent specific human attributes that can provide experiences to promote human values of cooperative relationship, perseverance, motivation, self-control, etc. (Mosston, & Ashworth, 2008). The teacher encourages one or more channels depending on the intended purpose and the TS used. The teacher decided objectives, learning experiences and anticipated outcomes. Each class period included one or more episodes of TS; an episode is a unit of time within teacher and learner are engaged in the same TS (Goldberger, 2012). The lesson structure was based on a specific teacher and student interaction, a main objective, an episode events description and a task description that were defined prior to teaching each lesson (Table 9). Additionally, as a function of the TS used the lessons included checklist with skill criteria, cues, common errors, feedback, etc. If during lessons development the teacher had to modify the TS, she used other TS in the same cluster.

Table 9. *Examples of physical education (PE) lessons in different contents related to teaching styles (TS).*

MASTS	TEACHING STYLE	LEARNING INTENTIONS	EXAMPLE
REPRODUCTION KNOWLEDGE	**Command (A)**	**Physical:** Motor skill acquisition	**TU3 CE** Music rhythm choreography directed by teacher
	Practice (B)	**Physical:** Motor skill development	**TU5 SG** Teacher instructions about foul shot in basketball
	Reciprocal (C)	**Social:** Working with others **Cognitive:** Observing, analyses	**TU6 SG** Practice the passes of soccer in pairs
	Self-Check (D)	**Social:** Helping others assess their own performance	**TU1 PFH** Shot put in strength workout. Success criteria on a teaching card
	Inclusion (E)	**Social:** Maximizing involvement. Assisting others to succeed	**TU4 AO** Using orientation routes in the field with different distances
PRODUCTION KNOWLEDGE	**Guided Discovery (F)**	**Cognitive:** Discovery learning	**TU5 SG** A clue to discover different basketball passes in pairs
	Convergent Discovery (G)	**Cognitive:** Independent Thinking **Social:** Confidence, work group	**TU 4** Small work group to discover compass use.
	Divergent Discovery (H)	**Cognitive:** Seek multiple responses **Social:** Work with others	**TU 2 PFH** Clues sheet to discover different speed types
	Learner-Designed Individual Program (I)	**Cognitive:** Planning	**TU 2 PFH** Organize their own training with a physical fitness circuit
	Learner-Initiated (J)	**Cognitive:** Selection and application **Social:** Personal and responsibility	**TU 3 CE** Create a choreography
	Self-Teaching (K)	**Cognitive:** Understanding **Social:** Independence	Not used

MASTS, Mosston and Ashworth Spectrum of Teaching Styles; TU, Teaching Unit; PFH, physical fitness and health; CE, Corporal Expression; OA, Outdoors activities; SG, Sports and games.

IV.2.2.4. Intervention by Grade Level

For year one of the intervention, 9-11th grade students participated. In year two of the intervention, only 10-11th grade students participated. The National Curriculum was taught in the PE program over the two years of the study. There were minor changes in the specific activities taught: TU about PFS in 9th - 10th - 11th grades included fitness games, strength, endurance, speed, flexibility and fitness circuit. TU about SG in 9th grade included basketball and soccer in 10th grade badminton and hockey and in 11th grade across sport gymnastics and volley. TU about OA in 9th grade included orientation, in 10th grade beach soccer and in 11th grade beach volley. TU about CE in 9th grade included rhythm and dance, in10th grade theatre and in 11th grade choreography.

IV.2.3. Assessing the Teaching Styles: Intervention Validation

IV.2.3.1. Videotaping of lessons.

In order to code TS used as a measure of intervention fidelity and validity, lessons were videotaped and subsequently coded. A total of 72 lessons (two lessons for unit and two lessons for each class and TS) were videotaped the first year of intervention and 48 were videotaped the second year (two lessons for each unit and two lessons for each class and TS) in the intervention groups (RK and PK). A total of 8 lessons (two lessons for unit) were videotaped the first year of intervention in the control group (MK). Lessons were filmed with a camera located in open-wide angle of the facility where the lesson was performed, in this way a full view of the learning-teaching interactions could be recorded. The teacher wore a wireless microphone in

order to improve the assessment of verbal interaction.

IV.2.3.2. Systematic Observation and Assessment Tool

Lessons from both methods of TS and also control group TS were coded with the Description Inventory of Landmark Teaching Styles (Asworth, 2010, 2004). This assessment tool was based on the MASTS (Mosston & Ashworth, 2002) and it is used to support the fidelity of the teaching styles taught in PE classes. The framework was refined in 2007 (Ashworth, 2007; SueSee, & Edwards, 2009; SueSee, Ashworth, & Edwards, 2006) It was further validated in Australia (Suesee & Edward, 2009) and is frequently used (Hewitt, Ashworth, & Edwards, 2010, 2011; Hewitt, 2015; SueSee, & Edwards, 2011, 2015).

IV.2.3.3. Expert coders

Two experienced coders viewed two classes for each TS (RK and PK) and for each of the six units across the four major contents. The primary TS used in each of the 12 lessons was coded using the descriptions from the Landmark Teaching Styles: A Spectrum Inventory. Interrater reliability was calculated across all classes using the following formula: *[(agreements / (agreements + disagreements))· 100)]* (Van der Mars, 1989). The agreement between the two experts overall was 87.5%. Thus showing a high level of interrater reliability and also supporting the fidelity of the TS used in the classes. These figures correspond with the recommendations of researchers, who regarded an agreement score of 80% or higher to provide appropriate reliability (Rushall, 1977; Van der Mars, 1989)

IV.2.4. Accelerometry Study Protocol

IV.2.4.1. Type of accelerometers

We used 100 Actigraph GT3X ACLs (dimensions: 3.8 cm x 3.7 cm x 1.8 cm; weight: 27 g). This device is a tri-axial ACL. Actigraph ACLs have shown adequate reproducibility, validity and feasibility in children and adolescents (Torres-Luque, 2014).

IV.2.4.2. Epoch length

The ACL collects and sums the activity counts over a user-defined epoch. Activity monitor data should be collected over the shortest possible epoch to retain as much information as possible about the original PA-related biosignal (Heil, 2012), but that allow the device to capture data over the number of days of monitoring established as the goal (Matthews, 2012). When assessing PA in children it is recommended that epoch durations are 10s or less (Rowlands, 2007). Bailey in 1995 reported that children engaged in very short bursts of intense PA interspersed with varying intervals of low and moderate intensity. In their study sample, the median duration of low and medium intensity activities was 6s, of high intensity activities only 3s with 95% lasting less than 15s (Bailey, 1995). Therefore, to be able to accurately capture these sporadic bursts of activity, we selected a time interval/epoch length of 1 second. To date, data obtained by 1-s epochs may not be informative on their own but can be summed to create 10-, 15-, or 30-s increments until the field develops a better understanding of data obtained from short sampling intervals (Strath, 2012).

IV.2.4.3. Duration of measurement

We should monitor activity for a sufficient number of days so that the resulting daily average reflects an individual usual or habitual level of PA, without overly burdensome on the participants or project resources (Trost, 2005). In light of the number of monitoring days needed to achieve an acceptable reliability, and the observation of weekend and weekday differences in physical activity patterns, a 7-d monitoring protocol would appear to be a sensible choice for youths (Trost, 2005). This monitoring period has been routinely used in PA monitor studies because they provide a sufficiently large number of days to achieve intraclass correlations around 80%, while also providing the opportunity to sample behavior on both week and weekend days (Matthews, 2012; Rowlands, 2007; Trost, 2000). Based on these findings, we collected data during seven consecutive days.

IV.2.4.4. Initializing the devices

Initialization is the process of preparing a PA monitor to collect data. The Actilife software (version 5.10.0) was used to initialize the ACLs and upload the collected data. Before initializing, the devices were fully charged (4.18V) by connecting them to a 7 port USB hub. The start date and time was set at the day when the devices were handed out to the children starting at 09.00 AM and the stop date and time was set at 02.00 PM the day when the devices were collected. The three axis (vertical, horizontal and perpendicular), steps and inclinometer were sampled and stored.

IV.2.4.5. Device placement

The device placement refers to the locations where the ACLs are placed, and how they are attached to those locations. Wearable activity sensors can be placed on different parts of a human body whose movements are being studied, but when we want to measure the whole-body movement, the sensors are commonly placed on the waist because of the fact that the waist is close to the center of mass of a whole human body and the accelerations measured by a single sensor at this location can better represent the major human motion (Yang & Hsu, 2010). Freedson in 2012 suggest that the device placement should be based on how monitors were positioned in calibration and validation studies (Freedson, 2012). Monitors can be worn under or over clothing but should be fit snugly against the body to prevent relative motion between the sensors and the parts of the human body (Matthews, 2012). It makes little difference whether the monitor is worn on the right or left side, but the need for a standard protocol would suggest that one side be used consistently. The right side may be most convenient because most people are right-handed (Ward, 2005).

Participants were fitted with ACLs located at the waist at the right side of the body in an elastic belt and were asked to wear the ACL either under or on their clothes all the time, except when sleeping or when the ACL could get wet. We instructed the participants to be aware that the ACL should be placed with the black label that covers the USB connection on the front.

IV.2.4.6. Diaries (log-books)

We asked children to fill in a diary recording the time of getting up in the morning and going to bed for sleeping. They also noted the time and reason why the device was

removed for 5 minutes or more for any activity such as swimming, or showering. We also asked whether the measurement day was a school day or non-school day (Appendix VII).

IV.2.4.7. Data collection

Researcher distributed the ACLs face-to-face at schools. Information about ACL use was given to the children orally and at the end of the information session ACLs were handed out. Researchers placed the ACL to the children's waist. Additionally, children and parents received a brochure about ACL use including the instructions for children (Appendix VII) and the diary (Appendix VIII). Teachers were also informed about the procedure and asked to remind the children to wear the devices every day. After the proposed wearing period, children brought the device back to school and handed it out to the researchers. Downloading the data from ACLs was done as soon as possible using the Actilife software (version 5.10.0), on the same computer where it was initialized to prevent disturbances that can be caused by the time offset between computers. The diary data were entered manually in Excel files.

IV.2.4.8. Data processing

Actilife software (version 5.10.0) was used for data reduction and analysis. All data contained within the time frame from when the monitor was initialized (i.e., when the students received their monitors) until the same time the following week was processed. For example, if students received their monitors at 10:00 AM on Friday, the data from Friday at 10:00 AM until the next Friday at 10:00 AM would be processed through the program. For days 2 to 7, all data from 00:01 until midnight was reduced to summary

variables. Day one and day eight were combined to form a composite seventh day of data.

IV.2.4.9. Data reduction

We removed days with incomplete information. A day was considered complete if it contained ≥ 10 hours of wear time for weekdays and ≥ 8 hours for weekend days considering different sleep patterns at weekends (Yıldırım, 2011). The decision was taken to consider ACLs as not worn if a period of 60 minutes of consecutive zeros, allowing for 2 minutes of non-zero interruptions, was encountered anywhere in the data array. All other count data contributed to the determination of ACL wear time.

The second data reduction step involved removing participants with an insufficient number of days of complete data. Based on existing precedence for using ACL data, only participants with ≥ 4 complete days, including one weekend day (Holman, 2011). It is important consider that children and adolescents reach different activity levels on the weekends compared to weekdays (Trost, 2000). The test-retest reliability of 4 days of ACL measurement in children and youth is 0.7 (Trost, 2005).

IV.2.4.10. Cut-points for activity categories

The output from ACL is a dimensionless unit commonly referred to as ACL counts. Researchers have attempted to calibrate these counts with energy expenditure in order to get a biological meaning to the output (Freedson, 2005). This has resulted in the publication of count thresholds relating to various categories of energy expenditure, that allow researchers to summarize time spent in a given intensity of activity (Rowlands, 2007). The availability of multiple cut points or equations has led to much confusion in the ACL literature (Welk, 2012). With the aim of reaching consensus regarding the

application of intensity related cut points for children and adolescents, Trost in 2011 simultaneously evaluated the classification accuracy of five independently developed and widely applied sets of youth-specific ActiGraph ACL cut points (Trost, 2011). After comparing the accuracy of the five sets of cut points using energy expenditure, measured via portable indirect calorimetry, as a criterion measure, they recommended that researchers use the Evenson in 2008 cut points to estimate time spent in sedentary, light-, moderate-, and vigorous-intensity activity in children and adolescents (Evenson, 2008). Of the five sets of cut points examined, only the Evenson cut points provided acceptable classification accuracy for all four levels of physical activity intensity and the MVPA cut point performed well among children of all ages. In Evenson (2008) and in Trost (2011) comparative studies, the selected activities ranged in intensity from sedentary to vigorous, included free-living PA typically performed by children and adolescents, and included both ambulatory and intermittent free-play activities.

On the basis of these findings, we selected the cut points from Evenson: ≤ 100 cpm for sedentary behaviour, < 2296 cpm for LPA, < 4012 cpm for MPA, and ≥ 4012 cpm for VPA (Evenson, 2008).

Automated error checking is useful for identifying periods of transient ACL malfunctioning and/or participant tampering that may not appear during routine calibration checks (Mâsse, 2005), so we also set a cut-point for the upper limit of count values to avoid spurious data based on the recommendations from Esliger (2005). It was shown that count values higher than 15,000 per minute are very unusual and implausible. For this reason the count values greater than 15.000 per minute were considered as missing values, as in a previous study (Yildirim, 2011).

IV.2.5. Body Composition study protocol

BC assessed using anthropometric method. All procedures followed the next protocol: All students were in fasting conditions, although water was permitted until one-hour before doing the measurements (except for body weight). Participants refrained from taking tea, coffee, chocolate or any other kind of stimulants; also they did not perform any intense exercises or efforts during the previous 24 hours before the tests.

IV.2.5.1. Anthropometry

The height and weight were measured to the nearest 0.1 cm 0.1 kg respectively with a stadiometer (Tanita® Leicester) and scale (Tanita®, model UM-060). An inextensible tape (Rosscraft, Canada) was used to obtain waist circumference (WC), arm, thigh and calf circumferences to the nearest 0.1 cm. Skinfolds (triceps, thigh and calf) were measured with a calibrated caliper (Holtain Ltd, Crosswell, UK) with a precision of 0.2 mm, on the right side of the body. All measurements were carried out according to the standardized procedures described in the literature (Lohman, Roche, Martorell, 1988) and in accordance with guidelines of The International Society for the Advancement of Kinanthropometry (Marfell-Jones, Olds, Stewart, & Carter, 2006). The same anthropometrist, who had an error below 3% in all sites, carried out all measurements.

IV.2.5.2. Body Composition components

Based on the previous measurements BC components were calculated as follow. Body mass index (BMI) was calculated as: *weight/height^2 (kg/m^2)*; international cut-offs

were used to calculate gender and age-specific Z-scores as suggested by WHO to compare BMI across ages during adolescence (WHO, 2010).

Fat Mass Percent (%FM, equations 1 and 2), and Fat Free Mass (FFM, equation 3) were calculated using the two compartments model described by Slaughter (Slaughter et al., 1988):

$$\%FM♀ = 0.610 \cdot (\sum \text{triceps skinfold} + \text{calf skinfold}) + 5.1 \qquad \textit{(Equation 1)}$$

$$\%FM♂ = 0.735 \cdot (\sum \text{triceps skinfold} + \text{calf skinfold}) + 1.0 \qquad \textit{(Equation 2)}$$

$$FFM\ (kg) = Weight - (\%FM/100 \cdot Weight) \qquad (\textit{Equation 3})$$

Skeletal Muscle Mass (SMM) was estimate from validated age-specific models based on corrected muscle girth model (Equation 4) (Quiterio, Carnero, Silva, Bright, & Sardinha, 2009), which were calculated from height, circumferences and skinfolds previously measured. So, muscle circumference was estimated from the corrected limb circumference by:

$$Mc = C - (\pi \cdot Skinfold) \qquad (\textit{Equation 4})$$

Where Mc = muscle circumference (cm), C = limb circumference (cm), skinfold (cm).

Poortmans' model (Poortmans, Boisseau, Moraine, Moreno-Reyes, & Goldman, 2005) was used for participants under 16-years (Equation 5) and Lee's model for those older than 16 years old (Equation 6) following the difference reported by Kim et al for those prepubertal and pubertal subjects (Kim, Shen et al. 2006)

$$SMM\ (kg) = Height \cdot (0.0064 \cdot McArm^2 + 0.0032 \cdot McThigh^2 + 0.0015 \cdot McCalf^2) + 2.56 \cdot Gender + 0.136 \cdot Age$$

(Equation 5)

$$SMM\ (kg) = Height \cdot (0.00587 \cdot McArm^2 + 0.00138 \cdot McThighG^2 + 0.00574 \cdot McCalf^2) + 2.4 \cdot sex - 0.026 \cdot age + race \cdot 4.4$$

(Equation 6)

Where gender = 1 for male and 0 for female; race = -1.6 for Asian, 1.2 for African American, and 0 for white or Hispanic.

FFM and FM indexes (FFMI & FMI) have been proposed as weight-status indexes for adults (VanItallie, Yang, Heymsfield, Funk, & Boileau, 1990) and recently for Spanish adolescents (Alvero-Cruz et al., 2010). We calculated FMI and FFMI using the classical BMI equation and substituting the mass component (equations 7 and 8), additionally we calculated de SMM index (SMMI; equation 9). These variables may help us to explain and correct variability introduced by the natural growing (height) in BC analysis, which influences some of the morphological changes during the intervention.

$$FMI = FM\ (kg) / Height\ (m)^2 \qquad \textit{(Equation 7)}$$

$$FFMI = FFM\ (kg) / Height\ (m)^2 \qquad \textit{(Equation 8)}$$

$$SMMI = SMM\ (kg) / Height\ (m)^2 \qquad \textit{(Equation 9)}$$

IV.2.6. Physical Condition Study Protocol

IV.2.6.1. Upper limbs strength

The Handgrip Strength (HGS) on right and left hands was measured using a digital handgrip dynamometer (T.K.K.5401, Takei, Japan), which records the maximum

reading performed in kg. After adapting handgrip to each subject, participant stand with the right elbow extended along the body without touching the trunk or thigh with the upper limb or dynamometer. When indicated the participant squeezed the dynamometer as strong as possible during 5 seconds. Two trials were permitted with a rest period of 3 minutes and the maximal measurement was recorded.

IV.2.6.2. Lower limbs strength

Isometric strenght of lower limbs was measured with an isometric back-leg lift dynamometer (TKK-5002, Psymtec). Briefly, participants pulled the dynamometer to compresses a steel spring with the force applied for their legs and back. A similar protocol, which was used for upper limbs, was followed in this assessment. The best trial was recorded for using in statistical analysis.

IV.2.6.3. Cardiorespiratory fitness

VO_{2max} was the indicator of cardiorespiratory fitness in this study. VO_{2max} was measured by indirect calorimetry technique using a portable breath-by-breath metabolic unit, developed by Metamax 3B (Cortex Biophysic, Leipzig, Germany) while performing a maximum test on a bench (Chester Step Test). Data from indirect calorimetry were collected using Metasoft v.1.11.05 software (Cortex Biophysic, Leipzig, Germany). Additionally, heart rate was continuously measured with heart rate monitor (Polar, Finland) during the test and record every minute. When a direct measurement was not possible an estimation using a steady-state linear regression approach was used (ACSM, 2013). Briefly, at least two stages of the bench test were used to estimate intercept and slope constants of the relationship between heart rate (independent variable, X axis) and estimated VO_2 for a constant load (dependent

variable, Y axis). VO_2 equation (Equation 7) to estimate VO_2 for a constant load were those proposed by de American College of Sports Medicine (ACSM, 2013):

$$VO_2\ (ml/kg/min) = (0.2 \times Cad) + (1.33 \times 1.8 \times Height \cdot Cad) + 3.5 \qquad (Equation\ 7)$$

Where, Cad = cadence (steps/minute); Height, bench height in meters.

The Chester Step Test is an incremental five-level step test, which was previously validated (Skyes et al. 2004). It consists of going up and down a bench (from 32-52 cm) at a pace set by a signal sound, which progressively increases in speed up to five levels. All adolescents engaged a previous test in order to set the bench height and accommodate them to the equipment, protocol and procedures. The initial step rate of Chester Step Test is 60 beats per minute (15 completes up and downs cycles), and it increases the tempo every 2 minutes in 5 cycles per minute (20, 25, 30, 35 beats) until the end of the 5th level. Therefore, the total time of the test is 10 min. The stepping rate was set by a recorded metronome in an mp3 file, played with a HP laptop. Further feedback information and guidance was given by researchers according to subject's performance during the test. Subjects were encouraged until exhaustion and the test was terminated either by the participant (because of dyspnea and/or leg fatigue) or by the supervisor whether the participant was unable to maintain right cadence for 15 seconds (De Carmago et al., 2011)

V. Chapter 1 – Teaching Styles in Physical Education: Pedagogy Assessment Tools Review

V.1. Introduction

This paper reviews the state of the art on pedagogic assessment tools to evaluate TS, which have been commonly used in PE classes. The most consulted databases in sport sciences have been explored, namely: WOK, PubMed, SCOPUS, Thesaurus, ERIC, Sport Discus, ProQuest, DICE and Dialnet. This study selected concrete keywords, languages (English or Spanish), publication year (since 1970 until 2015) and qualitative and quantitative studies where TS assessment tools were developed or validated. Inclusion criteria were used to select the papers included in this review. A total of 526 publications met the quantitative inclusion criteria. Using the qualitative inclusion criteria we found five studies that met all the criteria. In summary, five tools were identified and are discussed in this review paper including descriptions of TS scenarios, video recording procedures, questionnaires and factors controlled for in studies using these five instruments.

V.2. Keywords

Learning styles, learning strategies, approaches to learning, pedagogical assessment tools, behavioral assessment tools, learning orientations and teaching methods.

V.3. Background

There is recent interest in PE, PF and PA leading to a lifelong physically active lifestyle due to the downward health trends in children and youth in most developed countries (Janssen, & LeBlanc, 2010; Janssen, Wong, Colley, & Tremblay, 2013;

Strong, 2005). It is important to learn more in all of these areas and about effective PE. One of the most important variables related with the effectiveness is the TS that is used during PE classes. Effective teaching in PE programs, including the use of TS that promote PA participation, are important considerations in promoting lifetime PA patterns (Iserbyt, Elen, & Behets, 2010; Iserbyt, Madou, Vergauwen, & Behets, 2011; Munusturlar, 2014; Whipp, Jackson, Dimmock, & Soh, 2015). It is also important to consider students' perspectives and what motivates students to be physically active outside of school.

V.4. Assessment of Teaching Styles

Assessment of TS must be one of the most important concerns to evaluate the effectiveness of teachers' performances. The TS used by teachers can contribute to the effectiveness of their teaching and student learning outcomes (SueSee, & Edwards, 2011). Moreover, because TS may be influence by social and cultural characteristics, specific assessment tools to measure TS may be needed in each environment of an intervention and across different settings around the world. Knowing more about the assessment tools used to assess TS in PE programs, may lead to a better understanding of the teaching and learning processes.

The assessment of TS is mainly based on the degree to which teacher and students assume responsibility in PE classes. The most commonly used framework to describe TS in PE is based on Muska Mosston's theories, which postulated TS as a Spectrum (Doherty, 2010; Mosston, 1966a; Mosston & Ashworth, 2002). The original study was based in eight categories (Mosston, 1966a); later new ones were added until

authors determined that the complete spectrum of TS was comprised of eleven TS (Mosston & Ashworth, 2002), which describes a continuum designated by letters from A to K. Since the 1960's, this classification has been used as gold standard to assess TS across a multitude of studies (Byra, 2002; Byra, & Marks, 1993; Byra, Sanchez, & Wallhead, 2013; Chatoupis, 2005; Chatoupis, 2009; Chatoupis, 2010; Chatoupis, & Emmanuel, 2003a; Curtner-Smith, Hastey, & Kerr, 2001; Curtner-Smith, Todorovich, McCaughtry, &; Lacon, 2001; Ernst, 1998; Hennings, 2010; Hewitt, Ashworth, and Edwards, 2010; McCullick, 2002; Parker, & Curtner-Smith, 2012; Sanchez, Byra, & Wallhead, 2012; SueSee, & Edwards, 2015). Because it is difficult to describe individual TS used across classes and programs due to the fluidity of changes between styles, classifications may also be used to describe when a cluster of categories are used, these clusters can be described as: reproductive (A-E) and productive (F-K) teaching styles. Nowadays, in order to simplify the classification a cluster of categories is performed and, two categories are currently used: reproductive (A-E) and productive (F-K) styles.

When assessing teachers' effectiveness, it is important to determine that assessments are accurate. For example, it is important to show that the teaching strategy described in the PE program is the same strategy that is actually happening during the educative intervention, this is also called the fidelity of the intervention use (Rink, 2013; McKenzie, 2013). It has been common in the literature for authors to compare one TS versus another TS in order to determine the effectiveness of the styles in different teaching environments and situations (Byra, Sanchez, & Wallhead, 2013; Cleland, 1994; Dougherty, 1970; Maina, 1997; Patinanoglou, 2008). Finally, in multidisciplinary

school-based interventions, the knowledge of the TS used by teachers may be a cornerstone variable helping to explain possible final behavioral outcomes (for instance, out-school PA changes, dietary modifications and so on).

To our knowledge, there are not any international publications that systematically review the state of the art in TS assessment tools. The main goal of this paper was to perform a literature review on assessment instruments used to determine TS used in PE programs around the world.

V.5. Purpose

The main purpose of this study was to review pedagogical assessment tools used in PE to evaluate the TS adopted by teachers in class. Secondly, to find studies that aimed to validate these instruments around the world. Finally, produce a list of instruments and validation studies for instruments use to measure the international use of TS in PE classes.

The second purpose of this study was review pedagogical assessment tools related with others variables related to teacher effectiveness (e.g. time on learning, feedback) in PE and the validations studies.

V.6. Methods

Several databases were used (WOK, PubMed, SCOPUS, Thesaurus, ERIC, Sport Discus, ProQuest, DICE and Dialnet), to identify literature that appeared to be relates to the use of TS in PE classes. The search strategy focused on different terms and concepts. Keywords that were used for the search were based on terms in different

fields such as pediatrics (children, adolescents, youth), physical education (PE, PA), and pedagogy (learning styles, learning strategies, approaches to learning, TS, pedagogical assessment tools, behavioral assessment tools, motivational styles, learning orientations, teaching methods).

V.7. Inclusion Criteria

Identified studies suggested that some researchers produced models and instruments to assess TS used for different purposes. Therefore in this article the main inclusion criteria were to include pedagogical tools that were concerned with TS in relation with PE in elementary and secondary schools. We reviewed all identified that were published between 1st of January 1970 up to and including 31th of July 2015. Also, all papers that had been written in English or Spanish were selected.

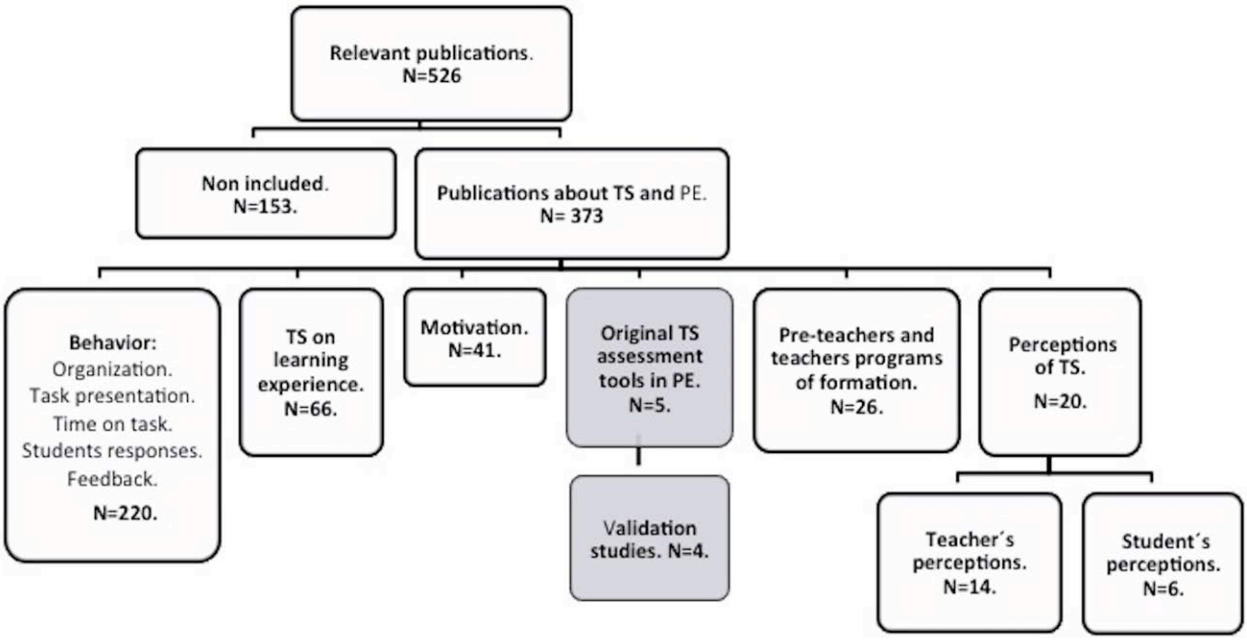
On the other hand the exclusion criteria of pedagogical tools included, papers that had been published in a language other than English or Spanish. Second, papers with pedagogical tools about sports outside school were also excluded. Finally, studies about TS in PE that did not include an original assessment tool. Conference proceedings and other unpublished papers were not included in the study.

V.8. Results

The literature search in databases yielded **526** potentially relevant publications. After the titles and abstract of publications were screened, **373** references were confirmed as related to TS and PE (Figure 1). Finally, a total of **five** original assessment

tools in PE were found to assess TS (Table 10), with **four** strong validation studies located for the five instruments (Table 11).

Figure 1. *TS assessment tools in PE: literature review.*



On the other hand, in relation with the second purpose in this review **seven** distinguished assessment tools related with other variables related to teacher effectiveness in PE were found (Table 12).

V.9. Systematic observation systems

V.9.1. Teaching Styles assessment tools

Assessment tools from our results can be summarized in five instruments (Asworth, 2010, 2004; Hasty, 1997; Salvara, 2001; Sherman, 1982; Tuckman, 1985).

These systematic observational system instruments established lesson scenarios descriptions and criteria sheets for each TS. These instruments are employed to verify the fidelity between teacher and learner behaviors and TS: (1) Style-Analysis Checklist. (2) Teacher-Student Interaction Scale, (3) The Instrument for Identifying Teaching Styles, (4) Instrument for Identifying Teaching and Learning Behaviors, (5) Inventory of Landmark Teaching Styles: A Spectrum Approach.

1. *Style-Analysis Checklist (Sherman, 1982).* In 1982 Michael Sherman designed eight individual checklists for thoroughly assessing each one of the eight TS described by Mosston in 1966 (Mosston, 1966a). Each one of checklists is an inventory of procedures and teacher and learning role descriptions. This procedure requires observing whether teacher or learners are performing each item included in the checklist, then the observer must mark behaviors observed and who performed them. If neither the teacher nor learner is making the decisions, the item is left black; the same procedure is followed when an unexpected behavior is observed from either teacher or learner. Sherman, (personal communication, January 1989) using this tool, a minimum score of 80% used as cut off value to confirm that the TS has been implemented.

2. Tuckman developed *Teacher-Student Interaction Scale* in 1985 (Tuckman, 1985). This tool assesses the teachers' style on directive and non-directive dimensions of the class; this instrument contains twenty-three items about verbal interaction (6 items), flexibility of classroom management (13 items) and TS (4 items). However, some studies in PE have used this assessment tool (Ferrer-

Caja, 2000). This instrument was originally to assess TS in overall education settings.

3. *The Instrument for Identifying Teaching Styles (IFITS).* Hasty in 1997 developed IFITS (Hasty, 1997), this assessment tool describes eight categories of the TS based on those originally identified by Mosston in 1981 (Mosston, 1981). Additionally, TS are organized in two main clusters: The first five styles (A-E) are reproductive styles and the last three styles (F-H) are productive styles. The procedure include film the class and, afterwards every 20 seconds a coder, using IFITS coding sheet, makes a decision about what TS teacher uses. An additional management category is also included in the instrument to designate the time teachers need to manage the logistic of the class. When two or more TS are used, the least direct style is given preference and recorded (Curtner-Smith, Hastey, & Kerr, 2001; Curtner-Smith, Todorovich, McCaughtry, &; Lacon, 2001).
4. *IITLB: Instrument for Identifying Teaching and Learning Behaviors.* Salvara in 2001, 2002a (Salvara, 2001; Salvara & Bironé, 2002) developed this assessment tool which includes seventeen categories of teaching and learning. All of the items related to behaviors both teacher and students do in PE classes. Each of these categories reflects a specific behavior in the process of learning that is specifically related to one of the TS proposed by Mosston in 2002 (Mosston & Ashworth, 2002). Salvara modified Mosston's Spectrum into three groups instead two: Reproduction of Knowledge, Discovery of Knowledge and Production of Knowledge. But this change does not affect the nomenclature and

characteristics of TS. So, each particular TS is determined by the sum of four different categories that were previously established.

5. *Inventory of Landmark Teaching Styles: A Spectrum Approach.* Mosston and Ashworth in 2002 continue identifying two clusters of TS in PE, but these authors introduced a variant adding three more TS (Mosston & Ashworth, 2002). In connection with the new Spectrum design, Ashworth developed an assessment tool to determinate which TS were being used by PE teachers in class (Asworth, 2010, 2004). This inventory describes images of the classroom that represents different landmark teaching-learning style from (A-E) RK TS to (F-K) PK TS. The essence of each style is reflected in a short description. These descriptions are used in different situations. The Identification of Classroom Teaching-Learning Styles based on the Spectrum of TS Framework (Asworth, 2010, 2004; Mosston & Ashworth, 2002) was refined in 2006 with the collaborative assistance of SueSuee and Edwards: Descriptions of Landmark Teaching Styles: A Spectrum Inventory (B. SueSee, 2006).

Table 10. *Teaching Styles assessment tools.*

ASSESSMENT TOOL	AUTHOR	ASSESSMENT TOOL USED IN DIFFERET STUDIES	COUNTRY
Style-Analysis Checklist	Sherman, M.A. (1982)	Marks, M., & Byra, M. (1993)	USA
		Byra, M., & Jenkins, J. (1998)	USA
		Ernst, M., & Byra, M. (1998)	USA
		Chatoupis, C., & Emmanuel, C. (2003)	GREECE
		Chatoupis, C. (2005)	GREECE
		Hennings, J., Wallhead, T., & Byra, M. (2010)	USA
		Iserbyt, P., Madou, B., Vergauwen, L., & Behets, D. (2011)	BELGIUM
		Sanchez, B; Byra, M; Wallhead, T.L. (2012)	USA
		Chatoupis, C. (2013)	GREECE
		Kirby, S; Byra, M; Readdy, T; Wallhead, T. (2015)	USA
Teacher-Student Interaction Scale	Tuckman, B. (1985)	Ferrer-Caja, E. and Weiss, M. R (2000)	USA
		Ferrer-Caja, E. and Weiss, M.R. (2002)	USA
IFITS	Hasty, D.L (1997)	Curtner-Smith, M.D, Hasty, D.L. and Keer, I.G. (2001)	ENGLAND
		Curtner-Smith, M.D, Todorovich, J.R., MacCaughtry, N.A and Lacon, S.A. (2001)	ENGLAND
		Bryant, L. G., & Curtner-Smith, M. D. (2008)	USA
		Bryant, L. G., & Curtner-Smith, M. D. (2009b)	USA
		Bryant, L. G., & Curtner-Smith, M. D. (2009a)	USA
		Parker, M. B. (2010)	USA
		Sofo, S., Beard, D., & Cape Girardeau, M. O. (2010)	USA
		SueSee, B., & Edwards, K. (2011)	AUSTRALIA
		Parker, M., & Curtner-Smith, M. (2012)	USA
		Hein, V., Ries, F., Pires, F., Caune, A., Ekler, J. H., Emeljanovas, A., & Valantiniene, I. (2012)	HUNGARY, ESTONIA, LETONIA, LITUANIA, SPAIN
ITLB	Salvara, M.I; (2001)	Salvara, M.I, Bojnár, J. and Bironé, E.N. (1995)	HUNGARY, GREECE

		Salvara, M.I. (2003)	HUNGARY, GREECE
Inventory of Landmark Teaching Styles	Asworth, S. (2010, 2008, 2006, 2004)	SueSee, B., & Edwards, K. (2011)	AUSTRALIA
		Hewitt, M., & Edwards, K. (2011)	AUSTRALIA
		Hewitt, M., & Edwards, K. (2013)	AUSTRALIA
		Hewitt, M (2015)	AUSTRALIA
		Pitsi, A; Digelidis, N; Papaioannou, A. (2015)	GREECE

IFITS, Instrument for Identifying Teaching Styles; ITLB, Instrument for Identifying Teaching and Learning Behaviors.

In addition, four of these assessment tools (Asworth, 2010, 2004; Hasty, 1997; Salvara, 2001; Tuckman, 1985) have been validated in six different studies (Bryant, & Curtner-Smith, 2009a; Bryant, & Curtner-Smith, 2008, 2009b; Salvara & Bironé, 2002; SueSee, & Edwards, 2011; Tuckman, 1994).

Table 11. *Validation Studies: TS assessment tools.*

ASSESSMENT TOOL	ORIGINAL STUDIES	VALIDATION STUDY	INTERVENTION IN VALIDATION STUDY		
Teacher-Student Interaction Scale.	Tuckman, B. (1985)	Tuckman, B. (1994)	No intervention in PE		
ITLB	Salvara, M.I; Bironé, N.E. (2001)	Salvara, M.I; (2002)	**Country:** Europe **Group:** 4th, 5th and 6th grade **Sample:** n= 42 (22 males/20 females) Greek and 42 (23 males/19 females) Hungarian teachers. **Content**: One lesson of each teacher. They taught any activity: athletics, gymnastics, basketball, volleyball, school-games.		
IFITS	Hasty, D.L (1997)	Bryant L.G. & Curtner-Smith, M.D. (2008, 2009a, 2009b)	**Country:** USA. (2008) **Group:** 4th and 5th grade pupils. **Sample:** n=113 (63 boys, 50 girls) **Content:** students assigned to view one of the two swimming lessons.	**Country:** USA. (2009a) **Group:** 10th and 11th grade pupils. **Sample:** n=109 (58 boys, 51 girls) **Content:** students assigned to view one of the two swimming lessons.	**Country:** USA. (2009b) **Group:** 7th and 8th grade pupils. **Sample:** n=201 (69 boys, 132girls) **Content:** students assigned to view one of the two swimming lessons.
Inventory of Landmark Teaching Styles	Asworth, S. (2010, 2008, 2006, 2004)	SueSee,B., & Edwards,K. (2011)	**Country:** Australia. **Sample:** two parts in the study: PART A: n = 110 teacher and 37 schools PART B: n = 9 teachers (6 male/1 female) **Content**: PART A: Questionnaire PART B: Rugby League (6 lessons), Netball (6), Gaelic football (3), Softball (3), Competitive aerobics (3), Archery (3), Orienteering (3).		

IFITS, Instrument for Identifying Teaching Styles; ITLB, Instrument for Identifying Teaching and Learning Behaviors.

V.9.2. Behaviors assessment tools

Seven distinguished assessment tools related with teacher effectiveness in PE were also found in this review (Table 12) and three validation studies (Table 13). These instruments may facilitate a more complete understanding of teaching-learning process providing valuable information about methodological strategies used by teachers. A physical educator's task presentation (giving explicit instructions or not), use of the class time (students have more or less decision capacity to manage the time in class), feedback presentation (teacher management feedback) and other multiple variables assessed with these specific tools suggest a methodological approach regarding TS (Byra, Sanchez, & Wallhead, 2013; Creasy, Whipp, & Jackson, 2012; Iserbyt, Elen, & Behets, 2010; Iserbyt, Madou, Vergauwen, & Behets, 2011; Jenkins, 2002; Munusturlar, 2014; Tipps, 1988.; Whipp et al., 2015). These instruments are employed to verify the fidelity between teacher and learner behaviors and TS: (1) The Flanders Interaction Analysis System, (2) Cheffers' Adaptation of Flanders' interaction Analysis System,(3) The Observation System for Content Development in Physical Education, (4) Academic learning time in physical education, (5) Physical Education Teacher Assessment Instrument, (6) Qualitative Measures of Teaching Performance Scale.

1. *The Flanders Interaction Analysis System (FIAS) (Flanders, 1970)*. This instrument has been used in classroom to describe verbal interaction patterns between teachers and students. FIAS was adapted for the PE environment by Cheffers in 1984, who developed an adaptation of FIAS which is designated as CAFIAS (Cheffers' Adaptation of Flanders'

interaction Analysis System) (Cheffers, Amidon, & Rogers, 1974; Cheffers, Mancini, Martinek, 1980).

2. *Cheffers' Adaptation of Flanders' interaction Analysis System (CAFIAS)* is a coding list to analyze the teacher influence in the teaching-learning process either as direct or indirect. It uses a system of categories to encode and quantifies classroom behavior of teachers and students. CAFIAS includes a non-verbal component that was not included in the original instrument from Flanders. The observer must be positioned inside the classroom or field environment while coding behaviors every three seconds, or as often as they change (Wright, 1995).
3. *The Observation System for Content Development in Physical Education (OSCD-PE).* In 1979 Judith Rink designed an instrument to assess the development of content and the management of PE classes by teachers (Rink, 1979). OSCD-PE contains 36 variables that are used to describe teacher behaviors in PE. The original procedure required audiotape recording to perform a continuous coding of teaching behavior functions in terms of the content dimensions of informing, refining, extending and applying and the management dimensions of conduct and organization. The instrument discriminates the use of these behaviors in terms of their relationship to the movement task, the target of behavior and their communication form (Gusthart, 1983). Nowadays, the video cameras allows for easier data collection.
4. *Academic learning time in physical education (ALT-PE)* is an indicator of management time in PE classes (Siedentop, Tousignant, & Parker,

1982). This instrument has been studied extensively as a measure of students' achievement and teacher effectiveness. Specifically, ALT-PE describes the amount of time students are engaged in motor activity at an appropriate level of difficulty. The more time the students are engaged in activities appropriate to their skill level, the greater the learning (Beckett, 1989; Silverman, 1985).

5. *Physical Education Teacher Assessment Instrument (PETAI).* This instrument assesses the percentage of time the teacher spent in five instructional and five managerial behaviors and the percentage of time that pupils spent engaged in skill learning (Phillips, 1986).
6. *Qualitative Measures of Teaching Performance Scale (QMTPS) (Rink, 1988).* Judith Rink and Peter Werner created QMTPS to measure qualitatively the communication system used by teacher to transmit information to students in USA schools. This tool includes a rating scale based on defined visual behaviors, which must be used to characterize the type of task, presentation of task (including: explicitness, visual demonstration, accuracy of cues, appropriate number of cues and qualitative cues), student responses and specific congruent feedback. This instrument QTMPS was based on OSCD-PE developed by Rink in 1979 (Rink, 1979).
7. *The Framework for Teaching Evaluation Instrument*, FFT by Danielson group, (2013) is another teacher evaluation instrument: however, it is not specific to the PE environment (Danielson Group, 2013). This instrument permit the user describe the environment and interaction between the

teacher and student using a structured questionnaire, which can be used to defined the TS profile. It is important to note that this tool has not been exclusively designed to determine TS, so it uses a wide assessment of the effectiveness of overall teaching process. Some FFT descriptors were modified to adapt this assessment tool accurately to PE, *Physical Education and Lesson Observation Tool* (PELOT) (Ministry of Singapore, 2013).

Table 12. *Behaviors assessment tools.*

ASSESSMENT TOOL	AUTHOR	ASSESSMENT TOOL USED IN DIFFERET STUDIES	COUNTRY
FIAS	Flanders, N. (1970)	Dougtherty, N.J (1971)	USA
		Nigaard, G. (1975)	USA
		Underwood, M. (1987)	ENGLAND
		Smith, S. D. (1989)	USA
CAFIAS	Cheffers, J.T.F; Amidon E; Rogers K. (1974) Cheffers J.T.F, Mancini, V.H, Martinek, T. (1980)	Mancini, V.H, Cheffers, J.T.F and Zaichkowsky L.D. (1976)	USA
		Martinek T.J , Zaichkowsky L.D and John T. F. (1977)	USA
		Lynch, P.M (1980)	USA
		Crowley, E.M. (1981)	USA
		Zervas, J (1982)	USA
		Emmanuel, C.H (1990)	GREECE
		Cheffers, I.T (1990)	USA
		Salvara, M.I, Bognár, J. and Biró, E.N. (1995)	GREECE, HUNGARY
		Theodorakou K., H (1997)	GREECE
OSCD-PE	Rink, J. (1979)	Gusthart, J.L and Rink, J.E. (1983)	USA
		Gusthart, J. L. (1985)	USA
		Rink, J. E., Werner, P. H., Hohn, R. C., Ward, D. S., & Timmermans, H. M. (1986)	USA
		Masser, L. S. (1987)	USA
		Werner, P. and Rink, J. (1989)	USA

		Masser, L.S. (1993)	USA
		Coules, E., & Tzetzis, G. (2005)	GREECE
		Pesce, C., Crova, C., Cereatti, L., Casella, R., & Bellucci, M. (2009)	ITALY
		Pesce, C., Crova, C., Marchetti, R., Struzzolino, I., Masci, I., Vannozzi, G., & Forte, R. (2013)	ITALY
		Crova, C., Struzzolino, I., Marchetti, R., Masci, I., Vannozzi, G., Forte, R., & Pesce, C. (2014)	ITALY
ALT-PE	Siedentop, D. Birdwell, D. & Metzler, M.A; (1979) Siedentop, D., Tousignant, M., & Parker, M. (1982).	Shute, S., Dodds, P., Placek, J., Rife, F., & Silverman, S. (1982)	USA
		Placek, J. (1982)	USA
		Metzler, M.A. (1983)	USA
		Aufderheide, S. (1983)	USA
		Godbout, P., Brunelle, J., & Tousignant, M. (1983)	CANADA
		Parker, M., & O'Sullivan, M. (1983)	USA
		Siedentop, D. (1983)	USA
		Webster, G. E. (1984)	USA
		Silverman, S., Dodds, P., Placek, J., Shute, S., & Rife, F. (1984)	USA
		Silverman, S. (1985)	USA
		Ashy, M. H., Lee, A. M., & Landin, D. K. (1988)	USA
		Tipps, C. R. (1988)	USA
		Van der Mars, H. (1989)	USA
		Beckett, K. D. (1989)	USA
		Silverman, S., Devillier, R., & Ramírez, T. (1991)	USA
		Buck, M., Harrison, J. M., & Bryce, G. R. (1991)	USA
		LaMaster, K. J., & Lacy, A. C. (1993)	USA
		Hastie, P. A. (1994)	AUSTRALIA
		Hastie, P. A. (1994)	AUSTRALIA
		Behets, D. (1997)	BELGIUM
		Temple, V. A., & Walkley, J. W. (1999)	AUSTRALIA
		Jenkins, J. M., Hamrick, C., & Todorovich, J. (2002)	USA
		Fernandez-Vivo, M. (2002)	USA
		Barrett, T. (2005)	USA
		Derri, V., Emmanouilidou, K., Vassiliadou, O., Kioumourtzoglou, E. & Olave, E. L. (2007)	GREECE

		Cluphf, D., & Vogler, E. W. (2008)	USA
		Ko, B. (2008)	USA
		Vogler, E. W., Van der Mars, H., Darst, P., & Cusimano, B. (2010)	USA
		Iserbyt, P., Elen, J. & Behets, D. (2010)	BELGIUM
		Iserbyt, P., Madou, B., Vergauwen, L., & Behets, D. (2011)	BELGIUM
		Bryan, C., & Sims, S. (2012)	USA
		Creasy, J.A; Whipp, P.R; Jackson, B. (2012)	AUSTRALIA
		Byra, M., Sanchez, B., & Wallhead, T. (2013)	USA
		Munusturlar, S., Mirzeoglu, N., & Mirzeoglu, A. D. (2014)	TURKEY
		Whipp, P. R., Jackson, B., Dimmock, J. A., & Soh, J. (2015)	AUSTRALIA
PETAI	Phillips, D.A., Carlisle, C., Steffen, J. and Stroot, S.; (1986)	Curtner-Smith, M. D., Wallace, S. J., & Wang, M. Q. (1999)	USA
		Lacon, S. A., & Curtner-Smith, M. D. (1998)	USA
		Curtner-Smith, M. D. (1998)	USA
		Engstrom, D. (1999)	USA
		Engstrom, D. (2000)	USA
		Yelling, M., Penney, D., & Swaine, I. L. (2000)	ENGLAND
		Laker, A. (2002)	USA
		Derry, J. A., & Phillips, D. A. (2004)	USA
		Bryant, L. G., & Curtner-Smith, M. D. (2008)	USA
		Bryant, L. G., & Curtner-Smith, M. (2009)	USA
		Bryant, L. G., & Curtner-Smith, M. (2009)	USA
QMTPS	Rink, J; & Werner, P. (1989)	Werner, P. and Rink, J. (1989)	USA
		Gusthart, J.L and Sprigings, E.J. (1989)	CANADA
		Gusthart, J.L and Kelly, I.M (1993)	CANADA
		Behets, D (1993)	BELGIUM
		Pellett, T., & Harrison, J. (1993)	USA
		O'Connor, A. (1994)	CANADA
		Kim, D.J. (1996)	USA
		Williams, L.G. (1997)	USA
		Gusthart JL, Kelly, I.M &; Rink, J.E. (1997)	USA

		Woods, A. M., & Lynn, S. K. (2001)	CANADA
		Wirszyla, C. (2002)	USA
		Vassiliadou, O., Derrii, V . Zisil, V. And Goudas M., and	GREECE
		Kioumourtzoglou, E. (2004). (Vassiliadou, 2004)	GREECE
		Kwak, E. C. (2005)	KOREA
		Rhoades, J. L. (2010)	USA
		Hall, T.J., Heidorn, B. and Welch, M., A. (2011)	USA
		Rhoades, J. L., & Woods, A. M. (2012)	USA
		Houston, J., & Kulinna, P. H. (2013)	USA
		Trendowski, T. N. (2013)	USA
		Derri, V., Vasiliadou, O., & Kioumourtzoglou, E. (2014)	GREECE
		Woods, A. M., & Lynn, S. K. (2014)	USA
FFT	Danielson group, (2013)	Rink, J. (2013)	USA

FIAS, Instrument for Identifying Teaching Styles; CAFIAS, Cheffers' Adaptation of Flanders' Interaction Analysis System; OSCD-PE, Observation System for Content Development in Physical Education; ALT-PE, Academic Learning Time in Physical Education, PETAI, Physical Education Teacher Assessment Instrument, QMTPS, Qualitative Measures of Teaching Performance Scale; FFT, Framework for Teaching Evaluation Instrument.

Table 13. *Validation studies: behavior assessment tools.*

ASSESSMENT TOOL	ORIGINAL STUDIES	VALIDATION STUDY	INTERVENTION IN VALIDATION STUDY
CAFIAS	Cheffers J, Amidon E, Rogers K. (1974).	Cheffers, I.T., (1990)	**Country:** United States **Groups:** 10 classes' middle school/junior high school **Sample:** n = 202 **Teachers:** 7 **Content:** Volleyball unit. Seven lessons. Two volleyball skills.
ALT-PE	Siedentop, D., Tousignant, M., & Parker, M. (1982)	Silverman, S., Devillier, R., & Ramírez, T. (1991).	**Country:** United States **Sample:** n = 60 **Content:** Volleyball unit. Seven lessons recorded. Two volleyball skills.
QMTPS	Rink J and Werner, P. (1989)	Gusthart JL, Kelly, I.M &; Rink, J.E. (1997)	**Country:** Canada **Groups:** 9 classes middle school **Sample:** n = 222 eight grades students (128 boys/94 girls **Teachers:** 9 (8 male/1 female) **Content:** Volleyball unit. Eight lessons. Two volleyball skills.

CAFIAS, Cheffers' Adaptation of Flanders' Interaction Analysis System; ALT-PE, Academic Learning Time in Physical Education, QMTPS, Qualitative Measures of Teaching Performance Scale.

V.9.3. Discussion

This research provides information about five specific assessment tools in regard with TS using during PE lessons. Each of these pedagogic assessment instruments has been developed to observe TS and analyze interactions between teacher and students in PE lessons. Two of them were developed between 1980 and 1990 (Sherman, 1982; Tuckman, 1985) and three of them were created later than 1990. Moreover, when analyzing these assessment tools of teacher effectiveness we found one tool that comes from general education area which is used in PE (Danielson Group., 2013; Flanders, 1970; Tuckman, 1985), other four instruments were created specifically for PE (Asworth, 2010, 2004; Hasty, 1997; Rink, 1979; Rink, 1989; Salvara, 2001; Sherman, 1982).

Focusing on the use of TS assessment tools in the studies analyzed in this review, a total of 27 studies were found. There were 13 research studies based in the USA , nine in Europe and five in Australia. In addition, studies which have used TS assessment tools in PE have increased significantly in the last fifteen years. 18,5% percent of these studies were published from 1990-1999 and 81,5% since 2000. Some recent studies published in 2015 used TS assessment tools but were centred at university students or sports coaches (Hewitt, & Edwards, 2011; Hewitt, 2015; Kirby, 2015; Pitsi, 2015). The most frequently used instrument appeared to be the IFITS used in 10 studies between 2001-2012. IFITS was followed by The Style-Analysis Checklist which was used in 9 research studies each one from 1993 to 2013. After *The Inventory of Landmark Teaching Styles* was used four times between 2011-2015. ITLB was used twice between 1995-2003, *and Teacher directive of Teacher-Student Interaction Measure* was used twice between 2000-2002.

A total of six studies were referred to the validity or ability of the tool to produce data that accurately represent the TS in PE classes. Tuckman validated the Teacher-Student Interaction Scale in 1994 (Tuckman, 1994), this assessment tool comes from the general education field but it was applied in different research studies about motivation related with TS (Ferrer-Caja & Weiss, 2002; Ferrer-Caja & Weiss, 2000). Salvara and Bironé in 2002 validated the ITLB in Europe, with 42 teachers (one lesson of each teacher) and different contents areas (athletics, gymnastics, basketball, volleyball, school-games) (Salvara & Bironé, 2002). Bryant and Curtner-Smith validated IFITS in three related studies during 2008 and 2009 in USA, the main content was swimming and they used two classes recorded in each study (Bryant, & Curtner-

Smith, 2008, 2009a, 2009b). SueSee and Edwards validated the Inventory of Landmark Teaching Styles in 2011 with a study divided in two parts, they used a questionnaire in the first part and second they evaluated different content areas in the second part (Rugby League, netball, Gaelic football, softball, competitive aerobics, archery, orienteering), the number of assessed classes ranging from tree to six (SueSee, & Edwards, 2011).

All of the TS tools mentioned are centered in the notion that the teaching-learning process consists of a chain of decision-making. Decisions are made previous, during and after PE lessons. This three sets of decisions to be made during each teacher learning process, lead to the anatomy of a TS (Mosston, 1981; Mosston, & Ashworth, 2008; Mosston & Ashworth, 2002). So, TS used are different depending on the varying degrees of involvement of teacher and student in these decisions.

Within these methods of systematic observation there are four instruments based on the classifications of Mosston TS. Into of them, there are two TS assessment tools (*Style-Analysis Checklist and IFITS*) that are based on Mosston classification TS dated in 1981 (Mosston, 1981). This first study divided the continuum in eight TS, five (A-E) Reproduction TS and three (F-H) Production TS (Mosston, 1981). On the other hand, there are also two instruments (*ITLB and Inventory of Landmark Teaching Styles)* that are grounded in the last Mosston and Asworth classification developed in 2002 (Mosston & Ashworth, 2002). The Spectrum of TS is divided in eleven TS, Reproduction TS (A-E) and Production TS (F-K). ITLB and Inventory of Landmark Teaching Styles exclude a Self-teaching or K style because it is considered outside the school context. Moreover, there are studies centered on the Spectrum of Muska Mosston (Mosston, 1966a, 1972, 1981; Mosston & Ashworth, 2002) without using any

assessment tool (Goldberger, 1980; Goudas, 1995; Morgan, 2005; Patinanoglou, 2008; Whipp et al., 2015; Zeng, 2009), as well there are several research studies (Jaakkola, 2011; Spittle, 2012) that used the Conthran and Kulinna instrument to assess perceptions of TS in PE (Cothran, & Ward, 2000; Kulinna, 2003).

Addressing the second purpose of this study, there were seven behavioral assessment tools in relation with variables that may be regarding with TS identified (*FIAS, CAFIAS, OSCD-PE, ALT-PE, PETAI, QMTPS and FFT*). These instruments have been used in different research studies to determine specific teacher behaviors that may be associated with students' achievement. Some studies compared the motor skill effects associated with different TS used (Byra, Sanchez, & Wallhead, 2013; Creasy et al., 2012; Iserbyt, Elen, & Behets, 2010; Iserbyt, Madou, Vergauwen, & Behets, 2011; Jenkins, 2002; Munusturlar, 2014; Tipps, 1988; Whipp et al., 2015). The TS most used in these studies is peer-tutoring style (Fernandez-Vivo, 2002; Iserbyt, Madou, Vergauwen, & Behets, 2011; Jenkins, 2002; Webster, 1984; Whipp et al., 2015; Whipp, Jackson, Dimmock, & Soh, 2015). A total of 92 studies were found and 62 of these behavioral assessment tools were used in USA research studies, while the other 19 studies were developed in Europe, 5 in Canada, 4 in Australia, 1 in Korea and 1 in Turkey. Forty % percent of these studies were published from 1965-1989, 27% from 1990-1999 and 33% since 2000. The most frequently used instrument appears to be the ALT-PE used in 36 studies between 1979-2015. ALT-PE was followed in use by the QMTPS which was used in 21 researche studies from 1989 to 2014. After that PETAI was used 11 times between 1999-2009. OSCD was used in 10 studies from 1983-2014,

CAFIAS was used in 9 studies between 1976-1997, FIAS was used four times between 1971-1989 and FFT once in 2013.

CAFIAS, ALT-PE and QMTPS validities studies were published between 1990-1997 (Cheffers, 1990; Gusthart, Kelly, & Rink, 1997; Silverman, Devillier, & Ramírez, 1991). CAFIAS, ALT-PE and QMTPS main researches were used in USA.

V.9.4. Conclusion

There are different pedagogic tools to assess TS in PE. The literature review suggest that many of these instruments were based on the classical approach proposed by Mosston (Mosston, 1966a) and reformulated during the 1980's (Mosston, & Ashworth, 1986), which postulated a broader to classify TS. Most papers addressed the teaching-learning found have been concerned with the teaching-learning process applied to sport skills, and few studies have been published to address the relationship between TS and health behaviors. Teachers may want to use a variety of different teaching methods to match the demands of their students and the curriculum. We did find several studies, however that focused on different aspects of the teaching (learning process such as perceptions, experiences and behaviors) that were widely reported in the international literature.

Although, the successful determinants of high quality of teaching in PE and sport have not been defined clearly, it is a salient concern for PE teachers. Several questions remain to be answered related to the best TS to promote healthy lifestyles among children. In the review process, we did not find any studies that addressed the relationship between TS and health PA behavior related to total daily PA patterns, BC

and PF. If teachers want to promote healthy lifestyles among youth, is essential to design effective teaching-learning interventions in this way.

VI. Chapter 2 – Impact of Teaching styles on Physical Activity Patterns, Body Composition and Physical Condition during Physical Education Classes

VI.1. Introduction

VI.1.1.Physical Activity

PA promotes health outcomes and plays a role as a preventive factor of metabolic and cardiovascular diseases during childhood and adolescence (Janssen, & LeBlanc, 2010; Janssen, Wong, Colley, & Tremblay, 2013; Strong, 2005). As widely reported in the literature, increased MVPA and reduced ST are the most important PA dimensions related with a healthy lifestyle, PC and BC profile during childhood and adolescence (Andersen, 2006; McKenzie, 2013). Several national organizations have called for youth to have 60 min/day of MVPA during elementary and secondary school (Tremblay, 2011; WHO, 2010). Another recommendation for PE lessons advises that the half of the class time should be comprised of MVPA to promote health (Pate, 2006).

Several international studies have shown that children and adolescents do not meet the current recommendation of an hour of MVPA per day (Dumith, Gigante, Domingues, & Kohl, 2011; Griffiths et al., 2013; Riddoch et al., 2007). Furthermore, PA levels decline with age especially in secondary school and in girls more than boys (Dumith et al., 2011). Even fewer European and Spanish youth meet these recommendations; with 20% - 60% of children and youth reportedly participating in at least 60 minutes of PA on typical days (Aibar, 2013a; Janssen, Katzmarzyk, Boyce, Vereecken, Mulvihill, Roberts, ... & Pickett, 2005). The findings are worse for older students (e.g., between 10 and 17 years old) where the value decrease with 9% of students meeting this standard (Aznar, 2011; Baptista, 2012; Laguna Nieto, 2011; López-Fernández, 2015).

There is a line of evidence that has suggested that schools may be effective

resources to promote healthy habits (McKenzie, 2013) and PE lessons and teachers have gained relevance in the context public health. As a consequence it is important to assess how teachers use strategies and provide students tools to engage in PA with the purpose of reduce sedentary behaviors and contribute to increase MVPA habits (Lonsdale et al., 2013). In order to increase student PA it is important to know how active youth are in PE classes and daily under different types of conditions. Many educational success criteria may be involved in PE classes as time on learning (Shute, 1982; Silverman, 1991), motivation (Chatoupis, & Emmanuel, 2003b; Ferrer-Caja, 2002), TS (Parker, 2012), student and teacher perception of TS so on (Cothran et al., 2005; Kulinna, 2003). Regarding TS, there is a lack of knowledge about influence of the TS in the promotion of daily MVPA, physical condition and body composition.).

VI.1.2. Teaching Styles

Mosston in 1966 proposed a continuum of TS based in the decision making process, a set of decisions made by the teacher and learner. The multiple options of interaction between them establish *The Spectrum of Teaching styles*. According to Spectrum theory, TS can be classified in two main clusters: Reproduction of Knowledge (RK) and Production Knowledge (PK). Mosston and Ashworth in 2002 continue identifying two clusters of TS, but these authors introduced an update adding three more TS (Mosston & Asworth, 2002, 2008). The RK cluster consists of the first five styles: Command (A), Practice (B), Reciprocal (C), Self-Check (D) and Inclusion (E), these styles reinforce the recreation of known information. Therefore, the next PK cluster consists of six styles: Guided Discovery (F), Convergent Discovery (G), Divergent Discovery (H), Learner-Designed Individual Program (I), Learner-Initiated (J) and Self-

Teaching (K). These styles promote discovery of new information and the learner is involved at a higher level of cognition. The eleven-landmark TS represent different teaching and learning experiences, but located between each concrete TS there are many pedagogical situations that are similar, but not the same, these variations are designed as a canopy (Mosston & Asworth. 2002). The Spectrum begins with the Command TS and the teacher making all of the decisions. As you move across the spectrum additional decisions are given to the learner ending with Self-Teaching and the learner making all of the decisions.

Early studies of MASTS focused on the study of two or more TS from the RK cluster (often to determine fitness or motor skill outcomes from classes taught using different TS) (Camberlain, 1979; Dougherty, 1970; Mariani, 1970), with the Self-Check Style not studied (Hewitt, 2015). These early studies also investigated different developmental channels (Boschee, 1974; Camberlain, 1979; Virgilio, 1979). The RK cluster had many effectiveness studies beginning in about 1980 (Chatoupis, 2010). More frequent RK studies were in Practice Style (B) (Chatoupis, 2005, 2008; Chatoupis, & Emmanuel, 2003b; Sanchez, Byra, & Wallhead, 2012; Zeng, 2009), followed by Reciprocal Style (C) (Byra, 2004; Ernst, 1998; Hennings, 2010). Researcher also looked at various educational factors that affected the teaching-learning process such as feedback (Byra, & Marks, 1993; Byra, Sanchez, & Wallhead, 2013), behaviors (Byra, & Jenkins, 1998; Byra, Sanchez, & Wallhead, 2013), motivation (Goudas, 1995) and promoting motor skill acquisition (Chatoupis, 2005). There are fewer studies from 1980 onwards on the PK cluster (Hewitt, 2015). Several researchers have compared different TS in both clusters RK and PK (Cleland, 1994) and other

studies have looked at only the PK (Maina, 1997).

It was our aim to observe the differences of total daily PA dimensions, body composition components (adiposity, FFM and SMM) and PC variables (cardiorespiratory fitness and strength) between two groups of adolescents who were taught during two academic years using RK or PK TSs. The study used the theoretical framework of MASTS (Mosston, 1966a, 1981; Mosston, & Ashworth, 1986, 2008; Mosston, & Asworth, 1994; Mosston & Ashworth, 2002). MASTS is one of the mostly widely used conceptions of TS used around the world. It has been recognized as a universal theory of teaching (Zeng, 2014) and has been extensively studied (www.spectrumofteachingstyles.org).

VI.2. Methods

VI.2.1. Participants

In the study young from thirteen to twenty years old provided data on their BC, PF and ACLs. These young attended two different public high schools in the south of Spain. The socio-economic and cultural context is medium and equal in both educative centers. The ethnic distribution of participants in the first high school was: 83% European, 9% Asian, 6% South and Central American and 2% African. In the second high school, the ethnic distribution of participants was: 85% European, 5% Asian, 9% South and Central American and 1% African.

From the first high school, a total of 138 accepted to participate in the study (boys = 74 and girls = 64), the recruitment rate was 85% and the attrition rate was 45.83%. A subsample of students also participated by wearing an accelerometer during

PE and daily during each of the weeks of data collection. For the purpose of the study a total of 82 adolescents agreed to wear accelerometer and complete data were obtained from 58 adolescents (boys =26 and girls = 32), the recruitment rate was 59.42% and the attrition rate was 29.26%.

From the second high school, a subsample of 38 students was selected as a control group (boys =20 and girls =18 girls). Complete accelerometer data were obtained from 33 adolescents (boys =20 and girls =13 girls), the attrition rate was 13.16 %. The distribution of participants in each academic course year and the amount of students that wear ACLs can be observed in the Figure 2. Moreover, the distribution of ACLs valid data in relation with TS can be observed in Figure 3.

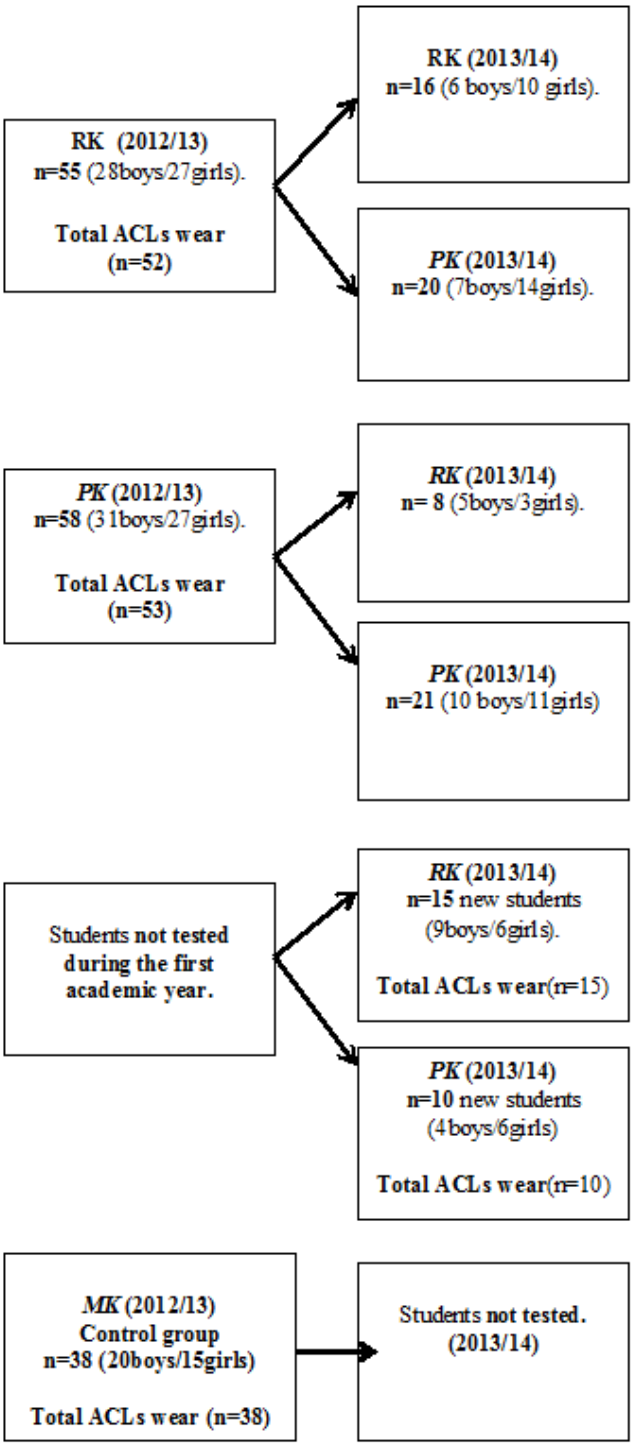


Figure 2. *Distribution of participants during the first and second academic course in relation with TS, gender and total ACLs wore.*

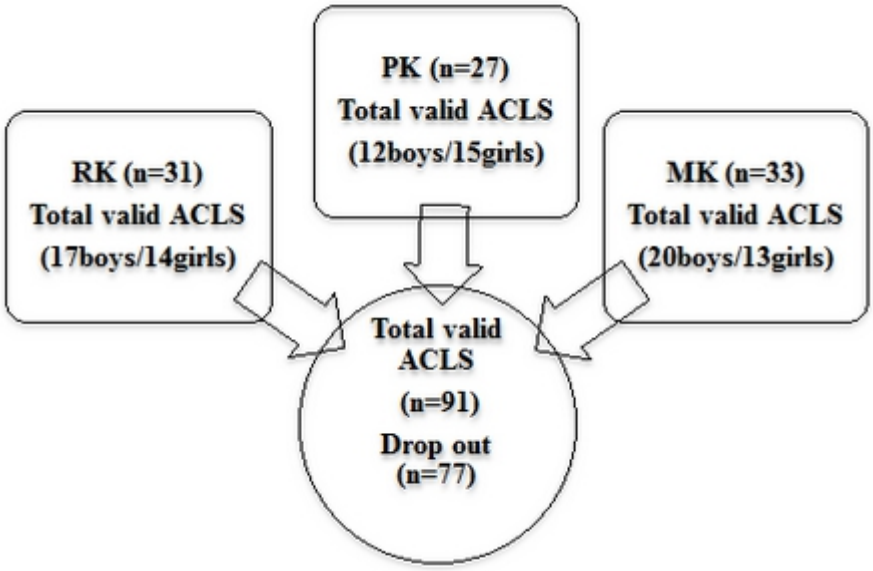


Figure 3. *Distribution of valid ACLs data in relation with TS.*).

VI.2.2. Design

One year randomized control trial. Recruitment and intervention were carried out in two-cohort along two consecutive years. Two intervention groups came from the same school, where a randomization by class group was performed. In this way, one group was taught with a PK and other with RK. The control group was selected from another school in the same city and socio-economical neighborhood. Students recruited in the first cohort were not the same than in the second and they were under a similar intervention.

VI.2.2.1. Setting

The first high school had a total of 306 students and was located in an urban community. Students had PE classes twice per week for a 60-minute lesson across the academic years. The high school does not offer sports activities outside school hours but

students can participate in extracurricular activities offered at the nearby sports hall. The PET promotes sports activities during the break. There is 30 minutes break each day at noon when students can also be active and participate in one of the following activities: soccer, basketball and volleyball competitions.

The second high school had a total of 398 students and was located in the same urban community. Students had PE classes twice per week for a 60-minute lesson across the academic years. This high school does not offer sports activities outside school hours but students can participate in extracurricular activities offered at the nearby sports hall. The PET promotes sports activities during the break. There is 30 minutes break each day at noon when students can also be active and participate in one of the following activities: soccer and basketball competitions.

VI.2.3. Intervention

VI.2.3.1. Curriculum

In the first secondary school, this study was a two-year ecological intervention during PE where two different TS were utilized in two randomly attributed groups (there were 2 groups of students by academic level). Teacher selected the TS following the classical Spectrum of Mosston: PK and RK (Mosston & Ashworth, 2002). Every year of intervention was based on The National curriculum (RD 1631/2006. RD 1467/2007. D 231/2007. D 416/2008). The existing curriculum included four required content areas: PFH Physical Fitness and Health, CE: Corporal Expression, OA: Outdoors Activities, SG: Sports and Games. During academic courses there are six didactic units in the intervention: two of PFH (18 lessons), one of CE (12 lessons), one

of OA (12 lessons) and two of SG (18 lessons). The study took place during the students' regularly scheduled PA classes (ecological perspective). Each year of the study involved 40 weeks and a total of 74 classes (60 lessons using specific TS). The same female teacher conducted all PE both years of the project. She had nine years of teaching experience in public high school students by the time of the study.

In the second high school, the control group was one group of students by academic level. The BC, PF and accelerometers assessments were only at the beginning of the academic course and during the first year. PE lessons were based on The National curriculum (RD 1631/2006. RD 1467/2007. D 231/2007. D 416/2008). The existing curriculum included four required content areas but the participants were assessed only during PF content. The male teacher not selected any concrete TS; he used mixed knowledge TS (MK). He had fifteen years of teaching experience in public high school students by the time of the study.

Before the intervention, permission for the study was granted for the schools authorities and students' parents by signed informed consent documents for being involved in the PA and biological assessments. Briefly, two weeks at the beginning of the course were used to organize explanatory meetings with the school administrative committee, parents and students. Then signed administrative authorizations (Appendix I-II) and informed consents (Appendix II-V) from school administration, parents and students were collected from those who accepted to participated in the study. PA, PC and BC assessments were carried out the next four weeks (see below) and at during the two last weeks of the end of the academic year. After pretesting, the intervention started

throughout the academic year with one intervention group using the RK and the other using PK.

During the first year of study, there were three groups that participated in the intervention RK (one per grade 9th, 10th and 11th) (60 lessons) and the other three groups were taught with PK (one per grade 9th, 10th and 11th) (60 lessons). The second year of the intervention two classes (one per grade 10th and 11th) were taught with PK (60 lessons) and the other two classes (one per grade 10th and 11th) were taught with RK (60 lessons). In the second high school, the control group was one group by level, two classes (one per grade 10th and 11th) (Table 14).

Table 14. *Study organization and content taught across the academic year.*

CONTENTS	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
TU1. PFH	TEST		18 LESSONS							
TU2. CE					12 LESSONS					
TU3. OA							12 LESSONS			
TU4. SG								18 LESSONS		TEST

TU, Teaching Unit; PFH, Physical Fitness and Health; CE, Corporal Expression; OA, Outdoors Activities; SG, Sports and games.

VI.2.3.2. Teaching Styles

In the first high school, the teacher used all TS of RK cluster (A-E) and the five first TS of PK cluster (F-J). It was decided not to use style K because this TS is not widely applied in PE schools context (Doherty, 2010). The teacher designed the

methodology following a progression, first she used TS where the teachers made more decisions than the learner and gradually the student took over more of the decisions. As described previously, there were four main contents across the year: PFH, CE, OA, SG, were planned to be taught in relation to the context at the school (schedule. weather. personal characteristics of students or academic level), but always at same period time in each TS. A total of six teaching units (TU) were developed and taught during every academic course in both RK and PK as follow (a similar plan was followed the second year): two PFH units had eleven and seven lessons respectively (TU1-TU2), one CE unit had twelve lessons (TU3), one OA unit had twelve lessons (TU4) two SG units had nine lessons both of them (TU5-TU6).

VI.2.3.3. Description of lessons

In both high schools PE lessons were designed following The National curriculum (RD 1631/2006. RD 1467/2007. D 231/2007. D 416/2008). Each lesson over the year of the study lasted 60 minutes, which were divided into warm up (10-15 min), lesson (35-40 min) and closure (10-15 min). In the first high school the lessons in RK and PK styles had the same content and the same number of class sessions. Teacher role and student role were determined by the TS used. The main aim of the lessons was the same in both TS but the learning intentions (physical, social, emotional, cognitive, moral) varied depending on the TS used. Learning intentions were equivalent with the five "developmental channels" described by Mosston in 1966. These channels represent specific human attributes that can provide experiences to promote human values of cooperative relationship, perseverance, motivation, self-control, etc. (Mosston, & Ashworth, 2008). The teacher encourages one or more channels depending on the

intended purpose and the TS used. The teacher decided objectives, learning experiences and anticipated outcomes. Each class period included one or more episodes of TS an episode is a unit of time within teacher and learner are engaged in the same TS (Goldberger, 2012). The lesson structure was based on a specific teacher and student interaction, a main objective, an episode events description and a task description that were defined prior to teaching each lesson. Additionally, as a function of the TS used the lessons included checklist with skill criteria, cues, common errors, feedback, etc. If during lessons development the teacher had to modify the TS, she used other TS in the same cluster.

VI.2.3.4. Intervention by Grade Level

For year one of the intervention, 9-11th grade students participated. In year two of the intervention, only 10-11th grade students participated. The National Curriculum was taught in the PE program over the two years of the study. There were minor changes in the specific activities taught: TU about PFH in 9th - 10th - 11th grades included fitness games, strength, endurance, speed, flexibility and fitness circuit. TU about SG in 9th grade included basketball and soccer in 10th grade badminton and hockey and in 11th grade across sport gymnastics and volley. TU about OA in 9th grade included orientation, in 10th grade beach soccer and in 11th grade beach volley. TU about CE in 9th grade included rhythm and dance, in10th grade theatre and in 11th grade choreography.

VI.2.4. Assessing the Teaching Styles: intervention validation

VI.2.4.1. Videotaping of lessons

In order to code TS used as a measure of intervention fidelity and validity, lessons were videotaped and subsequently coded. A total of 72 lessons (two lessons for unit and two lessons for each class and TS) were videotaped the first year of intervention and 48 were videotaped the second year (two lessons for each unit and two lessons for each class and TS) in the intervention groups (RK and PK). A total of 8 lessons (two lessons for unit) were videotaped the first year of intervention in the control group (MK). Lessons were filmed with a camera located in open-wide angle of the facility where the lesson was performed, in this way a full view of the learning-teaching interactions could be recorded. The teacher wore a wireless microphone in order to improve the assessment of verbal interaction.).

VI.2.4.2. Systematic Observation and TS Assessment Tool

Lessons from both methods of TS and also control group TS were coded with the Description Inventory of Landmark Teaching Styles (Asworth, 2010, 2004) (Appendix IX). This assessment tool was based on the MASTS (Mosston & Ashworth, 2002) and it is used to support the fidelity of the teaching styles taught in PE classes. The framework was refined in 2007 (Ashworth, 2007; SueSee, & Edwards, 2009; SueSee, Ashworth, & Edwards, 2006) It was further validated in Australia (Suesee & Edward, 2009) and is frequently used (Hewitt, Ashworth, and Edwards, 2010, 2011; Hewitt, 2015; SueSee, & Edwards, 2011, 2015).

VI.2.4.3. Expert coders

Two experienced coders viewed two classes for each TS (RK and PK) and for each of the six units across the four major contents. The primary TS used in each of the 12 lessons was coded using the descriptions from the Landmark Teaching Styles: A Spectrum Inventory. Interrater reliability was calculated across all classes using the following formula: *[(agreements / (agreements + disagreements))· 100)]* (Van der Mars, 1989). The agreement between the two experts overall was 87.5%. Thus showing a high level of interrater reliability and also supporting the fidelity of the TS used in the classes. These figures correspond with the recommendations of researchers, who regarded an agreement score of 80% or higher to provide appropriate reliability (Rushall, 1977; Van der Mars, 1989).

VI.2.5. Physical Activity assessment: accelerometer

PA was objectively measured by 3-axis ACLS during one week (Actigraph GT3X, Pensacola, FL) using the standard protocol (Holman, 2011). Briefly, the children wore a click-belt to fix the ACL around their waist. The ACL was taken off only to sleep, to take a shower or for swimming activities. The inclusion criterion to considerer a day as complete and valid was to meet ≥ 10 hours of wear time for weekdays and ≥ 8 hours for weekend day (Yıldırım, 2011); a period of 60 minutes of consecutive zeros, allowing for 2 minutes of non-zero interruptions, was considered as not valid (ACL not worn) when encountered anywhere in the data array. Only participants with ≥ 4 complete days, including one weekend day were included (Holman, 2011). PA dimensions were calculated from counts per minute for ST, light, moderate and vigorous intensities (Evenson, 2008) as minutes per day and percent of wear time; steps

per day were also recorded. Additionally, PA patterns were also specified for PE, recess time and total daily.

VI.2.6. Body Composition assessment

Height and weight were measured in scale (precision = 0.1 kg) and stadiometer (precision = 0.1 cm) respectively. BMI was calculated as: *weight/height*^{2} (kg/m^2); international cut-offs were used to calculate gender and age-specific Z-scores as suggested by WHO to compare BMI across ages during adolescence (WHO, 2010). Anthropometry was used to estimate BC from skinfold measurements as described elsewhere (Alvero-Cruz, 2014). Briefly a previously calibrated Holtain caliper was used to measure triceps, thigh, calf and subscapular skinfolds on the right side of the body; at the same level girths were measured with a tape. WC was also assessed at iliac crest level. The same anthropometrist, who had an error below 3% in all sites, carried out all measurements.

BC models, previously validated in adolescents, were used to estimate specific body components. %FM was calculated with Slaughter equations (Equations 1 and 2) (Slaughter, 1988), and FFM derived by the two-component model *(FFM = Weight - (%FM · Weight))*.

$$\%FM\ (girls) = 0.610\ (\sum SF\ (triceps + calf) + 5.1 \qquad (Equation\ 1)$$

$$\%FM\ (boys) = 0.735\ (\sum SF\ (triceps + calf) + 1.0 \qquad (Equation\ 2)$$

SMM was estimate from validated age-specific models based on corrected muscle girth model (Equation 3) (Quiterio, Carnero, Silva, Bright, & Sardinha, 2009), which

were calculated from height, circumferences and skinfolds previously measured. So, muscle circumference was estimated from the corrected limb circumference by:

$$Mc = C - (\pi \cdot Skinfold) \qquad \text{(Equation 3)}$$

where Mc = muscle circumference (cm), C = limb circumference (cm), skinfold (cm).

Poortmans' model (Poortmans, Boisseau, Moraine, Moreno-Reyes, & Goldman, 2005) was used for participants under 16-years (Equation 4) and Lee's model for those older than 16 years old (Equation 5) following the difference reported by Kim et al for those prepubertal and pubertal subjects (Kim, Shen et al. 2006).

$$SMM\ (kg) = Height \cdot (0.0064 \cdot McArm^2 + 0.0032 \cdot McThigh^2 + 0.0015 \cdot McCalf^2) + 2.56 \cdot Gender + 0.136 \cdot Age$$

(Equation 4)

$$SMM\ (kg) = Height \cdot (0.00587 \cdot McArm^2 + 0.00138 \cdot McThighG^2 + 0.00574 \cdot McCalf^2) + 2.4 \cdot sex - 0.026 \cdot age + race \cdot 4.4$$

(Equation 5)

where gender = 1 for male and 0 for female; race = -1.6 for Asian, 1.2 for African American, and 0 for white or Hispanic.

FFMI and FMI have been proposed as weight-status indexes for adults (VanItallie, Yang, Heymsfield, Funk, & Boileau, 1990) and recently for Spanish adolescents (Alvero-Cruz et al., 2010). We calculated FMI and FFMI using the classical BMI equation and substituting the mass component (Equations 6 and 7), additionally we calculated the SMMI (Equation 8). These variables may help us to explain and correct variability introduced by the natural growing (height) in body composition analysis, which influences some of the morphological changes during the intervention.

$$FMI = FM\ (kg) / Height\ (m)^2 \qquad (Equation\ 6)$$

$$FFMI = FFM\ (kg) / Height\ (m)^2 \qquad (Equation\ 7)$$

$$SMMI = SMM\ (kg) / Height\ (m)^2 \qquad (Equation\ 8)$$

VI.2.7. Physical Condition assessment

VI.2.7.1. Upper Limbs Strength

The handgrip strength on right and left hands was measured using a digital handgrip dynamometer (T.K.K.5401, Takei, Japan), which records the maximum reading performed in kg. After adapting handgrip to each subject, participant stand with the right elbow extended along the body without touching the trunk or thigh with the upper limb or dynamometer. When indicated the participant squeezed the dynamometer as strong as possible during 5 seconds. Two trials were permitted with a rest period of 3 minutes and the maximal measurement was recorded.

VI.2.7.2. Lower Limbs Strength

Isometric strength of lower limbs was measured with an isometric back-leg lift dynamometer (TKK-5002, Psymtec). Briefly, participants pulled the dynamometer to compresses a steel spring with the force applied for their legs and back. A similar protocol, which was used for upper limbs, was followed in this assessment. The best trial was recorded for using in statistical analysis.

VI.2.7.3. Cardiorespiratory Fitness

VO_{2max} was the indicator of cardiorespiratory fitness in this study. VO_{2max} was measured by indirect calorimetry technique using a portable breath-by-breath metabolic

unit, developed by Metamax 3B (Cortex Biophysic, Leipzig, Germany) while performing a maximum test on a bench (Chester Step Test). Data from indirect calorimetry were collected using Metasoft v. 1.11.05 software (Cortex Biophysic, Leipzig, Germany). Additionally, heart rate was continuously measured with heart rate monitor (Polar, Finland) during the test and record every minute. When a direct measurement was not possible an estimation using a steady-state linear regression approach was used (ACSM, 2013). Briefly, at least two stages of the bench test were used to estimate intercept and slope constants of the relationship between heart rate (independent variable, X axis) and estimated VO_2 for a constant load (dependent variable, Y axis). VO_2 equation (Equation 9) to estimate VO_2 for a constant load were those proposed by de American College of Sports Medicine (ACSM, 2013):

$$VO_2\ (ml/kg/min) = (0.2 \cdot Cad) + (1.33 \cdot 1.8 \cdot Height \cdot Cad) + 3.5 \qquad \text{(Equation 9)}$$

Where, Cad = cadence (steps/minute); Height, bench height in meters.

The Chester Step Test is an incremental five-level step test, which was previously validated (Skyes et al. 2004). It consists of going up and down a bench (from 32-52 cm) at a pace set by a signal sound, which progressively increases in speed up to five levels. All adolescents engaged a previous test in order to set the bench height and accommodate them to the equipment, protocol and procedures. The initial step rate of Chester Step Test is 60 beats per minute (15 completes up and downs cycles), and it increases the tempo every 2 minutes in 5 cycles per minute (20, 25, 30, 35 beats) until the end of the 5th level. Therefore, the total time of the test is 10 min. The stepping rate was set by a recorded metronome in an mp3 file, played with a HP laptop. Further feedback information and guidance was given by researchers according to subject's

performance during the test. Subjects' were encouraged until exhaustion and the test was terminated either by the participant (because of dyspnea and/or leg fatigue) or by the supervisor whether the participant was unable to maintain right cadence for 15 seconds (De Carmago et al., 2011).

VI.2.8. Data analysis

Data are shown as mean and standard deviation when normally distributed unless noted otherwise. Repeated measures analysis was carried out in order to compare PA, BC and PC differences between PK and RK (group effect), between End of the Physical Education Course (EOC) and Beginning of the Physical Education Course (BOC) (time effect) and differences for change (group-by-time interaction). Age was used as covariate and gender was included as independent factor in the model. Attrition rate was calculated as *[(n at EOC - n at BOC) / n at EOC] · 100.*

An Intention To Treat analysis (ITT) was conducted in order to discard a participation bias related with physical characteristics. So age, weight and BMI Z-score were compared between participants and non-participants. Gender and academic level proportions between participants and non-participants were assessed by Chi-square analysis.

Based in previous studies with adolescents from the same region, we calculated that considering an statistical power of 80%, a type I error of 5% and difference between groups of 5 minutes for MVPA and 10 minutes for ST, we will need a sample size of 36 and 32 participants respectively, which is below that the number of participants included in this study.

All statistical treatments were performed using a statistical software package (Statistical Package for the social Sciences, SPSS) and significance $p < 0.05$ was accepted to refuse the null hypothesis for all analysis.

VI.3. Results

PA daily patterns, BC and PF variables were analyzed at the beginning and at the end of the academic course in adolescents. The ITT analysis showed us there were not statistically significant differences between Non-Responders (NR) and Responders (R) for baseline sample characteristics and percent of females (table 15), however RK group had a higher proportion of NR students than MK (chi-squared = 6.804, $p < 0.05$; Table 15).

Table 15. *Responders and Non-Responders characteristics. Intention to treat analysis at baseline (ITT).*

Variables		NR (n = 87)				R (n = 79)			
		Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Age	*years*	16.43 ±	1.48	13.88	23.04	16.01 ±	1.36	13.79	20.68
Gender	*(F/M)*		(43 / 48)				(38 / 41)		
	%F		47. 30 %				48. 10 %		
Weight	*Kg*	61.67 ±	14.00	39.50	97.70	62.35 ±	13.35	40.00	101.40
Height	*cm*	166.17 ±	8.22	150.40	188.20	166.03 ±	7.46	150.80	182.40
BMI	*(kg/m²)*	22.17 ±	3.96	15.82	35.50	22.59 ±	4.59	16.02	36.36
TS	*(RK/PK/MK)*		(40 / 40 / 11)				(30 / 27 / 22)*		
	% TS		(44 % / 44 % / 12.10 %)				(38 % / 34.20 % / 27. 8 %)		

NR, Non responders; R, Responders; SD, Standard deviation; Min, Minimum; Max, Maximum; BMI, Body mass index; TS, Teaching style; RK, Reproduction knowledge; PK, Production knowledge; MK, Mixed Knowledge.

VI.3.1. Physical Activity

Differences on PA patterns between RK, PK and MK TS at the beginning of the academic year are presented in Table 16. The final sample was 54.17% of the eligible sample of 168 participants, whom accepted to wear an accelerometer. Non-significant differences between all PA dimensions were found across TS groups at the BOC. It was important to note that none of the groups met international guidelines for total daily PA both steps (11,000 steps/day for girls and 13,000 steps/day for boys) or MVPA (60 minutes/day both girls and boys).

Table 16. *Differences in physical activity (PA) patterns between reproduction knowledge (RK), production knowledge (PK) and mixed knowledge at the beginning of academic year (BOC).*

Variables		RK (n= 31)				PK (n=27)				MK (n=33)				Total (n=91)			
		Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
SedT	*(min/day)*	620.80 ±	70.90	467.90	748.20	640.80 ±	70.70	460.10	770.30	632.20 ±	73.60	398.0	770.70	630.90 ±	71.50	398.0	770.70
LPA	*(min/day)*	91.55 ±	33.56	39.47	176.57	87.25 ±	25.17	50.030	171.73	82.18 ±	30.97	42.53	178.05	86.87 ±	30.25	39.47	178.05
MPA	*(min/day)*	30.30 ±	11.28	10.50	58.68	28.27 ±	10.76	12.39	59.87	33.58 ±	12.37	13.00	67.54	30.89 ±	11.62	10.50	67.54
VPA	*(min/day)*	19.86 ±	11.83	2.87	48.09	19.25 ±	11.28	4.26	50.23	27.09 ±	14.44	5.64	62.42	22.30 ±	13.07	2.87	62.42
MVPA	*(min/day)*	50.16 ±	19.42	15.15	97.36	47.51 ±	19.51	16.66	97.05	60.67 ±	19.69	23.51	103.26	53.18 ±	20.17	15.15	103.26
Steps	*(steps/day)*	8105 ±	2772	2650	15703	7954 ±	2484	4187	14257	9278 ±	2779	3393	14656	8481 ±	2727	2650	15703

RK, Reproduction knowledge; PK, Production knowledge; MK, Mixed Knowledge; SD, Standard deviation; Min, Minimum; Max, Maximum; SedT, Sedentary time; LPA, Light physical activity; MPA, Moderate physical activity; VPA, Vigorous physical activity; MVPA, Moderate-Vigorous physical activity; Steps, Steps.

Regarding longitudinal changes, we could observe RK did not change any PA pattern except for LPA. Conversely, PK increased all PA dimensions and reduced ST, although these trends were not always statistically significant. Specifically, we found a significant positive time effect for LPA ($F=24.23$; $p<0.01$) and in MPA ($F=4.41$; $p<0.05$). There was also a negative time effect for VPA ($F=3.47$; $p<0.05$), which had an interaction with TS; so, MK group reduced significantly VPA while PK and MK did not change significantly (Figure 4).

Additionally, significant differences in the change of mean PA dimensions were observed between RK and MK: VPA for RK=19.98±11.57 (BOC) and 18.77±12.53 (EOC) vs. MK=30.44±15.09 (BOC) and 21.83±10.79 (EOC); MVPA for RK=49.52±19.26 (BOC) and 47.46±19.19 (EOC) vs. 63.83±19.63 (BOC) vs. 58.34±34.05 (EOC) and steps RK=7936.15±2145.44 (BOC) and 7929.68±2590.49 (EOC) vs. MK=7929.68±2590.48 (BOC) and 9477.65±3112.31 (EOC) (Figure 4). Nevertheless, these differences had only between-subjects effect and the interaction time effect in TS group was only found for VPA and MPA.

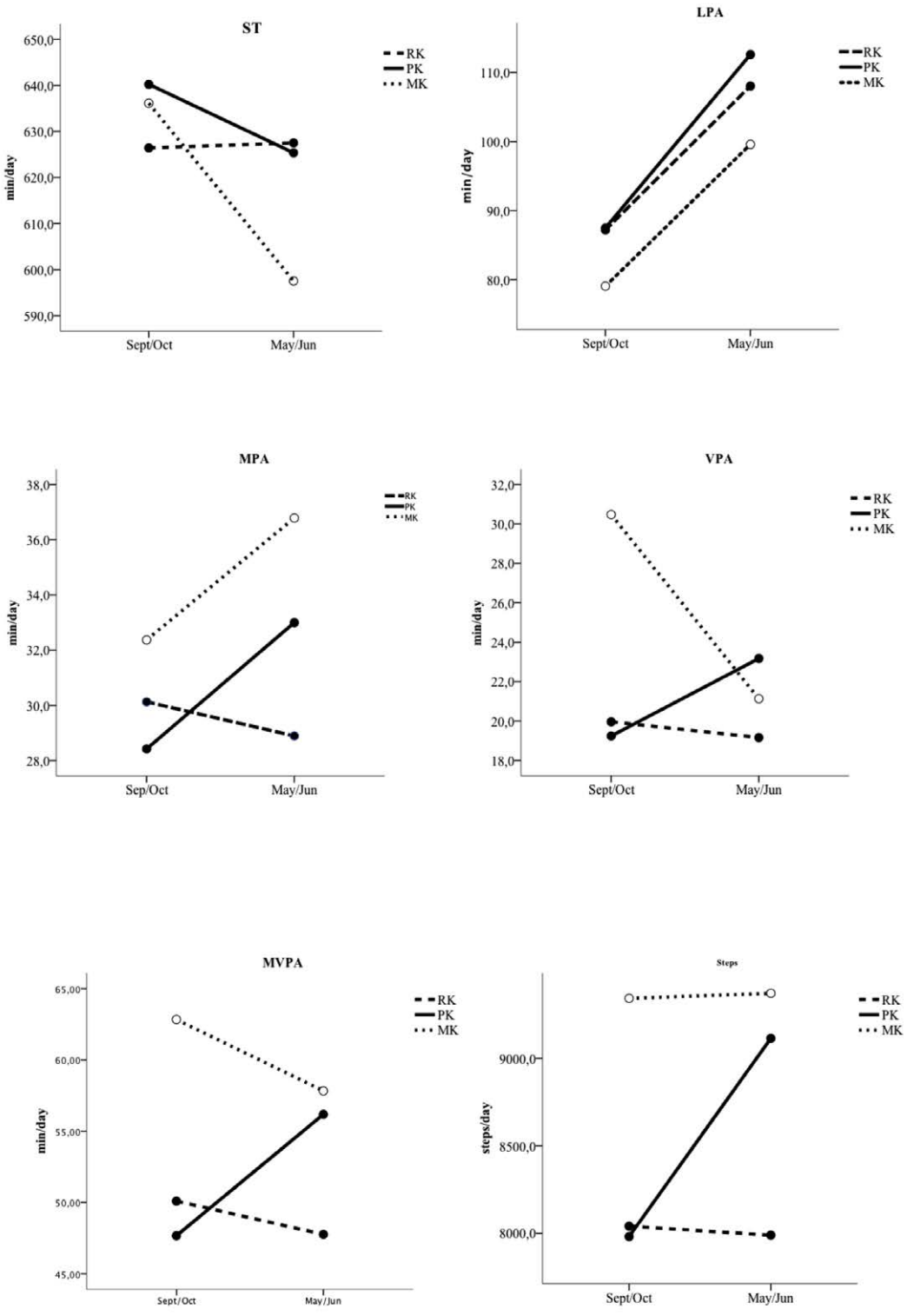


Figure 4. *Differences in PA patterns after one academic year between RK, PK and MK TS; ST, Sedentary time; LPA, Light physical activity; MPA, Moderate physical activity; VPA, Vigorous physical activity; MVP, Moderate-Vigorous physical activity; Steps, Steps. GLMRM Time: LPA (P=0.000), MPA (P=0.039); GLMRM Time x TS: VPA (P=0.037).*

VI.3.2. Body Composition

BC differences between RK, PK and MK TS at the beginning of the academic year are presented in Table 17. We analyzed 96.61% of the 176 eligible participants. There were not significant differences across TS groups.

Regarding changes after one academic year of intervention, differences in BC variables by gender and TSs are comprised in Table 18. We could not assess the total sample from the start of the intervention and an attrition rate of 36.66% was registered (73.44% of 176 initial participants).

There was significant time effects for FFM ($F=9.97$; $p<0.01$), SMM ($F=13.75$; $p<0.01$), WC ($F=5.08$; $p< 0.05$) and SMMI ($F=6.76$; $p< 0.05$) but there were not significant interactions time x TS (Figure 5). Significance values at the univariate level trend to be significant in FM ($p=0.055$), WC ($p=0.060$) and FMI ($p=0.075$) (Table 18). The change in FFM both boys and girls considered together was close to be statistically significant ($p= 0.054$, table 18), however when analyzed the gender effect and their interactions, we could observe a significant interaction time x gender x TS for FFM, which indicated boys in RK group increased significantly more their FFM than other groups and girls from RK group (Table 18).

Table 17. *Differences in Body Composition (BC) between reproduction knowledge (RK), production knowledge (PK) and mixed knowledge (MK) at the beginning of academic year.*

Variables		RK (n= 68)				PK (n=65)				MK (n=38)				Total (n=171)			
		Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Age	*years*	15.88	± 1.23	13.79	19.23	16.52	± 1.69	14.08	23.04	16.45	± 1.14	13.88	19.22	16.25	± 1.43	13.79	23.04
Weight	*kg*	61.74	± 14.79	39.50	101.40	61.66	± 13.52	40.70	97.70	62.53	± 12.25	39.40	89.00	61.89	± 13.71	39.40	101.40
Height	*cm*	165.05	± 8.00	150.80	188.20	166.55	± 7.48	150.4	181.70	167.24	± 8.69	149.1	182.40	166.10	± 7.97	149.10	188.20
FM	*%*	23.74	± 11.34	1.00	52.60	22.65	± 8.97	1.00	52.60	19.35	± 6.10	9.40	36.2	22.38	± 9.62	1.00	52.60
FFM	*kg*	47.20	± 11.07	30.21	79.50	47.46	± 10.09	31.08	74.17	49.24	± 8.75	31.50	67.00	47.74	± 10.20	30.21	79.50
SMM	*kg*	24.40	± 7.06	7.03	47.12	24.94	± 6.44	9.30	42.81	26.67	± 6.42	4.50	36.71	23.75	± 7.97	2.12	47.12
Waist	*cm*	80.80	± 12.02	60.20	116.50	81.19	± 10.75	62.60	117.50	82.26	± 9.29	65.10	105.00	81.30	± 10.89	60.20	117.50
BMI	*(kg/m^2)*	22.58	± 4.84	15.82	36.36	22.09	± 3.95	15.86	35.50	26.67	± 1.88	17.30	31.20	22.32	± 4.23	15.82	36.36
FMI	*(kg/m^2)*	5.74	± 4.07	0.21	17.95	5.20	± 3.03	0.19	18.67	4.38	± 1.88	1.77	10.61	5.24	± 3.34	0.19	18.67
FFMI	*(kg/m^2)*	17.15	± 2.87	12.10	24.77	16.94	± 2.44	11.90	22.52	17.40	± 2.12	13.81	22.64	17.13	± 2.55	11.90	24.77
SSMI	*(kg/m^2)*	8.92	± 2.42	0.79	16.90	8.90	± 1.83	3.15	14.56	9.52	± 2.50	1.77	10.63	9.04	± 2.34	0.79	16.90

RK, Reproduction knowledge; PK, Production knowledge; MK, Mixed Knowledge; SD, Standard deviation; Min, Minimum; Max, Maximum; FM, Fat mass; FFM, Fat free mass; SMM, Skeletal muscle mass; WC, Waist circumference; BMI, Body mass index; FM, Fat mass index; FFMI, Fat free mass index; SMMI; Skeletal muscle mass index.

Table 18. *Differences in body composition (BC) variables by gender after one academic year intervention period with teaching styles (TS).*

Variables			RK (n=51)					PK (n=37)					MK (n=32)					GLM			
			Sept/Oct			May/Jun		Sept/Oct			May/Jun		Sept/Oct			May/Jun					
			n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD	Time	Time x TS	Time x G	Time x TS x G
FMP	%	Girls	29	28.50	± 8.65	28.12	± 7.38	18	26.81	± 9.10	26.92	± 8.07	10	23.27	± 6.92	26.59	± 7.61				
		Boys	22	22.38	± 14.21	20.77	± 12.39	19	19.84	± 10.17	19.56	± 11.46	22	16.90	± 4.70	17.36	± 6.15	-	0.055	-	-
		Total	51	25.86	± 11.66	24.95	± 10.41	37	23.23	± 10.16	23.14	± 10.50	32	18.89	± 6.15	20.24	± 7.83				
FFM	*kg*	Girls	29	40.19	± 6.51	40.96	± 6.76	18	39.62	± 4.74	41.32	± 4.29	10	41.59	± 7.85	40.89	± 6.61				
		Boys	22	48.64	± 9.03	51.77	± 11.05	19	54.62	± 7.63	54.84	± 8.37	22	53.09	± 6.06	53.95	± 5.24	0.02	0.054	-	0.025
		Total	51	43.84	± 8.71	45.62	± 10.30	37	47.32	± 9.87	48.26	± 9.52	32	49.49	± 8.49	49.87	± 8.32				
SMM	*kg*	Girls	29	21.96	± 5.43	22.27	± 5.23	18	20.69	± 3.61	21.61	± 3.68	10	25.18	± 8.30	25.52	± 7.33				
		Boys	22	28.76	± 7.22	30.38	± 8.08	19	30.32	± 5.20	30.68	± 4.14	22	28.15	± 3.94	29.39	± 3.01	0.00	-	-	-
		Total	51	24.89	± 7.07	25.77	± 7.70	37	25.64	± 6.59	26.27	± 6.01	32	27.22	± 5.70	28.18	± 5.01				
WC	*cm*	Girls	29	79.65	± 10.62	82.52	± 11.16	18	79.14	± 11.24	81.38	± 11.71	10	81.45	± 10.90	80.24	± 12.92				
		Boys	22	81.79	± 14.88	82.81	± 14.54	19	83.71	± 13.37	84.50	± 12.73	22	81.75	± 9.53	81.86	± 9.47	0.026	-	-	-
		Total	51	80.57	± 12.54	82.65	± 12.59	37	81.49	± 12.43	82.98	± 12.18	32	81.66	± 9.80	81.36	± 10.48				
BMI	*(kg/m2)*	Girls	29	22.34	± 4.80	22.53	± 4.50	18	21.00	± 4.34	21.72	± 4.22	10	21.47	± 4.31	21.84	± 4.54				
		Boys	22	23.18	± 6.08	23.46	± 6.05	19	23.65	± 4.49	23.55	± 4.05	22	22.36	± 3.57	22.23	± 3.52	-	-	-	-
		Total	51	22.70	± 5.35	22.93	± 5.19	37	22.36	± 4.56	22.66	± 4.18	32	22.08	± 3.77	22.11	± 3.80				
FMI	*(kg/m²)*	Girls	29	6.68	± 3.42	6.57	± 2.85	18	5.94	± 3.29	6.14	± 3.12	10	5.21	± 2.66	6.09	± 3.17				
		Boys	22	5.91	± 5.55	5.37	± 4.80	19	5.07	± 3.97	4.96	± 4.15	22	3.82	± 1.39	4.03	± 2.24	-	-	-	-
		Total	51	6.34	± 4.43	6.05	± 3.82	37	5.49	± 3.63	5.53	± 3.68	32	4.26	± 1.94	4.67	± 2.70				
FFMI	*(kg/m²)*	Girls	29	15.66	± 2.14	15.95	± 2.24	18	15.06	± 1.69	15.58	± 1.46	10	15.98	± 1.92	15.75	± 1.62				
		Boys	22	17.27	± 2.18	18.08	± 3.55	19	18.58	± 1.84	18.59	± 2.13	22	18.17	± 1.94	18.20	± 1.66	0.057	-	-	-
		Total	51	16.36	± 2.28	16.87	± 3.04	37	16.87	± 2.49	17.13	± 2.37	32	17.48	± 2.16	17.43	± 1.99				
SMMI	*(kg/m²)*	Girls	29	8.59	± 2.20	8.71	± 2.14	18	7.82	± 1.40	8.17	± 1.45	10	9.76	± 3.23	9.85	± 2.71				
		Boys	22	10.04	± 2.34	10.60	± 2.61	19	10.30	± 1.58	10.42	± 1.18	22	9.53	± 1.60	9.92	± 1.09	0.011	-	-	-
		Total	51	9.21	± 2.35	9.53	± 2.51	37	9.09	± 1.94	9.33	± 1.73	32	9.61	± 2.18	9.90	± 1.71				

TS, teaching style; RK, Reproduction knowledge; PK, Production knowledge; MK, Mixed Knowledge; G, Gender; SD, Standard deviation; FM, Fat mass; FFM, Fat free mass, SMM, Skeletal muscle mass; WC, Waist circumference; BMI, Body mass index; FM, Fat mass index; FFMI, Fat free mass index; SMMI, Skeletal muscle mass index; GLM, General lineal model.

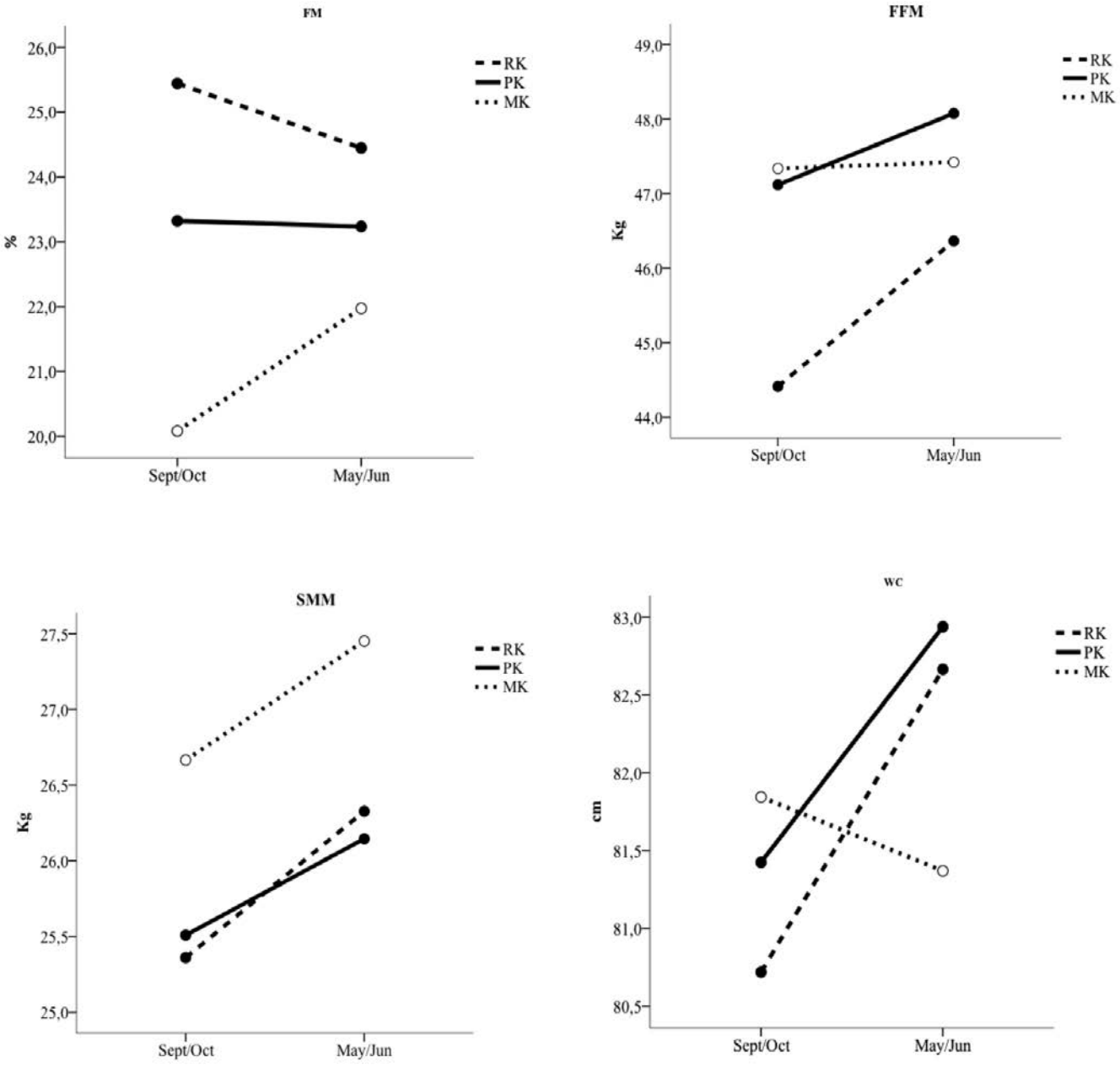


Figure 5. *Differences in body composition (BC) after one academic year between reproduction knowledge (RK), production knowledge (PK) and mixed knowledge (MK) teaching styles (TS). FM, Fat mass; FFM, Fat free mass; SMM, Skeletal muscle mass; WC, Waist circumference. GLMRM Time: FFM (P=0.002), SMM (P=0.000), WC (P=0.026).*

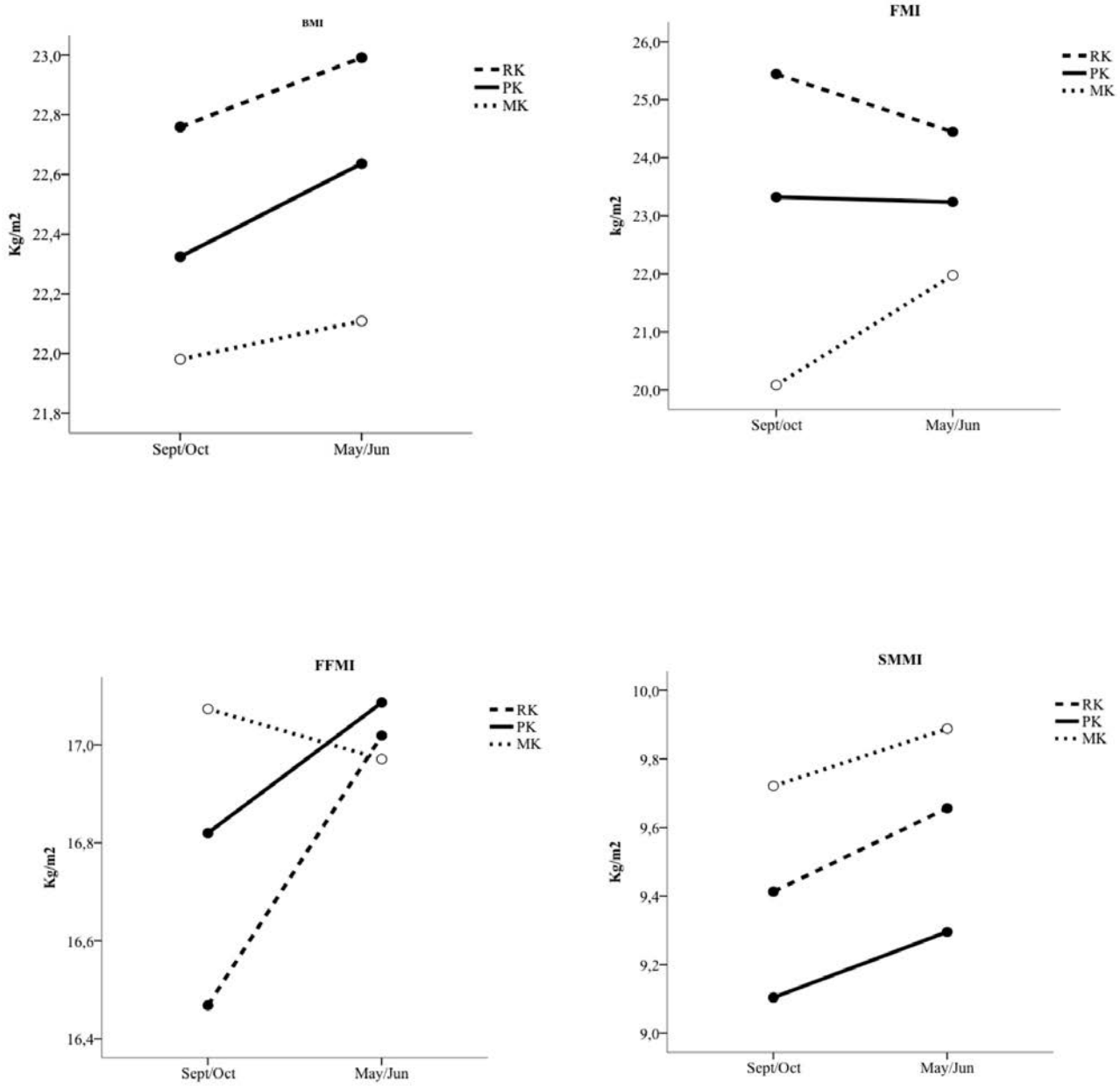


Figure 6. *Differences in body composition (BC) after one academic year between reproduction knowledge (RK), production knowledge (PK) and mixed knowledge (MK) teaching styles (TS). BMI, Body mass index; FMI, Fat mass index; FFMI, Fat free mass index; SMMI, Skeletal muscle mass index. GLMRM Time: SMMI (0.011).*

VI.3.3. Physical Fitness

PF values at the BOC are presented in Table 19. As reported to BC variables 96.61% of participants were successfully assessed for the whole set of exercise tests. Except for VO_{2max}, which was significantly higher for MK group than for the other two, all mean values were similar across TS groups (Table 19).

Table 19. *Differences in physical fitness (PF) between reproduction knowledge (RK), production knowledge (PK) and mixed knowledge at the beginning of academic year (BOC).*

Variables		RK (n= 65)				PK (n=58)				MK (n=36)				Total (n=171)			
		Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
RGS	*(Kg)*	28.35	± 9.00	14.20	53.80	29.18	± 9.46	10.10	56.20	31.45	± 9.00	14.10	46.40	29.33	± 9.19	10.10	56.20
LGS	*(Kg)*	26.65	± 8.32	14.60	46.10	27.08	± 8.75	11.10	52.40	30.21	± 8.63	15.60	44.50	27.58	± 8.61	11.10	52.40
LLS	*(Kg)*	75.12	± 30.01	10.00	145.00	80.73	± 33.85	15.00	155.00	88.18	± 28.04	50.00	141.00	79.96	± 31.27	10.00	155.00
VO_{2Max}	*(ml/kg/min)*	31.98	± 8.64	15.95	58.19	33.47	± 8.73	16.00	49.48	38.86	± 6.64	28.31	52.31**	34.15	± 8.63	15.95	58.19

RK, Reproduction knowledge; PK, Production knowledge; MK, Mixed Knowledge; RGS, Right handgrip strength; LGS, Left handgrip strength; LLS, Lower limb strength; VO2max, Maximal oxygen uptake.

***, $p<0.01$ for one-way ANOVA.*

There were significant time effects for RGS ($F=40.03$; $p<0.01$), LGS ($F=26.29$; $p<0.01$) and LLS ($F=10.57$; $p<0.01$) variables (Figure 7). Additionally, a significant interaction was observed between time and TS for LLS ($F=4.85$; $p<0.01$), which informed that PK and MK reduced significantly LLS while RK did not change it (Figure 7). Also, significant interactions were observed between time and gender for LGS (girls; BOC=21.83±4.94kg and EOC=22.78±5.19 kg vs. boys; BOC=32.26±7.04 kg and EOC=35.49±7.89 kg; $p<0.005$).

Repeated contrasts pre (BOC) and post (EOC) intervention between TS groups revealed significant differences between RK and MK for all physical fitness assessment: RGS (BOC=27.04±8.51kg and EOC=29.48±9.71 kg vs. BOC=32.38±9.16 kg and EOC=34.12±9.58 kg); LGS (BOC=29.92±8.63 kg and EOC=25.47±7.88 kg vs. BOC=35.83±5.08 kg and EOC=38.08±4.78 kg); LLS (BOC=86.92±25.22 kg and EOC=87.50±20.02 kg vs. BOC=106.65±19.39 kg and EOC=95.41±16.92 kg) and for VO_{2max} (BOC=31.21±8.26 ml/kg/min and EOC=31.87±9.38 ml/kg/min vs. BOC=38.63±6.55 ml/kg/min and EOC=36.37±11.51 ml/kg/min). Nevertheless, except for LLS these differences had only between-subject effect and the pattern of change was barely different across TS groups. None significant differences were found between PK vs. MK or PK vs. RK (Figure 7).

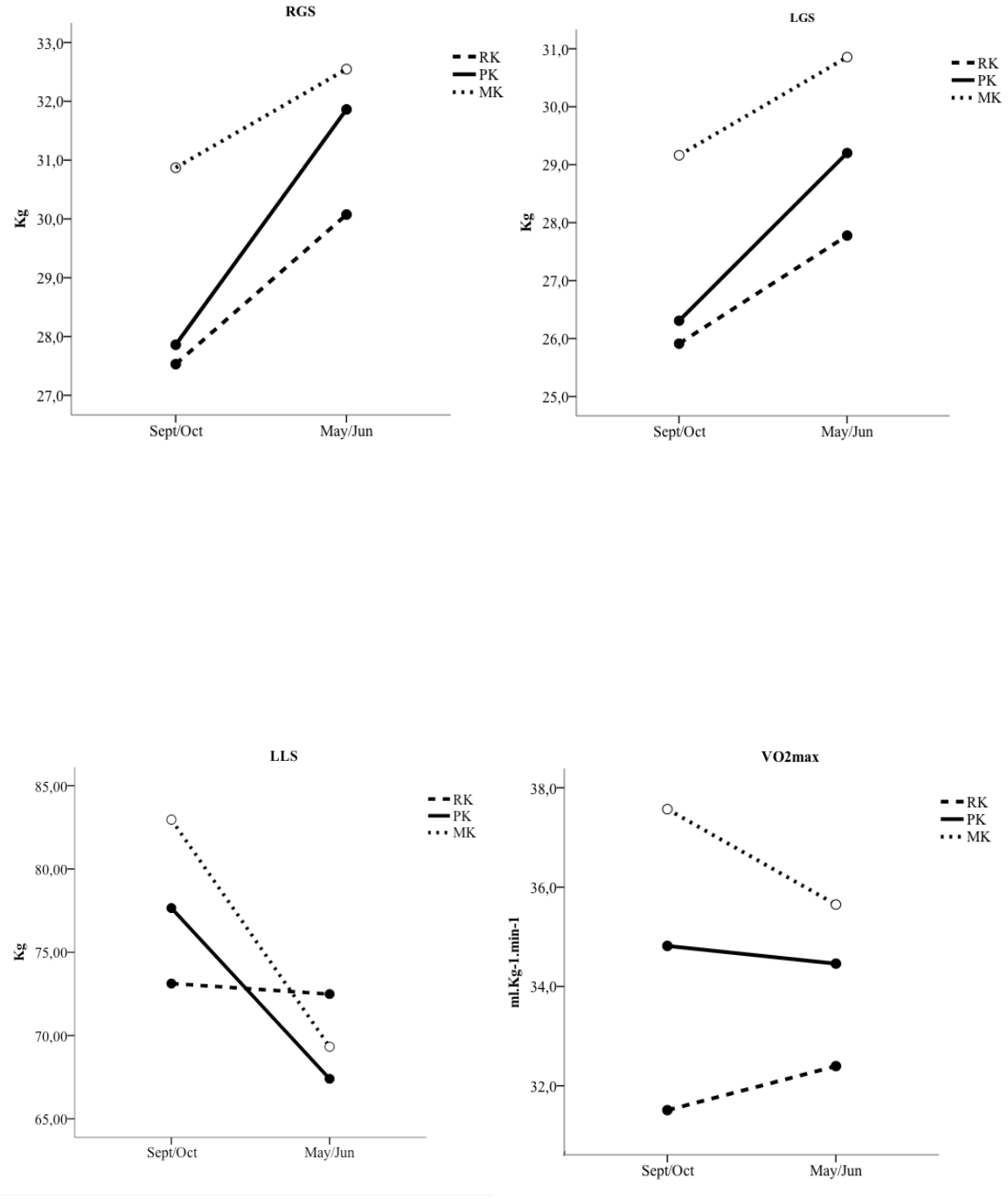


Figure 7. *Differences in physical fitness (PF) after one academic year between reproduction knowledge (RK), production knowledge (PK) and mixed knowledge (MK) teaching styles (TS). RGS, right handgrip strength; LGS, left handgrip strength; LLS, lower limb strength; VO2max, maximal oxygen uptake. GLMRM Time: RGS (P=0.000), LGS (P=0.000), LLS (P=0.000); GLM Time x TS: LLS (P=0.000); GLMRM Time x Gender: RGS (P=0.009), LGS (P=0.64).*

VI.4. Contents

PA patterns differences between three different contents during both academic courses of duration study were analyzed in 45.24% of participants (n=168, Table 20).

Regarding to daily PA patterns related with the three different contents, there were significant differences between CE and PFH in SedT (F=4.15; p=0.019), LPA (F=10.78; p=0.002), MPA (F=4.54; p=0.011), MVPA (3.41; p=0.038) and Steps (F=5.13; p=0.005). Also, significant differences were found between CE and SG (p=0.038) and between PFH and SG (p=0.001) (Table 20).

In relation with the percentage of total time during PE class, PA patterns were similar either PK or RK except in LPA (RK=13.9% and PK=10.3%, P = 0.01; Figure 8).

Table 20 . *Differences in physical activity (PA) patterns between physical fitness and health (PHF), sports and games (SG) and corporal expression (CE) contents.*

Variables		PFH (n= 65)				SG (n=56)				CE (n=31)				Total (n=152)			
		Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
SedT	*(min/day)*	611.63	± 72.47#	72.47	748.22	606.68	± 76.46	448.40	792.61	566.14	± 77.86	421.01	689.00	600.53	± 76.61	421.01	792.61
LPA	*(min/day)*	82.17	± 26.91	26.91	172.71	122.00	± 66.11*	60.28	541.27	111.18	± 45.54*	11.00	290.56	102.76	± 51.43	11.00	541.27
MPA	*(min/day)*	30.07	± 11.14#	11.14	67.56	31.39	± 13.99#	11.94	86.74	38.85	± 17.46	12.48	78.99	32.34	± 13.99	10.50	86.74
VPA	*(min/day)*	17.14	± 11.36	11.36	66.67	16.99	± 10.84	2.05	47.52	22.27	± 20.06	4.04	111.49	18.13	± 13.49	2.05	111.49
MVPA	*(min/day)*	47.21	± 19.40#	19.40	134.23	48.54	± 21.17	15.25	118.18	59.00	± 25.64	17.58	124.55	50.11	± 21.77	15.15	134.23
Steps	*(steps/day)*	7419	± 2207#	2207	17619	7853	± 2683	3337	17350	9173	± 2823	5213	16565	7937	± 2588	2650	17619

*PFH, Physical fitness and health; SG, Sports and games; CE, Corporal expression; SD, Standard deviation; Min, Minimum; Max, Maximum; SedT, Sedentary time; LPA, Light physical activity; MPA, Moderate physical activity; VPA, Vigorous physical activity; MVPA, Moderate-Vigorous physical activity; Steps, Steps. *, Indicates significant differences with PFH (P<0.05) for one way ANOVA; & Indicates significant differences with SG (P< 0.05) for one way ANOVA; #, Indicates significant differences with CE (P<0.05) for one way ANOVA.*

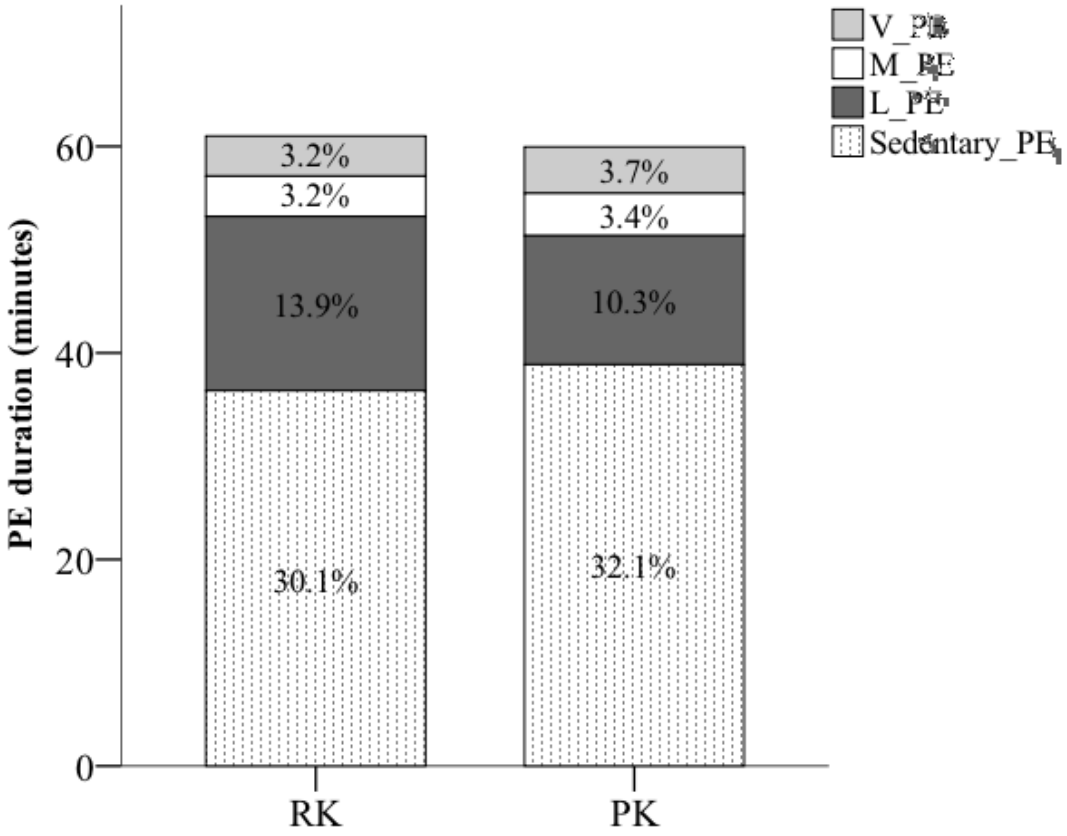


Figure 8. *Relative contribution (percentage of total PE class time) of PA patterns during PE classes, differences between RK and PK (PC content). PE, physical education; RK, reproduction knowledge; PK, production knowledge. V_PE, vigorous physical activity in physical education; M_PE; moderate physical activity in physical education; L_PE; light physical activity in physical education; Sedentary_PE; sedentary time in physical education. GLM.*

VI.5. Discussion

In our knowledge, this was the first study to assess how the structure and methodology in PE classes (i.e., type of activity and complete MASTS) influenced in daily PA patterns, BC and PF along one academic year in adolescents. Our results suggested that variations in teaching methodology during secondary PE classes could

modify adolescents' PA patterns, although their BC variables and PF level were not changed as a result of lesson content or TS.

VI.5.1. Physical Activity

An objective, accurate and detailed assessment of PA is needed to understand about healthy patterns (Butte et al., 2012). To collect this precise information indirect methods have been replaced by ACLs (Cliff, Reilly & Okely; 2009). In this research daily PA patterns were measured at the BOC and at the EOC in adolescents with ACLs. Our main finding related with PA was that PA patterns (minutes per day at specific intensities) were affected by change in TS. The PA volume and intensity levels varied based on different content and TS. Specifically, PK group raised significantly all PA daily patterns except sedentary time after one-academic year. Regarding to RK and MK, there were significant differences between these TS for VPA, MVPA and steps. Specifically, RK group remained stable in MVA, VPA and steps while MK group raised MPA and decreased VPA, MVPA (Figure 4). These results suggest that the structure of PE lessons and TS used allows students to have higher engagement in PA at and after school period. These results are in accordance with previous research from Erwin et al., (2013) who find similar results in a sample of 313 students, this study used ACLs and pedometer to assess PA patterns in relation with four different lessons types: (a) team choice, (b) team no choice, (c) individual choice and (d) individual no choice. Thus, PETs should consider how curriculum choices and teaching presentation could influence students' PA, potentially due to their motivation for the activities involved (Erwin, Stellino, Betts, Beighle, Jonhson; 2013)

VI.5.1.1 Meeting recommendations

Results obtained at baseline (BOC) determined that MVPA in MK and PK groups were not enough to meet international recommendations of healthy PA for young people (60 min/day of MVPA or 11,000 and 13,000 steps/day for girls and boys respectively) (Janssen, Wong, Colley, & Tremblay, 2013; McClain, Abraham, Brusseau & Tudor-Locke, 2008, Strong, 2005; Tremblay, 2011; Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002; WHO, 2010) In accordance with previous research, which confirmed that young people from Europe and Spain tend to be below the guidelines (between 51 to 58 min/day of MVPA) (Aibar, 2013a; Janssen, Katzmarzyk, Boyce, Vereecken, Mulvihill, Roberts,... & Pickett, 2005). The control group (MK) accrued the limit of these recommendations on average (Table 15), thus it appears to be adolescents in MK group were above average national values (Table 15). Although, we cannot attribute these results to physical characteristics differences or bias selection since we PA, BC and demographic characteristics were similar at BOC, additionally our ITT analysis did not show significant differences between responders and non-responders. Nevertheless, MK students were enrolled in a different school and we could argue these differences were related with environmental differences.

Regarding to steps recommendations Adams et al. (2013) suggested an amount of 9000 steps per day or more for adolescents to reach goals formulated in the health guidelines (WHO, 2010). In the present study, the baseline assessment determined the intervention groups (RK and PK) did not accrue enough steps to meet these recommendations. The control group was within the limit of these recommendations (Table 15). These results could be even worse if we compare our results with those

suggested by Tudor-Locke et col., who propose 11,000 and 13,0000 steps/day for girls and boys respectively.

Our intervention result in an elevation in all total daily PA patterns in PK groups but not for RK, which remained with similar values. These results may have fairly relevance in a health perspective since PK met healthy recommendations at EOC and MK kept similar values. However, there is still a concern related with the place or time where the behavior happened, so it could be discussed the educative value of PE classes if the PA was only modified during the class by itself and not after school time. Although, it could be speculative we do not believe this result could be only related with a PA elevation during PE since both groups were taught with the same content. Regardless a data analysis of individual changes during PE classes would clarify this controversy. In order to resolve this doubt we carried an individual analysis of PA during PE classes in a subset of students (Figure 8), our results confirm data from previous studies where none significant differences were found between different TSs (Whipp, Jackson, Dimmock, & Soh, 2015). However, a novel finding of this study was that the percent of sedentary time, which a variable barely studied in the PE field, was significantly increased in RK group. This result could have important implications for health since sedentary has a specific physiology (Hamilton, Healy, Dunstan, Zderic, & Owen, 2008; Thyfault, Du, Kraus, Levine, & Booth, 2015) and it has been recently reported that interrupting sedentary time has specific benefits for metabolic function health (Belcher et al., 2015).

It could be still debated these results were also influenced by content was used during PE classes. Although, this could be speculative we believed this is not provable

since all environment conditions where similar for both groups (RK and PK) including the contents, and MK did not change the overall PA behavior after academic year.

VI.5.1.2. Physical Activity and contents used in Physical Education classes

Several studies suggest that levels of daily PA and levels of PA in PE classes are associated. Thus, adolescents usually more active in PE classes are often also more active outside the school context (Marques, Fossati & Curi; 2012; Ruch et al.; 2012). Therefore, the amount of PA promote in PE classes could be determinate by type of content and TS used. The main finding in this study was that RK styles promoted a higher amount of LPA during PE than PK. Furthermore, at least the 60% of time in PE classes students are not involved in PA; around 36 minutes per class is sedentary time (Figure 8). Nevertheless, our results must be influenced by the content used in the PE (strength and flexibility) because there were not in accordance with findings from Ward et al. (2008), whom reported PA levels were better when PE classes included opportunity for students choice (less directive TS); and this study used PFH content. Nevertheless, our results are in accordance with other study that concluded that teacher using directive TS increased PA patterns more than student-choice TS using SG content in PE classes (Erwin, Stellino, Betts, Beighle, Jonhson, 2013) and it is also in accordance with a recent research published in 2015 that analyzed the influence of TS (peer teaching) on PA patterns assessed with ACLs in PE classes (Whipp, Jackson, Dimmock, & Soh, 2015) concluding that there were no significant differences between intervention and control group for time spent in LPA, VPA and MVPA. So, variations in content and TS may have impact on adolescents' PA patterns in PE classes but there is still controversy about how content may affect TS.

In relation with scholar contents used following The National Curriculum, there were significant differences in all PA patterns between CE and PFH unless in VPA. Furthermore, differences between CE and SG were found in MPA and additionally between PFH and SG in LPA. CE was the content more effective in promotion of PA daily pattern; SG was second content more effective and the last one PFH (Table 20). Our results were not in accordance with other studies referred to one specific content in PE classes assessed with ACLs, which determined that SG and PFH contents promote more amount of MVPA than CE contents (Aelterman et al., 2012; Fairclough & Stratton, 2003b, Murillo et al., 2014). Nonetheless, it should be noted that the type of activity in the content is essential to assess PA patterns (Kulinna et al., 2003; Fairclough & Stratton, 2005). So, in our study one reason could be possible that PFH did not promote a high amount of MVPA due to the type of activity used was strength and flexibility and it is possibly that ACLs could not detected completely this type of activities (most of them did not involved acceleration of whole body). Other reason could be students rehearsed the choreography outside classes. Thus, CE promoted the highest amount of PA daily patterns but not during PE classes.

Concerning total daily PA patterns assessed at the BOC and at the EOC in relation with these results of PA in PE classes, revealed that TS used in PE classes and type of content are two factors to consider. As pointed out in the previous paragraphs, during academic course adolescents were taught with PK had better results than RK. Students in PK group increased all their PA daily patterns and decreased ST while analyzing a concrete content PE classes (PFH) RK was the most effective TS. The

implication of our results to rise chronically total daily PA is a question that needs to be confirmed in longitudinal studies, and a wider range of activities during PE.

VI.5.2. Body Composition

Our findings, contrary to the hypothesis that different TS used in PE classes could produce variations in BC, suggested no significant differences in BC variables were produced by lesson content or TS. Results from this study indicated that lesson content and TS did not highly impact BC components in secondary students, which may be mainly affected by maturation (Malina, 1978; Malina, Koziel, & Bielicki, 1999). Girls could increase her weight because of FM increased (Roemmich & Rogol, 1999) and boys because of SMM increased during adolescence by hormonal influence (Schoenau, Neu, Mokov, Wassmer, & Manz, 2000; Tanner, Whitehouse, Hughes, & Carter, 1976). Previous studies found few effects of school based health promotion programs on adiposity or body weight (Sallis, Chen, Castro; 1995, Fairclough & Stratton; 2005b, 2006b, Marques et al.; 2012). So, present results support earlier findings.

There were not significant differences in the baseline between the intervention groups (RK and PK) and the control group (MK), neither differences between BOC and EOC influenced by TS, although p values were close to be significant in FM, FFM, WC and FMI. After one academic year, the main significant differences were found between RK and MK in relation with FM and FFM. Specifically, PK group raised all BC components except for FM and FMI both variables remain relatively stable. Regarding to RK all variables raised excluding FM and FMI, in this case both variables decreased.

Finally, MK group increased FM, SMM, BMI, FMI, SSMI, and WC was diminished and FFMI remaining FFM variable stable (Figure 5). These results are in accordance with the natural chemical maturation during adolescents, which postulate skeletal muscle increased significantly in a short period of time in males (Schoenau et al., 2000) (Malina, 1978; Malina et al., 1999). It was surprising to note a significant interaction between gender, TS and intervention was found, we have not any scientific clue to explain this finding. However if PK style promotes a behavior, which made male students increase PA enough to promote a significant increment in FFM, this is a question which remains to be confirmed in future studies.

VI.5.3. Physical Fitness

The PF variables are important determinants of several health outcomes (Simons-Morton, Parcel, O'Hara, Blair, & Pate, 1988) and school interventions have been proved to effective to improved PF outcomes (Amini, Djazayery, Majdzadeh, Taghdisi, & Jazayeri, 2015; Kriemler et al., 2011; Lai et al., 2014; Sun et al., 2013). Currently, the use of ACLs is an effective assessment tool to quantify PA levels and there is an evidence that regular PA improves BC, cardiorespiratory and muscular fitness, bone health and metabolic health biomarkers among children and adolescents (Committee., 2008).

In this study there were no significant differences between groups in strength variables but VO_{2max} showed significant differences between intervention groups (RK and PK) and control group (MK) in the baseline. VO_{2max} remained quite stable across the academic year. Regarding RGS and LGS, both of them increased during academic curse in the three groups while LLS decreased in PK and MK remarkably. Although it

could be related to poor compliance with the assessment protocol in the second assessment (EOC). Our results were according to other study, which suggested that the promotion of PA with specific PE programs increased the amount of PA patterns but not enough to produce a cardiorespiratory training effect (Sallis et al., 1997). Also, overall results of PF may have not been improved since our intervention was not specifically created for; additionally, it was plausible intervention time was not enough to improve PF-related health outcomes as suggested in recent meta-analysis (Lai et al., 2014).

VI.6. Conclusion

The connection between TS and content used in PE classes and their influence in PA patterns, BC and PF have an important implication in the global effort to reduce obesity and ST during adolescence. As consequence, the effectiveness of certain TS used in PE classes could determine new ways to increase PA patterns. In summary, in this study PK and RK TS used in different PE classes during the academic year did not promote an overall significant difference in PA daily patterns. However, it stood out PK TS due to an increment in all-total daily PA patterns. It is important understand how various lesson types and structure of PE contexts increase PA patterns to engage in learning and promote healthy behaviors. Our results also support the conclusion that PE teachers with a proper training and support can improve their teaching (Lonsdale et al., 2013). Effective teacher would have the potential to provide children and adolescents much more PA than they receive in typical PE classes (Sallis et al., 1997). PA contributes to multiple health benefits in youth (Andersen et al., 2006; McKenzie & Lounsbery, 2013). So, further work is needed to promote similar programs

in diverse schools throughout day-to-day adolescents life to evaluate effectiveness of teacher intervention to improve PA-related health outcomes. New researches focused on the influence of methodologies in relation with TS and the influence of contents in PE would be an important advance in this field to engage adolescents to a more active and less sedentary lifestyle. .

VI.7. Study limitations

Future researches could extend the assessment of PA daily patterns, BC and PF related to TS in school context with larger samples, although this is a long-term intervention and engage adolescents it is extremely difficult to accomplish in this sort of projects. Moreover, the adolescent lack of commitment was other important limitation in this study because they many times do not wear the ACLs and it is not possible achieve the protocol recommended to obtain valid ACLs data (Holman, 2011; Yıldırım, 2011). Additionally, ACLs with valid data have the limitation that these devices do not recognize all PA behavior (e.g., strength or flexibility activities).

We could also be unsuccessful to find more significant differences in our health outcomes due to the duration of the intervention. It has been recently reported in a meta-analysis that at least one-year of intervention it is necessary in order to find significant differences in the most important health outcomes related with PA interventions (Lai et al., 2014).

It should be important set out future researches about the contribution of different contents developed in the scholar context (PFH, CE, OA and SG) in these PA daily patterns related with TS. However, power statistical analysis should be carried out

and attrition rated considered in order knowing the minimal sample size to avoid type II error and confirm or refuse our hypothesis without bias related with small sample size.

Finally, it should be noted that maturation may have influence in the PA, BC and PF variables for this reason future research in this topic should include maturation control.

VII. Conclusions

VII.1. Conclusions Chapter 1

1. Our literature search provided information about five specific assessment tools in regard with TS using during PE lessons (*Style-Analysis Checklist*, *Teacher-Student Interaction Scale, IFITS, ITLB, Inventory of Landmark Teaching Styles)* and a total of six validation studies.
2. The literature review suggest that many of the TS pedagogical assessment tools in PE were based on the classical MASTS (Mosston, 1966a; Mosston & Ashworth, 2002).
3. We found seven widely reported instruments *(FIAS, CAFIAS, OSCD-PE, ALT-PE, PETAI, QMTPS, FFT)* and a total of three validation studies from the international literature, which were focused on different aspects of the teaching-learning process such as perceptions, experiences and behaviors that were.
4. We could not find any studies that addressed the relationship between RK and PK TS on total daily PA behavior and health-related PC variables.

VII.2. Conclusions Chapter 2

VII.2.1. Physical Activity daily patterns conclusions

1. The main finding was that PK, RK and MK TS used in different PE classes during the academic year promoted a significant difference in PA daily patterns. We found a significant positive time effect for LPA and in MPA. There was also a negative time effect for VPA, which had an interaction with TS; so, MK group reduced significantly VPA while PK and MK did not change significantly.
2. PK TS group stands out because increased in total daily PA (LPA, MPA, VPA,

MVPA and steps) along the time while RK group remained quite stable except for a small increase in LPA.

3. We observed significant differences between RK and MK TS in VPA, MVPA and steps. All together, these results may suggest that PK may be used at least partially during the teaching-learning process in order to increase total daily PA.

VII.2.2. Body Composition conclusions

1. We did not find significant differences on BC between TS, although there were significant differences found in FFM, SMM, WC and SMMI after the academic year, which could be associated with the effect of maturation.

VII.2.3. Physical Fitness conclusions

1. RGS, LGS and LLS change significantly after the intervention period, there were also significant differences between groups for LLS, which decreased remarkably in MK and RK, we hypothesized the assessment instrument and protocol might have influenced our results.
2. We recorded higher strength values in MK than MK, however the rate of change after intervention was not significantly differente and it may have been reltated with differences in maturation.

VII.2.4. Physical Activity and contents conclusions:

1. Finally, in relation with scholar contents there were significant differences in all PA patterns between CE and PFH except for VPA. Additionally, MPA was

significantly different between CE and SG, and LPA between PFH and SG. Although, these results may be confirmed in future research, nonetheless they may be useful in order to design PE classes, which aim specific PA goals.

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IX. Appendix

Appendix I: Funding acceptance document from Spanish Ministry of Economy and Competitiveness

Appendix II: Research and protocols information for Eligible Education Centers

Appendix III: Written informed consent for schools

Appendix IV: Written informed consent for participants

Appendix V: Participants approval document

Appendix VI: Example-form for data collection

Appendix VII: Accelerometer information for participants

Appendix VIII: Accelerometer example-form for data collection

Appendix IX: Inventory of landmark teaching styles

Appendix X: Extended English abstract

Appendix XI: Extended Spanish abstract

Appendix XII: Extended Spanish abstract – Spanish abbreviations

MINISTERIO
DE CIENCIA
E INNOVACIÓN

SECRETARÍA DE ESTADO DE INVESTIGACIÓN
DIRECCIÓN GENERAL DE INVESTIGACIÓN Y GESTIÓN DEL PLAN NACIONAL DE I+D+i
SUBDIRECCIÓN GENERAL DE PROYECTOS DE INVESTIGACIÓN

COMUNICACIÓN SOBRE LA PUBLICACIÓN DE LA RESOLUCIÓN DEFINITIVA DE CONCESIÓN DE AYUDAS PARA LA REALIZACIÓN DE PROYECTOS DE INVESTIGACIÓN, SUBPROGRAMA DE PROYECTOS DE INVESTIGACIÓN FUNDAMENTAL NO ORIENTADA. CONVOCATORIA 2011

REFERENCIA: DEP2011-30565
INVESTIGADOR/A PRINCIPAL: Dr./a: ELVIS ALVAREZ CARNERO
ORGANISMO: UNIVERSIDAD DE MALAGA
CENTRO: FACULTAD DE CIENCIAS DE LA EDUCACION
TÍTULO: EDUCACION FISICA ESCOLAR, GASTO ENERGETICO, OBESIDAD Y SALUD INFANTIL: ¿ES LA INTERVENCION ESCOLAR DE LOS PROFESORES EF UN REAL ARMA EN LA GUERRA CONTRA LA OBESIDAD?
DURACIÓN EN AÑOS: 3

En virtud de las competencias conferidas a esta Subdirección General de Proyectos de Investigación y de acuerdo con lo dispuesto por la Orden PRE/621/2008 de 7 de marzo (BOE de 8 de marzo), por la que se regulan las bases, el régimen de ayudas y la gestión de la línea instrumental de proyectos I+D+i, en el marco del Plan Nacional I+D+i 2008-2011, y la Resolución de 20 de diciembre de 2010 (BOE de 21 de diciembre), por la que se aprueba la convocatoria para el año 2011 del procedimiento de concesión de ayudas para la realización de proyectos de investigación, subprograma de Proyectos de Investigación Fundamental no Orientada, dentro del Programa Nacional de Proyectos de Investigación Fundamental, en el marco del VI Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica 2008-2011, tras la conclusión del proceso de evaluación, que se ha realizado aplicando los criterios de valoración recogidos en la orden de bases y la resolución de convocatoria, esta Subdirección General de Proyectos de Investigación, como órgano instructor de la convocatoria ha elevado la propuesta de resolución definitiva al órgano competente para resolver, que ha dictado la resolución definitiva de consesión de ayudas de la convocatoria.

Dicha resolución, con el anexo de proyectos aprobados ha sido publicada en la sede electrónica del Ministerio de Ciencia e Innovación (https://sede.micinn.gob.es), según lo dispuesto en el punto 3 del artículo 21 de la resolución de convocatoria. El plazo para la interposición de recursos contra la resolución de la convocatoria se iniciará al día siguiente de su publicación.

En Facilita, la nueva Carpeta Virtual de Expedientes (https://sede.micinn.gob.es/facilita/), donde ha recibido esta comunicación informativa, encontrará una ficha económica detallada de la financiación asignada a su proyecto. Le rogamos que dé traslado a la unidad gestora de su institución de dicha ficha económica.

Finalmente, le aconsejamos que lea detenidamente las instrucciones de ejecución y justificación de los proyectos de esta convocatoria, a las que puede acceder desde la página web del Ministerio (www.micinn.es), en la sección de ayudas y convocatorias, en el apartado de justificación de la convocatoria 2011; en ellas se indica cuándo es preciso solicitar autorización para las modificaciones en las condiciones aprobadas en la resolución de concesión y la forma en que debe hacerlo. En cualquier caso, deberá indicar cualquier cambio en los diferentes informes de seguimiento y final.

Reciba un cordial saludo.

Aníbal González Pérez

Subdirección General de
Proyectos de Investigación

Ramírez de Arellano, 29
28071, MADRID

Estudio GEOS

"En este documento se presenta la información resumida sobre el estudio GEOS. Su finalidad es dar una visión global del proyecto a los responsables de centros educativos de enseñanza primaria y secundaria, con el objetivo de obtener su colaboración para el proyecto. En caso de aceptar la colaboración se realizará una reunión para una explicación más detallada del mismo".

TÍTULO DEL PROYECTO: *Educación Física Escolar, Gasto Energético Diario, Obesidad y Salud Infantil: ¿Es la intervención escolar de los profesores de educación física un arma real en la guerra contra la obesidad?*

CARACTERÍSTICAS TÉCNICAS DEL PROYECTO:

- Proyecto desarrollado en el Laboratório de Biodinámica y Composición Corporal de la Facultad de Ciencias de la Educación de la Universidad de Málaga.
- Colaboran la Escuela de Medicina del Deporte de la Universidad de Málaga y la Facultad de Ciencias de la Educación de la Universidad de Jaén.
- Financiado por el Ministerio de Ciencia e Innovación. Plan Nacional I+D+i 2008-2011. Referencia: DEP2011-30565.
- Todos los procedimientos están de acuerdo con las normas de la declaración de Helsinki para estudios de investigación con humanos, actualizadas en la 59ª Asamblea general en Seoul en Octubre del 2008 .

RESUMEN DEL PROYECTO

El diseño de este estudio está focalizado en algunos de los aspectos más relevantes en el área de obesidad infantil y juvenil. Se analizará la influencia de las estilos/modelos y estrategias de enseñanza en la educación física escolar (EF), en los comportamientos de AF escolar, extarescolar deportiva y extraescolar no estructurada. Es un estudio longitudinal y en él se observarán los comportamientos de actividad física (AF) y las alteraciones de la composición corporal molecular y celular, de escolares españoles durante 1 año natural completo. En el se realizarán evaluaciones de composición corporal, gasto energético (GE) y AF utilizando técnologías de referencia y elevada precisión.

Las dos novedades principales del estudio son: Su diseño, en el cual se coordina el área de la actividad física para la salud y las estrategias de enseñanza, durante una intervención longitudinal y ecológica; sin embargo, la principal novedad del proyecto será la evaluación de GE real de los niños y adolescetens con la técnica del agua doblemente marcada (ADM), la cual nunca ha sido realizada en España. La evaluación de la composición corporal utilizando la hidrometría, la bioimpedancia multifrecuencia, y la densimetria radiológica (DXA), son otra novedad importante por su elevado coste.

OBJETIVOS:

- Estudiar longitudinalmente los cambios de la composición corporal, GE, AF, e ingesta energética.
- Analizar las diferencias en las respuestas fisiológicas y de comportamientos de AF, como consecuencia de la utilización de modelos de enseñanza verticales o constructivistas, en las clases de EF.
- Utilizar la técnica del ADM para validar instrumentos de campo (cuestionarios o acelerómetros) para estimar el GE de niños y adolescentes españoles.

SOLICITUD AL CENTRO Y A LOS PARTICIPANTES

- Para la realización del proyecto necesitaremos de 9 centros de primaria y secundaria. En cada centro serán seleccionados 180 niños de todos los niveles educativos entre los 8 a los 16 años.
- Los niños tendrán que realizar 3 momentos de evaluación durante el año: Septiembre/octubre, Junio y septiembre.
- En cada momento de evaluación habrá dos días de recogida de datos:
    - Día 1: Gasto energético con isótopos, cuestionarios y composición corporal; condición física.
- Reunión con los responsables de educación de los estudiantes.
- Evaluación observacional de seis clases de EF del mismo profesor; dos en cada trimestre.
- Posible utilización de alguna aplicación informática sobre el contenidos transversales en actividad física para la salud.

BENEFICIOS:

- Los participantes podrán beneficiarse de una evaluación rigurosa y completa de su condición física saludable y de su composición corporal. Será entregado un informe completo después de cada evaluación.
- Los centros participantes formarán parte de la primera red nacional de centros educativos donde se realizan evaluaciones isotópicas para evaluar el gasto energético y la composición corporal. Además de formar parte de un proyecto de investigación financiado por el ministerio de ciencia e innovación.

RIESGOS:

- Los riesgos para los niños y adolescentes es mínimo, pues ninguna de las evaluaciones utilizará material invasivo y el consumo de drogas u otros componentes que puedan interferir con la salud de los alumnos.
- Las pruebas físicas realizadas tendrán características similares a aquellas realizadas de forma tradicional por los profesores de EF, y estarán siempre vigiladas por uno de los médicos del proyecto.
- Se utilizarán isótopos en algunas de las evaluaciones, sin embargo, estos son estables y por tanto, sin cualquier riesgo para la salud de los escolares.
- Antes de la inclusión en el proyecto todos los alumnos deben tener firma el consentimiento de sus padres o en su defecto el responsable por su educación.
- Las instalaciones del centro no sufrirán cualquier deterioro pues ninguna de las evaluaciones utilizará el centro de forma intensiva.
- Alguna de las evaluaciones tendrá que ser realizada en el laboratorio de biodinámica y composición corporal de la universidad de málaga, sin embargo, estas solamente se realizarán si los padres o responsables de educación transportan a los niños a nuestras instalaciones fuera del horario escolar.
- En ningún caso se realizarán experimentos o ensayos clínicos con los alumnos, solamente evaluaciones y observaciones de sus comportamientos de AF.

CARACTERÍSTICAS DE LOS PARTICIPANTES

- INVESTIGADOR PRINCIPAL: Elvis Álvarez Carnero (Director del Laboratorio de Biodinámica y Composición Corporal, Universidad de Málaga).

- INVESTIGADORES: Jesus Barrera Exposito (Universidad de Málaga), José Ramón Alvero Cruz (Universidad de Málaga), José Carlos García Fernández (Universidad de Málaga), José Luis Chinchilla Minguet (Universidad de Málaga), Ivan Lopez Fernández (Universidad de Málaga), Lorena Correas Lopez (EADE), Margarita Carrillo de Albornoz (Universidad de Málaga), Gema Torres Luque (Universidad de Jaén).

- CENTROS PARTICIPANTES: El proyecto se llevará a cabo durante 3 años. Cada año tomarán parte 3 centros andaluces. El primer año tomarán parte en el estudio:

    - 1 Centro de Enseñanza Secundaria de Ronda.
    - 1 Centro de Enseñanza Primaria de Jaén.
    - 1 Centro de Enseñanza Secundaria de Málaga.

El Investigador Principal

Elvis Álvarez Carnero, PhD

UNIVERSIDAD DE MÁLAGA
LABORATORIO DE BIODINÁMICA
Y COMPOSICIÓN CORPORAL

GOBIERNO DE ESPAÑA · MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD · SECRETARÍA DE ESTADO DE INVESTIGACIÓN, DESARROLLO E INNOVACIÓN

_____ a 30 de septiembre de 2012

A/A del Sr. Director del centro educativo_____:

El sobrepeso y la obesidad son uno de los principales problemas de la salud de nuestros niños/as y cuanto antes se detecte y orienten sus costumbres alimenticias y de actividad física menos condiciones patológicas asociadas a la obesidad aparecerán en el futuro.

Considerando la información presentada en el párrafo precedente, solicito el consentimiento del Claustro, Consejo Escolar y Asociación de Padres de Alumnos/as para la puesta en práctica del Proyecto GEOS que aparece descrito a continuación. Se trata de una extensión Proyecto ESCCOLA desarrollado en otros centros españoles (andaluces) en años precendentes; en dichos centros fue evaluada la composición corporal y los hábitos de salud de más de 500 alumnos/as. En este caso el Proyecto GEOS, también realizado en colaboración con la Universidad de Málaga, tiene mayor relevancia al tratarse de un estudio I+D+i del plan nacional de investigación, subvencionado por el Ministerio de Ciencia e Innovación (ahora de Economía y Competitividad). Las pruebas son muy similares a las del estudio ESCCOLA (se describen en el documento informativo). Se llevará a cabo en tres fases del mismo año natural (la primera en Octubre/Noviembre, la segunda en Junio antes de las vacaciones y la tercera a la vuelta de vacaciones en Septiembre). Este primer contacto como objetivo, la autorización para la participación del centro que usted dirige como centro candidato. Los **centros candidatos** realizaran un primer estudio piloto que se describe en la hoja informativa, en dicho estudio se recogeran de forma completamente anónima algunos datos básicos de los escolares. Después de la realización del estudio piloto, los niños que hayan participado, podrán entrar en la selección aleatoria de participantes en el proyecot final (bienio 2013-2014).

Sin más que agradecer su atención y esperando su respuesta se despide atentamente

Nombre del Profesor responsáble en el Centro

(_____)

Facultad de Ciencias de la Educación
Departamento de Didáctica de la Expresión Musical, Plástica y Corporal
Campus de Teatinos, s/n. 29071-Málaga Tlf.: 952 13 24 51

UNIVERSIDAD DE MÁLAGA
LABORATORIO DE BIODINÁMICA
Y COMPOSICIÓN CORPORAL

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Proyecto GEOS

Documento Informativo para posibles participantes

1. **Objetivos:**
   - Estudiar el gasto energético (calorías que gasta durante la semana), los hábitos de alimentación (cantidad y calidad de las calorías ingeridas) y la composición corporal (sobrepeso y obesidad) de escolares andaluces.
   - Evaluar las posibles alteraciones del aparato músculo-esquelético (columna vertebral, caderas, rodillas y pies).

2. **Metodología Empleada:**
   - Antropometría: Mediciones de talla, peso, pliegues de grasa y perímetros corporales.
   - Aparato locomotor: Exploración estática y dinámica de la columna vertebral, caderas, rodillas y pies.
   - Impedancia Bioeléctrica: Estimaciones de masa magra.
   - Agua doblemente marcada: Utilización de agua marcada con dos isótopos estables (deuterio y oxígeno 18) para medir el gasto energético y la cantidad de agua dentro del cuerpo de los escolares.
   - Batería de condición física: Evaluación de la resistencia cardiovascular, la fuerza, la flexibilidad, la capacidad de salto y la coordinación.
   - Cuestionarios: Recogida de datos de alimentación, prácticas de actividad física, estilo de vida, salud y maduración.

3. **Beneficios derivados del estudio:**
   - Conocimiento con elevada precisión del gasto energético, composición corporal e ingesta calórica en edades infantiles y juveniles, y de sus asociaciones con la salud de los escolares.
   - Observar la evolución de los comportamientos saludables, la composición corporal y del gasto calórico durante el año escolar.
   - Obsequio de una evaluación de densimetría y analítica en el Laboratorio de Biodinámica y Composición Corporal de la Universidad de Málaga.

4. El estudio se realizará en dos días. La batería de condición física se realizará durante la tarde, el resto de tests se realizarán durante una mañana.
5. Todos los tests y evaluaciones han sido utilizados en poblaciones semejantes en diversos estudios españoles y en otros países, no conociéndose efectos adversos resultantes de los mismos.
6. La participación en el estudio tiene un carácter TOTALMENTE voluntario, así como la posibilidad de retirarse del mismo en cualquier momento sin dar ninguna explicación.
7. Todo el tratamiento de datos tendrá un riguroso celo y solamente el investigador principal del proyecto tendrá acceso a la base de datos de nombres de los participantes. Para efectos de tratamiento estadístico los participantes aparecerán identificados con un código numérico, garantizándose el anonimato en todo momento.
8. Cada una de las pruebas y valoraciones serán supervisadas por especialistas en fisiología del ejercicio (médicos deportivos y licenciados en ciencias de la actividad física).
9. El investigador responsable del estudio mantendrá informado al participante y a sus tutores, y se les entregará un informe final personalizado con los resultados del estudio.

Los padres o tutores podrán consultar cualquier duda o tema relacionado con el estudio durante la reunión informativa el día ___ de _____ a las __:__ horas en el _____.

La participación no supondrá alteración alguna del desarrollo normal de las clases, no implicando más pérdida lectiva para el alumno que la del día de las pruebas con el consentimiento y la colaboración del profesorado.

TODOS LOS PROCEDIMIENTOS UTILIZADOS ESTÁN ACORDES CON LA DECLARACIÓN DE HELSINKI PARA ESTUDIOS CON HUMANOS

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Campus de Teatinos, s/n. 29071-Málaga Tlf.: 952 13 24 51

UNIVERSIDAD DE MÁLAGA
LABORATORIO DE BIODINÁMICA
Y COMPOSICIÓN CORPORAL

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

Proyecto GEOS

Consentimiento Informado para la Participación en el Estudio

Yo, (nombre y apellidos del padre/madre) _____ **con DNI nº:_____, autorizo a mi hijo/a_____ del curso _____a la participación en el estudio GEOS en el centro educativo _____. Además:**

- He leído la hoja de información que se ha entregado.
- He recibido suficiente información sobre el estudio.
- Podré resolver todas las dudas sobre el estudio con el Dr. Elvis Álvarez Carnero investigador principal del proyecto (Universidad de Málaga), y con el Profesor _____ docente del centro educativo _____ _____, durante la reunión informativa que se celebrará el día _____ del _____ del 2011, a las ___:___ horas.

Comprendo que su participación es voluntaria.

Comprendo que el niño puede o puedo retirarse/lo del estudio:

1. *Cuando quiera.*
2. *Sin tener que dar explicaciones.*
3. *Sin que esto repercuta en su evaluación educativa.*

Doy la conformidad para que mi hijo/a participe en el estudio GEOS:

"Educación Física Escolar, Gasto Energético, Obesidad y Salud Infantil: ¿Es la Intervención Escolar de los Profesores de Educación Física un Arma Real en la Guerra contra la Obesidad?"

En _____, _____ de _____ del 2011

Firma del Participante Firma del padre, madre o tutor

ID:_____ ID_Padres:_____ ID_ACL:_____ ID_POD:_____

Nombre:_____ FN:_____ Género:___

Nº DIA :	FECHA:

1. BIAs.

Peso:_____ Estatura:_____ TANNER V:_____ TANNER G: _____

Tanita		**X**		**X**	**X**	**X**	**X**
MediSys							
Omron	**X**	**X**		**X**	**X**	**X**	**X**
Tanita4	**TBW**	**Tronco**	**%MG**	**MS_Der**	**MS_Iz**	**MI_Der**	**MI_Iz**
VISCAN	**PC**		**%MG**		**Ratio**		

2. Antropometría.

Variables	1ª Medida	2ª Medida	Media
Perímetro Brazo			
Perímetro antebrazo (Der. / Izq.)			
Perímetro Cintura (Crestas Ilíacas)			
Perímetro Muslo			
Perímetro de la Pierna			
Pliegue Tricipital			
Pliegue Antebrazo (Der. / Izq.)			
Pliegue Subescapular			
Pliegue Crural			
Pliegue Gemelar			

3. Evaluación de la Condición Física.

Variables	1ª Medida	2ª Medida	AJUSTES/NOTAS
CMJ			
CMJA			
Prensión Izq.			Distancia:
Prensión **DER.**			Distancia:
15 metros			
30 metros			
Sit&Reach			Distancia:
Back-Reach			
F. Isométrica M.I.			

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Blood Pressure

RESTING SIT 5 MINUTES
DON'T TALK!!!

Perímetro Brazo	

	PAS	PAD	HR	TIME
RIGHT				
LEFT				
RIGHT				
LEFT				

CARDIOVASCULAR FITNESS

TIME:_____ STEP HEIGHT:_____

HR STAND (AFTER 1 MINUTE)

HR 1st Stage		HR 2nd St		HR 3rd St		HR 4th St		HR 5th St	
1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd

TOTAL TIME (MINUTES AND SECONDS): _____:_____

RECOVERY (HR AFTER)

1ST MINUTE	**2ND MINUTE**	**3RD MINUTE**

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INSTRUCCIONES PARA EL USO DEL ACELERÓMETRO

1. Lleva el cinturón durante todo el día hasta que te indiquen los profesores de Educación Física.
2. Quítate el cinturón justo antes de irte a la cama. Déjalo en algún lugar en el que te acuerdes de ponértelo en cuanto te levantes por la mañana.
3. Asegúrate de que el aparato rojo está en el lado derecho de tu cintura.
4. Asegúrate de que el cinturón está bien ajustado a tu cintura. Puedes llevarlo por encima o por debajo de la ropa.
5. Es frágil. No lo golpees ni lo dejes caer al suelo.
6. NO DEJES QUE SE MOJE. Quítate el cinturón mientras te duchas, te bañas o practicas cualquier actividad en la que se pueda mojar. No olvides ponértelo cuando salgas del agua.
7. Por favor, anota en el diario a qué hora te pones y te quitas el acelerómetro y para qué.

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DIARIO DEL ACELERÓMETRO

En la tabla de la derecha puedes ver un ejemplo de cómo rellenar el diario. Anota las horas en las que te pones el cinturón al levantarte y te lo quitas al acostarte. Cada vez que te lo quites durante más de 5 minutos durante el día, anota también el tiempo y la actividad por la que te lo has quitado (por ejemplo, natación). Recuerda que debes llevarlo puesto el máximo tiempo posible para que los datos sean válidos. ¡No lo olvides!

Día	VIERNES 30 MAYO
Me levanto	7:30
Me acuesto	23:00
Actividad	Horario
1.Natación	18:00-19:00

Nombre y apellidos / Código:

Día									
Me levanto									
Me acuesto									
Actividad	Horario	Horario	Horario	Horario	Horario	Horario	Horario	Horario	Horario

Description Inventory of Landmark Teaching Styles: A Spectrum Approach

The following descriptions offer images of the classroom that represent different landmark teaching-learning expectations and each expectation inherently promotes a set of decisions and a set of learning outcomes in content and human behavior. Thus, each description represents a significantly different teaching-learning style (O-T-L-O).

The image provided represents the following landmark style	The following five teaching-learning styles promote reproduction cognitive operations while engaged in the task. The content in these styles may be new to the learner or the content may be a review or a practice or a test of previously experienced content.
Command Style-A	The teacher selects the task that the students perform in a unison, choreographed or precision performance image following the exact pacing and rhythm (cues) set by the teacher.
Practice Style-B	The teacher selects the subject matter tasks, the quantity, and the time limits so that students can practice individually and privately. The teacher circulates among all students and offers private feedback. The students learn to set a pace to practice tasks within an allocated time frame.
Reciprocal Style-C	The teacher selects the subject matter tasks and presents the expectations for students to work with a partner. One student (the doer) practices the task, while the other student (the observer) uses a teacher prepared criteria (checklist) to offer immediate feedback about the performance to the doer. When the first set of tasks are finished, the students switch roles and continue to the second* set of tasks. The teacher interacts with the observer to affirm the use of the criteria and the accuracy of the feedback comments and/or to redirect the observer's focus to specific performance details on the criteria. This experience offers practice in giving and receiving immediate feedback about the task and practice in developing comparing, contrasting, communicating, and social skills. *(*In physical or manipulative tasks, both practice tasks can be the same).*

Self-Check Style-D	The teacher selects the subject matter tasks and designs the criteria (performance checklist) for the students. Students individually practice the tasks and check their own performance using the checklist. The teacher privately communicates with students to listen to their self-assessment comments and either reinforces the learner's use of the criteria or redirects the learner's focus to specific performance details on the criteria.
Inclusion Style-E	The teacher selects the subject matter tasks and designs multiple levels of difficulty for each task. Students select the level of difficulty that is appropriate to their performance. If inappropriate level decisions are made, the student may change the level choice. Students check their performance using the teacher prepared performance checklist (criteria sheet). The teacher circulates to acknowledge the choices the students have made and to ask questions for clarification to affirm the accuracy of the students' assessment process and/or to redirects the learner's focus to specific performance details on the criteria. The teacher does not suggest level changes. Performance standards are established before students can move from one level to another.
	The next six teaching-learning styles promote different discovery structures and cognitive operations while engaged in the task. The content in these styles is new and not known in advance of the experience to the learner.
Guided Discovery Style-F	The teacher asks one student a series of specific questions*; each question has only one correct answer. The questions are sequenced in a logical pattern so that each answer leads the student step by step to discover the anticipated concept, principle, relationship or solution. (Content appropriate for Guided Discovery includes principles, rules, concepts, and relationships. Non-examples of discovery content include isolated facts, skills, dates, names—these content examples cannot be discovered.) **Note: There are cognitive liabilities when this style is used in a large group. The discovery process is interrupted per student in a group setting; therefore, the content acquisition cannot be guaranteed for each student.*
Convergent Discovery Style-G	The teacher designs a situation or question that has one specific correct response —the situation or question is new and the response is not previously known to the students. The learners are given individual and private time to use their thinking and questioning skills to sequentially and logically discover the anticipated answer.

Divergent Discovery Style-H	The teacher designs a single or series of problems, situations or questions that seek multiple solutions to the *same* problem. The task is new to the students; therefore, each student is invited to discover new possibilities, as they produce multiple (divergent) responses to the specific problem. The teacher acknowledges the production of multiple ideas rather than any singular idea.
Learner-Designed Individual Program Style-I	The teacher designates a broad subject matter/topic. Within that topic each student is responsible for producing an individual learning program that includes setting goals and the process for accomplishing the goals. The learners design, implement, refine the program, and create performance criteria for their individual learning programs. The teacher acknowledges the production of ideas and asks questions for information or clarification about the learning program.
Learner-Initiated Style-J	A learner initiates a request to the teacher to plan his/her own learning experience. In this experience the student makes all decisions: selects the subject matter intent, designs, executes, and identifies the assessment criteria for the learning experience. The teacher participates when and how the learner requests. The teacher acknowledges the learner's successful implementation of the plans and initiates questions where discrepancies emerge between the learner's intent and actions. It is not the teacher's job to evaluate, rather act as a reference source between the indicated intent and action. ** This style is only for the individual who approaches the teacher to request this experience; it is not a whole class experience.*
Self-Teaching Style-K	This style is independent of the teacher and not initiated by the teacher. The learner takes the role of both student & teacher setting all learning objectives. The learner self-initiates and is independently motivated to engage in this learning experience. The learner makes decisions about subject matter intent, design, execution, and assessment of the learning experiences. Feedback from others occurs only IF the learner seeks it. (This style is outside the realm of the classroom environment.)

Ashworth, S. (2010, 2008, 2006 2004). Description inventory of landmark teaching styles: A spectrum approach. Unpublished article.

Resumen

Introducción

Aumentar la cantidad de actividad física Moderada-Vigorosa (AFMV) y reducir el tiempo sedentario (TS) son factores clave para un estilo de vida saludable durante la niñez y adolescencia (Andersen, 2006). Los estudios sugieren que los centros educativos deben ser uno de los medios que promuevan hábitos de vida saludables (Andersen, 2006; McKenzie, 2013). Por lo tanto, en las clases de educación física (EF) es importante evaluar cómo los profesores utilizan estrategias y proporcionan a los estudiantes herramientas para involucrar al alumnado en la actividad física (AF) con el propósito de reducir el riesgo de comportamientos sedentarios y promover hábitos de AFMV para un estilo de vida saludable (Lonsdale et al., 2013). Es importante ampliar el conocimiento acerca de los aspectos que influyen en suscitar una EF efectiva y una de las variables más importantes relacionados con la eficacia es el estilo de enseñanza (EE) que se utiliza durante las clases de EF. La enseñanza efectiva en los programas de EF, incluyendo el uso de EE que promueven la participación en la AF, son consideraciones importantes en la promoción de patrones de AF vitalicios (Iserbyt, Elen, & Behets, 2010; Munusturlar, 2014; Whipp, Jackson, Dimmock, & Soh, 2015). Hay muchos factores que pueden estar implicados en el éxito o no de la clase de EF que quiera promover comportamientos saludables fuera de la escuela, como por ejemplo los EE, el tiempo de aprendizaje, la motivación, la percepción del profesor y de los estudiantes sobre los EE y así sucesivamente (Chatoupis, 2003b; Cothran, 2005; Mosston & Ashworth, 2002; Silverman, Devillier, & Ramírez, 1991).

En cuanto a los EE, hay una falta de conocimiento acerca de las herramientas de evaluación pedagógicas utilizadas en las clases de EF para reconocer los EE, así como también se desconoce la influencia del tipo de EE en la promoción de patrones de AF diarios, en las variables de composición corporal (CC) y en la condición física (CF). A partir de estas dos importantes cuestiones se ha considerado establecer dos grandes capítulos en esta tesis doctoral con dos objetivos primordiales claramente relacionados.

- ✓ El primer objetivo de este estudio fue revisar el estado del arte de las herramientas de evaluación pedagógicas para valorar los EE, las cuales se han utilizado frecuentemente en las clases de EF. Además, se han revisado estudios que tenían como objetivo validar estos instrumentos. Por otro lado se han recogido estudios que contemplan otras herramientas de evaluación pedagógica y validaciones de las mismas relacionadas con otros factores que influyen en la efectividad en las clases de EF (ej. tiempo en la tarea, retroalimentación). ***(Capítulo 1).***

- ✓ El segundo objetivo principal fue el de observar las diferencias en los patrones de AF diaria (TS, actividad física ligera (AFL), actividad física moderada (AFM), actividad física vigorosa (AFV), AFMV y pasos), CC (masa de grasa (MG), masa libre de grasa (MLG), masa muscular esquelética (MME), perímetro de cintura (PC), índice de masa de grasa (IMG), índice de masa libre de grasa (IMLG), índice de masa muscular esquelética (IMME) e índice de masa corporal (IMC)), y CF (prueba de resistencia de fuerza en las manos derecha e izquierda (PRFMD y PRFMI respectivamente), fuerza de los miembros inferiores (FMI) y consumo máximo de oxígeno (VO_2 Max)) entre dos grupos de adolescentes a los cuales se les impartió clase durante todo un año académico mediante diferentes EE: reproducción de modelos (RM) o bien producción de modelos (PM), siguiendo el clásico Espectro de Estilos de Esnseñanza de Mosston y Ashworth (Mosston and Ashworth Spectrum of Teaching Styles (MASTS)) (Mosston & Ashworth, 2002). Adicionalmente, un grupo de control sin un EE definido (modelo mixto (MM)) fue medido y posteriormente comparado con los anteriores grupos RM y PM en los que se realiza la intervención). También se analizaron las diferencias entre los patrones totales de AF diarios en función del contenido trabajado en las clases de EF ***(Capítulo 2).***

Capítulo 1

I. Método

En esta revisión exhaustiva sobre las herramientas de evaluación pedagógicas se utilizaron varias bases de datos (WOK, SCOPUS, THESAURUS, ERIC, SPORT DISCUS, DICE, DIALNET,

PROQUEST, PUBMED) para identificar literatura relacionada con el uso de EE en clases de EF. La estrategia de búsqueda y recopilación se centró en diferentes términos y conceptos. Las palabras clave que se utilizaron para la búsqueda se basaron en los términos de diferentes campos como la pediatría (niños, adolescentes, jóvenes), la educación física (educación física, actividad física) y la pedagogía (estilos de aprendizaje, estrategias de aprendizaje, enfoques de aprendizaje, enseñanza de estilos , herramientas de evaluación pedagógica, herramientas de evaluación de comportamiento, estilos de motivación, orientaciones de aprendizaje, métodos de enseñanza).

I.1. Criterios de inclusión

Los estudios encontrados sugirieron que algunos investigadores han producido modelos e instrumentos para evaluar EE utilizados para diferentes propósitos. Por lo tanto, en esta revisión los principales criterios de inclusión consistían en incluir herramientas pedagógicas que se ocupan de los EE en relación con la EF dentro de la educación primaria y secundaria. Se revisaron todos los estudios publicados entre el 1 de enero 1970 hasta el 31 de julio de 2015. Además, se seleccionaron todas las publicaciones que habían sido escritas en inglés o en español.

Por otro lado, entre los criterios de exclusión de herramientas pedagógicas se encuentran aquellas publicaciones en otro idioma que no fuera inglés o español, los documentos con herramientas pedagógicas sobre deportes fuera del contexto escolar y los estudios acerca de EE en EF que no incluían una herramienta pedagógica de evaluación. Las actas de congresos y otros documentos no publicados tampoco se incluyeron en el presente estudio.

II. Resultados

La búsqueda bibliográfica en las bases de datos concluyó con 526 publicaciones potencialmente relevantes. A continuación se filtraron los títulos y resúmenes de publicaciones, confirmándose 373 referencias en relación con EE en EF y 153 estudios que no cumplían con los criterios de inclusión. Por último, se encontraron un total de 5 herramientas de evaluación originales de EF para evaluar los EE, con 4 estudios de validación para los 5 instrumentos encontrados.

Por otro lado, y relacionado con el segundo propósito de la presente revisión, se encontraron siete herramientas diferentes de evaluación relacionadas con otras variables asociadas a la efectividad del profesor en EF durante el proceso de enseñanza-aprendizaje.

II.1. Sistemas de observación sistemática

II.1.1. Herramientas de evaluación de EE:

Las herramientas de evaluación con las que concluyen los resultados se pueden resumir en cinco instrumentos (Ashworth, 2010, 2004; Hasty, 1997; Salvara, 2001; Sherman, 1982; Tuckman, 1985) y seis estudios de validación. Estas herramientas de observación sistemática establecieron tanto descripciones de escenarios donde se desarrolla el proceso de enseñanza como hojas de criterios para cada EE. Estos instrumentos se utilizan para verificar la fidelidad en los comportamientos entre profesor y alumno y su relación con los EE: (1) Lista de Verificación del Análisis del estilo de enseñanza. (2) Escala de Interacción entre Profesor y Alumno, (3) Herramienta de Identificación de estilo de enseñanza, (4) Herramienta de Identificación de Comportamientos en el Proceso de Enseñanza y Aprendizaje e (5) Inventario de estilos de enseñanza relevantes: aproximación espectral

1. *Lista de Verificación del Análisis del Estilo de Enseñanza. (Sherman, 1982).* En 1982 Michael Sherman diseñó ocho listas de control individuales para evaluar a fondo cada uno de los ocho EE descritos por Mosston en 1966 (Mosston, 1966a). Cada una de las listas de control es un inventario de procedimientos con las descripciones de los roles tanto del alumnado como del profesorado. Este procedimiento requiere observar si el docente o el alumnado están realizando cada elemento incluido en la lista de verificación, donde a continuación el observador debe marcar comportamientos observados y quién los realiza. Si ni el profesor ni el alumno están tomando las decisiones, el elemento o ítem se deja en blanco; el mismo procedimiento se sigue cuando se observe un comportamiento inesperado, ya sea por parte del profesor o del alumno. Sherman (comunicación personal, Enero 1989), utilizando esta herramienta, implementó una puntación mínima del 80% como valor de corte para confirmar que el EE se ha implementado.
2. Tuckman desarrolló la *Escala de Interacción entre Profesor y Alumno (Tuckman, 1985).* Esta herramienta evalúa el EE de los docentes desde la dimensión directiva y no directiva de la clase;

este instrumento contiene 23 ítems: 6 sobre la interacción verbal, 13 sobre la flexibilidad de la gestión en el aula y 4 sobre el EE. Aunque esta herramienta fue originalmente diseñado para evaluar EE en el ámbito de la educación general, algunos estudios en EF la han utilizado (Ferrer-Caja, 2000)

3. *Herramienta de Identificación de los estilo de enseñanza (Instrument for Identifying Teaching Styles (IFITS) (Hasty, 1997)* Esta herramienta de evaluación describe ocho categorías de EE Basándose en aquellos originalmente identificados por Mosston en 1981 (Mosston, 1981). Cabe añadir que los EE se organizan en dos grupos principales: Los primeros cinco estilos (A-E) son reproductivos y los últimos tres estilos (F-H) son productivos. El procedimiento incluye grabar la clase para que después cada 20 segundos un codificador ,usando la hoja de codificación de IFITS, tome una decisión sobre qué EE está utilizando el profesor. Una categoría adicional respecto a la organización se incluye en el instrumento para asignar el tiempo que los profesores necesitan para gestionar la logística de la clase. Cuando se utilizan dos o más estilos de enseñanza, se da preferencia y se recoge el estilo menos directivo (Curtner-Smith, Hastey, & Kerr, 2001; Curtner-Smith, Todorovich, McCaughtry & Lacon, 2001).
4. *Herramienta de Identificación de Comportamientos en el Proceso de Enseñanza y Aprendizaje (Instrument for Identifying Teaching and Learning Behaviors (IITLB)) (Salvara, 2001; Salvara & Bironé, 2002a).* En este caso la herramienta de evaluación incluye diecisiete categorías de enseñanza y aprendizaje. Se observan todos los elementos relacionados con los comportamientos en las clases de EE, tanto de profesores como de alumnos. Cada una de estas categorías refleja un comportamiento específico en el proceso de aprendizaje que se relaciona específicamente con uno de los EE propuestos por Mosston en 2002 (Mosston & Ashworth, 2002). Salvara hizo una variación en el sistema de clasificación de Mosston dividiendo las dos grandes categorías de EE (RM y PM) en tres: Reproducción del Conocimiento, Descubrimiento del Conocimiento y Producción del Conocimiento. Pero este cambio no afecta a la nomenclatura y características de EE. Por lo tanto, cada EE propio se determina por la suma de cuatro categorías diferentes previamente establecidas.

5. *Inventario de Estilos de Enseñanza Relevantes: Aproximación Espectral*. Mosston y Ashworth en 2002 continúan identificando dos categorías principales de EE en EF (RM y PM), pero estos autores introducen una importante modificación añadiendo tres EE más, pasando de ocho a once (Mosston & Ashworth, 2002). En relación con el nuevo diseño de espectro, Ashworth desarrolló una herramienta de evaluación para determinar cuál de los estilos estaban siendo utilizados por los profesores de EE durante la clase (Ashworth, 2010, 2004). Esta herramienta describe las imágenes de la clase que representan diferentes estilos de enseñanza-aprendizaje relevantes, los cuales abarcan desde la primera categoría de RM que engloba los cinco primeros estilos (A-E) hasta la segunda categoría PM que comprende los seis estilos siguientes (F-K). La esencia de cada estilo se refleja en una breve descripción. Las descripciones resultantes se utilizan en diferentes situaciones. El Inventario de estilos de enseñanza (Ashworth, 2010, 2004; Mosston & Ashworth, 2002) se perfeccionó en 2006 con la colaboración de SueSuee y Edwards: Descripciones de Estilos de Enseñanza: Un Inventario del Espectro (SueSee, Ashworth, & Edwards, 2006).

II.I.2 Herramientas de evaluación de comportamientos

También se encontraron en esta revisión siete herramientas de evaluación que se quieren destacar por estar relacionados con la efectividad de los docentes en las clases de EF y porque se han utilizado en numerosos estudios en todo el mundo. Estos instrumentos pueden facilitar una comprensión más profunda del proceso de enseñanza-aprendizaje ya que proporciona información valiosa sobre las estrategias metodológicas utilizadas por los profesores: estrategias respecto a la presentación de las tareas físicas por parte del educador (dando instrucciones explícitas o no), el uso del tiempo de clase (los estudiantes tienen más o menos capacidad de decisión para gestionar el tiempo en clase), la presentación de retroalimentación (realimentación de la gestión del profesor) y otras múltiples variables evaluadas con estas herramientas específicas sugieren una aproximación metodológica que observa y considera los EE (Byra, 2013; Creasy, Whipp, & Jackson, 2012; Iserbyt, Elen, & Behets, 2010; Iserbyt, Madou, Vergauwen, & Behets, 2011; Jenkins, 2002; Munusturlar, 2014; Tipps, 1988.; Whipp et al., 2015). También se encontraron cuuatro estudios de validación.

Estos instrumentos se utilizan para verificar la fidelidad de las conductas entre profesorado y alumnado y lo relaciona con el EE: (1) El Sistema de Análisis de Interacción de Flanders, (2) la Adaptación del Sistema de Análisis de Interacción de Cheffers, (3) el Sistema de Observación para el Desarrollo de Contenido en Educación Física, (4) el Tiempo de Aprendizaje Académico en Educación Física, (5) el Instrumento de Evaluación del Profesor de Educación Física, (6) la Escala de Medidas Cualitativas de la Enseñanza, (7) Marco para el Instrumento de Evaluación de la Enseñanza.

1. *Sistema de Análisis de Interacción de Flanders (Flanders Interaction Anaysis System(SAIF)) (Flanders, 1970).* Este instrumento ha sido utilizado en el aula para describir los patrones de interacción verbal entre profesores y alumnos. FIAS fue adaptado para el contexto de la EF por Cheffers en 1984, que desarrolló una adaptación de la FIAS denominada como CAFIAS (Adaptación del sistema de análisis de la interacción de Flanders) (Cheffers' Adaptation of Flanders' interaction Analysis System (Cheffers, Amidon, & Rogers, 1974; Cheffers, Mancini, Martinek, 1980)).
2. *Adaptación del Sistema de Análisis de Interacción de Cheffers (Cheffers' Adaptation of Flanders' Interaction Analysis System (CAFIAS)) (Cheffers, Amidon, & Rogers, 1974; Cheffers, Mancini, Martinek, 1980)).* Es una lista de codificación realizada para analizar de manera directa e indirecta la influencia del docente en el proceso de enseñanza-aprendizaje. Utiliza un sistema de categorías para codificar y cuantificar comportamientos en el aula tanto de profesores como de estudiantes. CAFIAS incluye una componente no verbal que no se incluyó en el instrumento original de Flanders. El observador debe colocarse en clase o en el patio (o en el ambiente de estudio) mientras se realiza la codificación de comportamientos cada tres segundos, o cada vez que los mismos cambien (Wright, 1995).
3. *Sistema de Observación para el Desarrollo de Contenido en Educación Física (Observation System for Content Development in Physical Education(OSCD-PE)).* En 1979 Judith Rink diseñó un instrumento para evaluar el desarrollo de los contenidos y la gestión de las clases de EF por los profesores (Rink, 1979). El OSCD-PE contiene 36 variables que se usan para describir los comportamientos de los docentes en EF. En el procedimiento original se requería la grabación del audio (en cinta) para realizar una codificación continua de las funciones del

comportamiento docente en cuanto a las variables contenidas de informar, refinar, ampliar y aplicar todas las dimensiones de gestión de la conducta y la organización. El instrumento discrimina el uso de estos comportamientos en relación con la tarea de movimiento, el objetivo de la conducta y su forma de comunicación (Gusthart, 1983). Hoy en día, las cámaras de vídeo permiten una mayor facilidad a la hora de recoger todos los datos.

4. *Tiempo de Aprendizaje Académico en Educación Física (Academic Learning Time in Physical Education (ALT-PE)).* Es un indicador de la gestión del tiempo en las clases de EF (Siedentop, Tousignant, y Parker, 1982). Este instrumento ha sido estudiado ampliamente como una medida de los logros de los estudiantes y de la efectividad de los docentes. Específicamente, el ALT-PE describe la cantidad de tiempo que los estudiantes participan en la actividad motora a un nivel adecuado de dificultad: Cuanto más tiempo participan en actividades apropiadas para su nivel de habilidad, mayor es el aprendizaje (Beckett, 1989; Silverman, 1985).
5. *Instrumento de Evaluación del Profesor de Educación Física (Physical Education Teacher Assessment Instrument (PETAI)).* Este instrumento evalúa el porcentaje de tiempo que el profesor emplea en cinco comportamientos de instrucción y cinco comportamientos de gestión, así como el porcentaje de tiempo que los alumnos han dedicado a participar en habilidades prácticas (Phillips, 1986).
6. *Escala de Medidas Cualitativas de la Enseñanza (Qualitative Measures of Teaching Performance Scale (QMTPS)) (Rink, 1988).* Judith Rink y Peter Werner crearon el QMTPS para medir cualitativamente el sistema de comunicación utilizado por el maestro para transmitir información a los estudiantes en las escuelas de Estados Unidos. Esta herramienta incluye una escala de calificación basado en comportamientos visuales definidos, que debe ser utilizada para caracterizar el tipo de tarea, la presentación de la misma (incluyendo: explicitud, demostración visual, precisión de las pistas, el número apropiado de las mismas y señales cualitativas), las respuestas de los estudiantes y una retroalimentación específica y congruente. Este instrumento QMTPS se basa en el *OSCD-PE* desarrollado por Rink en 1979 (Rink, 1979).
7. *Marco para el Instrumento de Evaluación de la Enseñanza (Framework for Teaching Evaluation Instrument(FTT)).* Realizado por el grupo Danielson (2013), se trata de otro

instrumento de evaluación de los comportamientos y eficacia de los profesores pero no es específico para el contexto de la EF (Group, 2013.). Este instrumento permite al usuario describir el entorno y la interacción entre el profesor y el alumno mediante un cuestionario estructurado que se puede utilizar para definido el perfil del EE empleado. Es destacable que esta herramienta no ha sido diseñada exclusivamente para determinar el EE, por lo que utiliza una amplia evaluación de la eficacia del proceso de enseñanza general. Algunas descripciones del FTT fueron modificadas para adaptar esta herramienta de evaluación con más precisión a la EF: la llamada *Herramienta de Observación de la Lección y de la Educación Física (Physical Education and Lesson Observation Tool (PELOT)) (Ministry of Singapore, 2013)*.

III. Discusión

Centrándose en el uso de herramientas de evaluación de EE en los estudios analizados en esta revisión, se encontraron un total de 27. Hubo 13 estudios de investigación con sede en los EE.UU., nueve en Europa y cinco en Australia. Además, los estudios que han utilizado las herramientas de evaluación de EE en EF han aumentado considerablemente en los últimos quince años. El 18,5% de estos estudios se publicaron entre 1990 y 1999, y el 81,5% desde el año 2000. Algunos estudios recientes publicados en 2015 utilizaron herramientas de evaluación del EE pero se centraron en estudiantes universitarios o entrenadores deportivos (Hewitt, & Edwards, 2011; Hewitt, 2015; Kirby, 2015; Pitsi, 2015). El instrumento más utilizado parecía ser los IFITS utilizados en 10 estudios entre 2001 y 2012. IFITS fue seguido por la Lista de Verificación Estilo-Análisis, utilizada en 9 estudios de investigación cada uno, de 1993 a 2013. Después se utilizó el Inventario de Estilos de Enseñanza Relevantes cuatro veces entre 2011 y 2015. IITLB se utilizó dos veces entre 1995 y 2003, mientras que la Medida de la Directiva de Enseñanza Profesor-Alumno fue utilizada dos veces entre 2000 y 2002.

Un total de seis estudios se referían a la validez o la capacidad de la herramienta para producir datos que representen de forma precisa el ES en las clases de EF. Tuckman validó la Escala Interacción Maestro-Estudiante en 1994 (Tuckman, 1994). Esta herramienta de evaluación proviene del campo de la educación general pero se aplicó en diferentes estudios de investigación sobre la motivación relacionada con los EE (Ferrer-Caja, 2002, 2002). Salvara y Bironé en 2002 validaron el IITLB en Europa, con 42

profesores (una lección de cada maestro) y diferentes áreas de contenido (atletismo, gimnasia, baloncesto, voleibol, juegos escolares) (Salvara & Bironé, 2002). Bryant y Curtner-Smith validaron el IFITS en tres estudios relacionados durante el año 2008 y 2009 en EE.UU., donde el contenido principal era la natación y utilizaron dos clases grabadas en cada estudio (Bryant, & Curtner-Smith, 2009a; Bryant, & Curtner-Smith, 2008, 2009b). SueSee y Edwards validaron el Inventario de Estilos de Enseñanza Relevantes en 2011 con un estudio dividido en dos partes; utilizaron un cuestionario en la primera y en la segunda evaluaron diferentes áreas de contenido (Liga de rugby, baloncesto, fútbol gaélico, softball, ejercicios aeróbicos competitivos, tiro con arco, orientación). El número de clases evaluadas estaban entre tres y seis (SueSee, & Edwards, 2011).

Todas las herramientas de EE mencionadas se centran en la idea de que el proceso de enseñanza-aprendizaje consiste en una cadena de toma de decisiones. Las decisiones se toman antes, durante y después de las clases de EF. Estos tres conjuntos de decisiones a tomar durante cada proceso de aprendizaje docente conducen a la anatomía o constitución de un EE (Mosston, 1981; Mosston, & Ashworth, 2008; Mosston & Ashworth, 2002). De esta manera, los EE empleados son diferentes en función de los distintos grados de participación de profesores y alumnos en estas decisiones.

Dentro de estos métodos de observación sistemática hay cuatro instrumentos basados en las clasificaciones de los EE de Mosston. Dentro de ellos hay dos herramientas de evaluación de EE (Lista de Verificación del Análisis del Estilo de Enseñanza y IFITS) que se basan en la clasificación de EE de Mosston fechadas en 1981. Este primer estudio divide el continuo en ocho EE; cinco EE DE RM (A-E) y tres EE de PM (F-H) (Mosston, 1981). Por otro lado, también hay dos instrumentos (IITLB e Inventario de Estilos de Enseñanza Relevantes) que se basan en la última clasificación de Mosston y Ashworth desarrollada en el año 2002 (Mosston & Ashworth, 2002). El espectro de los EE se divide en once: cinco EE de RM (A-E) y seis EE de PM (F-K). Tanto el IITLB como el Inventario de Estilos de Enseñanza Relevantes excluyen un estilo de auto-enseñanza (correspondería al estilo K) ya que se considera fuera del contexto escolar. Además, hay estudios centrados en el espectro de Muska Mosston (Mosston, 1966a, 1972, 1981; Mosston & Ashworth, 2002) que no utilizan ninguna herramienta de evaluación (Goldberger, 1980; Goudas, 1995; Morgan, 2005; Patinanoglou, 2008; Whipp et al., 2015; Zeng, 2009), además de que existen varios estudios de investigación (Jaakkola, 2011; Spittle, 2012) que emplearon el instrumento de

Conthran y Kulinna para evaluar la percepción de los EE en el EF (Cothran & Ward, 2000; Kulinna, 2003).

Centrándose en el segundo objetivo de este estudio, hubo siete herramientas de evaluación de comportamiento en relación con las variables que pueden ser contempladas con un EE identificado (FIAS, CAFIAS, OSCD-PE, ALT-PE, PETAI, QMTPS y FTT). Estos instrumentos se han utilizado en diferentes estudios de investigación para determinar los comportamientos específicos de docentes que pueden estar asociados con el éxito de los estudiantes. Algunos estudios compararon los efectos de habilidad motora asociados con diferentes EE utilizados(Byra, Sanchez & Wallhead, 2013; Creasy et al., 2012; P. Iserbyt, Elen, & Behets, 2010; Iserbyt, Madou, Vergauwen, & Behets, 2011; Jenkins, 2002; Munusturlar, 2014; Tipps, 1988; Whipp et al., 2015). El EE más utilizado en estos estudios es el *"peer-tutoring"* (enseñanza recíproca) (Fernandez-Vivo, 2002; Iserbyt, Madou, Vergauwen, & Behets, 2011; Jenkins, 2002; Webster, 1984; Whipp et al., 2015; Whipp, Jackson, Dimmock, & Soh, 2015). Se encontraron un total de 92 estudios y 62 de estas herramientas de evaluación de comportamiento se utilizaron en estudios de investigación de EE.UU., mientras que los otros estudios se desarrollaron como sigue: 19 en Europa, 5 en Canadá, 4 en Australia, 1 en Corea y 1 en Turquía. El 40% de estos estudios se publicaron entre 1965 y 1989, el 27% desde 1990 hasta 1999 y el 33% desde el año 2000. El instrumento más utilizado parece ser el ALT-PE, empleado en 36 estudios entre 1979 y 2015. ALT-PE fue seguido en uso por el QMTPS que fue utilizado en 21 estudios de investigación entre 1989 y 2014. A continuación el PETAI se utilizó 11 veces entre 1999 y 2009. OSCD-PE fue utilizado en 10 estudios entre 1983 y 2014, mientras que CAFIAS se utilizó en 9 estudios entre 1976 y 1997, FIAS fue utilizado en 4 ocasiones entre 1971 a 1989 y FTT una sola vez en 2013. Los estudios CAFIAS, ALT-PE y QMTPS se publicaron entre 1990 y 1997 (Cheffers, 1990; Gusthart, Kelly, & Rink, 1997; Silverman, Devillier, & Ramírez, 1991). Los estudios CAFIAS, QMTPS y ALT-PE se utilizaron en EE.UU.

IV. Conclusiones

Existen diferentes herramientas pedagógicas para evaluar los EE en EF. La revisión de la literatura sugiere que muchos de estos instrumentos se basan en el enfoque clásico propuesto por Mosston (Mosston, 1966a) y reformulado durante la década de los años ochenta (Mosston, & Ashworth, 1986),

cuando se postuló una mayor amplitud para clasificar los EE. También se observa que la mayoría de los estudios se han centrado en el proceso de enseñanza-aprendizaje enfocado a la eficacia de las habilidades deportivas, y se han encontrado un menor número estudios que aborden la relación entre los EE y su posible influencia en los estilos de vida saludables. Los profesores pueden querer usar una variedad de diferentes métodos de enseñanza que se correlacione con las demandas de sus estudiantes y del plan de estudios correspondiente en cada caso. También se encontraron varios estudios, que aunque se centraban en diferentes aspectos de la enseñanza (procesos de aprendizaje tales como percepciones, experiencias y comportamientos) fueron ampliamente citados en la literatura internacional.

Aunque los determinantes de éxito de la alta calidad de la enseñanza en EF y el deporte no se han definido claramente, es una preocupación relevante para los profesores de EF. Quedan varias preguntas sin responder sobre el mejor EE que promueva estilos de vida saludables entre los niños. En el proceso de revisión no se encontraron estudios que abordaran la relación entre el EE y los hábitos de AF saludables relacionados con los patrones totales diarios de AF, la CC y la CF. Si los profesores quieren promover estilos de vida saludables entre los jóvenes, es esencial diseñar intervenciones eficaces de enseñanza-aprendizaje en esta línea.

Capítulo 2

I. Método

I.1. Muestra

En el primer instituto de enseñanza secundaria, un total de 138 estudiantes aceptaron participar en el estudio (chicos=74 y chicas=64). En el segundo instituto de enseñanza secundaria, un total de 38 estudiantes fueron seleccionados como grupo de control (chicos=20 y chicas=18). Se obtuvieron datos completos de acelerómetros (ACL) de 91 adolescentes (chicos=46 y chicas=45). Los estudiantes aceptaron llevar el ACL para registrar una semana completa de su FA diaria total al inicio del año académico (IC) y otra semana al final del año académico (FC). Después de analizar los datos de los ACLs, el índice de deserción fue de un 29,26% en el grupo de intervención y de un 13,16%. en el grupo control.

I.2. Estilo de enseñanza

Cuatro grupos de clases de EF fueron aleatorizados para recibir una enseñanza durante dos cursos académicos de acuerdo con dos estrategias diferentes de enseñanza-aprendizaje: RM y PM, siguiendo el clásico MASTS (Mosston & Ashworth, 2002). Un total de 72 lecciones fueron grabadas durante el primer año y 48 lecciones durante el segundo año. Las lecciones de ambos métodos de EE fueron codificadas con la descripción del Inventario de Estilos de Enseñanza Relevantes de Ashworth (Ashworth, 2010, 2004). Esta herramienta de evaluación se basó en MASTS (Mosston & Ashworth, 2002) y se emplea para verificar la fidelidad de los EE que se imparten en clases de EF. Esta herramienta de evaluación se perfeccionó y refinó en 2007 (Ashworth, 2007; SueSee, & Edwards, 2009; SueSee, Ashworth, & Edwards, 2006). Además, dicha herramienta fue validada con mayor profundidad en Australia (SueSee & Edward, 2009). Los contenidos y el docente en las clases de EF fueron los mismos para todos los estudiantes en el grupo de intervención. El grupo control utilizó el mismo contenido que el grupo de intervención pero el profesor fue diferente. Ocho clases del grupo control fueron grabadas y también codificadas con la descripción del Inventario de Estilos de Enseñanza Relevantes.

Dos observadores experimentados vieron dos clases para cada EE (RM y PM) y para cada una de las seis unidades a lo largo de los cuatro contenidos principales. La fiabilidad entre evaluadores se calculó en todas las clases utilizando la siguiente fórmula*: [(acuerdos / (acuerdos + convenios)) · 100]* (Van der Mars, 1989). El acuerdo entre los dos expertos en general fue del 87,5%. Estas cifras corresponden a las recomendaciones de los investigadores, que consideraron una puntuación de acuerdo del 80% o superior para proporcionar una fiabilidad adecuada (Rushall, 1977; Van der Mars, 1989).

I.3. Composición corporal

La altura y el peso se midieron en escala (precisión = 0,1 kg) y estadiómetro (precisión = 0,1 cm), respectivamente. El IMC se calculó como: *peso / talla^2 (kg/m^2);* se emplearon los puntos de corte internacionales para calcular el Z-score por edades y por género según lo sugerido por la Organización Mundial de la Salud para comparar el IMC entre todas las edades durante la adolescencia (OMS, 2010). La antropometría se utilizó para estimar la composición corporal a partir de mediciones de los pliegues cutáneos como describe Alvero-Cruz (Alvero-Cruz, 2014). El porcentaje de masa grasa (%MG) se

calculó según las ecuaciones de Slaughter (Slaughter, 1988), y la MLG se obtuvo por el modelo de dos componentes [*MLG = Peso - (% MG · Peso)]*. Se aplicaron modelos específicos para cada edad validados para obtener la MME en base a las variables antropométricas de Poortmans (Poortmans, 2005) y a las de Lee (Lee, 2000).

1.4. Evaluación de la actividad física

Una semana de actividad física diaria total se registró utilizando ACL (Actigraph GT3X) al IC y otra semana en el FC. Se colocaron los ACLs alrededor de la cintura de los participantes con un cinturón elástico. Los participantes llevaban un cinturón con cierre automático de pestaña para fijar el ACL alrededor de la cintura en el lado derecho del cuerpo. Solo se quitaron los ACLs para dormir, ducharse y realizar actividades relacionadas con la natación. Se eliminan del estudio los días con información incompleta. Los criterios de inclusión para considerar un día completo indican que deben existir ≥ 10 horas de tiempo de uso para los días de semana y ≥ 8 horas para los días de fin de semana (Yildirim, 2011). Sólo los participantes con ≥ 4 días completos durante la semana y un día completo del fin de semana se incluyeron en el estudio (Holman, 2011). Se tomó la decisión de considerar el ACL como no colocado si hay un período de 60 minutos de ceros consecutivos, permitiendo 2 minutos de interrupciones distinto a cero, que se encuentren en cualquier parte de la matriz de datos. Se calcularon las diferencias entre IC y FC para los patrones de AF y cantidad de AF total diaria. El análisis de medidas repetidas se llevó a cabo con el fin de comparar las diferencias entre grupos y el efecto del tiempo. Se asumió un error de tipo I por debajo de 0,05 para rechazar la hipótesis nula.

I.5. Condición Física

Evaluación de la fuerza en miembros superiores. La fuerza medida tanto en la PRFMD como en la PRFMI se obtiene utilizando un dinamómetro digital de agarre manual (T.K.K.5401, Takei, Japan), el cual registra la lectura máxima realizada en kg. Después de la adaptación de la empuñadura para cada sujeto, el participante se coloca de pie con el codo extendido a lo largo del cuerpo sin tocar el tronco o el muslo con la extremidad superior o con el dinamómetro. Cuando se le indica, el participante apretará el dinamómetro tan fuerte como le sea posible durante 5 segundos. Se permitieron dos ensayos con un

período de descanso de 3 minutos entre los mismos y como resultado se anotó la medida mayor (máxima).

Evaluación de la fuerza en miembros inferiores. La FMI isométrica se midió con un dinamómetro isométrico de espalda-pierna (TKK-5002, Psymtec). Los participantes tiraron del dinamómetro para comprimir un resorte de acero con la fuerza aplicada por sus piernas y espalda. Un protocolo similar, el que se utilizó para las extremidades superiores, se siguio también en esta valoración. El mejor de los intentos fue el registrado para usarlo en el análisis estadístico.

Capacidad cardiorrespiratoria. El VO_2 Max fue el indicador de la aptitud cardiorrespiratoria en este estudio. El VO_2 Max se midió mediante la técnica de calorimetría indirecta usando una unidad metabólica portátil "respiración-a -respiración" (breath-by-breath), desarrollada por Metamax 3B (Cortex Biophysic, Leipzig, Germany), mientras se realiza una prueba máxima en un banco (prueba de paso de Chester). Los datos de calorimetría indirecta se recopilaron mediante Metasoft v. 11/1/05 software (Cortex Biophysic, Leipzig, Germany). Además, el ritmo cardíaco durante la prueba se monitorizó y registró cada minuto mediante pulsómetro (Polar, Finlandia). Cuando una medición directa no era posible, se utilizaba una estimación utilizando un enfoque de regresión lineal en estado estacionario (ACSM, 2013). En resumen, se utilizaron al menos dos etapas de la prueba de banco para estimar las constantes de intersección y de pendiente en la relación entre la frecuencia cardiaca (variable independiente, eje X) y VO_2 Max estimado para una carga constante (variable dependiente, eje Y).

La Prueba del Paso de Chester es un test progresivo de cinco niveles, que fue validado previamente (Skyes et al. 2004). Consiste en subir y bajar de un banco (de altura entre 32 y 52 cm) a un ritmo marcado por una señal sonora, y que aumenta progresivamente su velocidad hasta cinco niveles. Todos los adolescentes ejecutan anteriormente una prueba con el fin de ajustar la altura del banco apropiada y acostumbrarlos al equipo, al protocolo y a los procedimientos. La tasa de ritmo inicial de la Prueba de Chester es de 60 pulsaciones por minuto (15 ciclos completos de subida y bajada) y aumenta el ritmo cada 2 minutos en 5 ciclos por minuto (20, 25, 30, 35 pulsaciones) hasta el final del quinto nivel. Por lo tanto, el tiempo total de la prueba es 10 min. La tasa de subida-bajada (un paso o "step") era establecida por un archivo mp3 que contiene la grabación de un metrónomo y era reproducida con un ordenador portátil HP. Los investigadores proporcionaron la pauta y una información de

retroalimentación más detallada de acuerdo con el desempeño de la actividad física por el alumno durante la prueba. Se animó a los sujetos a acabar la prueba por completo. La misma se dio por concluida bien cuando lo solicitó el participante (a causa de la disnea y/o fatiga de las piernas) o cuando el supervisor observaba que el participante era incapaz de mantener la cadencia de ritmo durante 15 segundos (De Camargo et al., 2011) .

I.6. Análisis de los datos

Los datos muestran cómo la media y la desviación estándar se distribuyen normalmente a menos que se indique lo contrario. Se llevó a cabo un análisis de medidas repetidas con el fin de comparar la AF, la CC y las diferencias de condición física entre PM y RM (efecto de grupo) , entre el IC y el FC (efecto tiempo) y las diferencias de grupo por tiempo de interacción . Se utilizó como covariable la edad, y el género se incluyó como factor independiente en el modelo. La tasa de deserción se calculó como*: [((n FC- n IC) / n FC) x 100]*.

Un análisis de intención de tratamiento (TTI) se llevó a cabo con el fin de descartar un sesgo de participación relacionados con las características físicas. Así que la edad, el peso y el IMC Z-score se compararon entre participantes y no participantes. Las proporciones de género y de nivel académico entre los participantes y no participantes se valoraron mediante el análisis de Chi–cuadrado.

En base a los anteriores estudios con adolescentes de la misma región, se calculó (considerando un poder estadístico del 80% , un error de tipo I del 5% y una diferencia entre los grupos de 5 minutos para AFMV y de 10 minutos para TS) que se necesita un tamaño de muestra mínimo de 36 y 32 participantes respectivamente, lo cual está por debajo del número de participantes incluidos en este estudio.

Todos los tratamientos estadísticos se realizaron utilizando un software de paquete estadístico (SPSS). Una Significancia Estadística (P) de $P<0,05$ fue aceptada de rechazar la hipótesis nula en todos los análisis.

II. Resultados

El TTI mostró que no existían diferencias estadísticas entre los que no responden (NR) y los que responden (R) en el estudio para las características principales de la muestra de referencia. Sin embargo, el porcentaje femenino del grupo RM tenía una mayor proporción de estudiantes que NR (Chi-cuadrado=6,804) .

II.1. Actividad física

La muestra analizada incluía un 54,17% de la muestra de 168 participantes que cumplían los criterios y llevaron ACLs. En el nivel invariable hubo diferencias significativas en cuanto a la AFL (P = 0,000) y a la AFM (p = 0,039) se refiere, en relación con la variable tiempo. También hubo diferencias significativas en el AFV (P=0,037) en relación con el tiempo y el EE.

En cuanto a los patrones de EF relacionados con tres diferentes contenidos hay diferencias significativas entre la Educación Física y Salud (EFS) y la Expresión Corporal (EC) en TS (P=0,019), AFL (P=0,002), AFM (P=0,011), AFMV (P=0,038) y los pasos (P=0,005). Más diferencias significativas fueron halladas entre los Juegos y Deportes (JD) y la EC (P=0,038), así como entre EFS y JD (P=0,000).

II.2. Composición corporal

Tanto en CC como en CF la muestra analizada incluía 96,61% de la muestra de 176 participantes que cumplían los criterios. La muestra analizada de las diferencias en las variables en CC por género después de un período de intervención de un año académico con diferentes EE incluyeron un 73,44% de la muestra de 176 participantes posibles. Hubo diferencias significativas en la MLG (P=0,002), la MME (P=0,000), el PC (P=0,026) y el IMME (P=0,011) en relación con la variable temporal.

II.3. Aptitud física

Se dieron diferencias significativas en el level invariante en cuanto a la PRFMD (P=0,000), la PRFMI (P = 0,000) y la FMI (P=0,000), en relación con la variable tiempo. También fueron significativas las diferencia entre el tiempo y el EE en la FMI (P=0,000). Por último, se encontraron diferencias significativas entre el tiempo y el género en la PRFMD (P=0,009) y en la DMI (P=0,64).

III. Discusión

III.1. Actividad Física

Existen diferencias significativas en el nivel del análisis estadístico univariado en cuanto a AF (P<0,01) y en AFM (P<0,05) en relación con la variable tiempo y también hubo diferencias significativas en la AFV (P<0,05) en relación con el tiempo y el EE. Se encontraron diferencias significativas en la media (P=0,042) entre RM (19,98±11,57 vs. 18,77±12,53) y MM (30,44±15,09 vs. 21,83±10,79) para AFV. Existen diferencias significativas en la media (P=0,009) entre RM (49,5 ±19,26 vs. 47,46±19,19) y MM (63,83±19,63 vs. 58,34±34,05) para AFMV. También fueron significativas las diferencias en la media (P=0,033) entre RM (7936,15±2145,44 vs 7929,68±2590,49) y MM (7929,68±2590,48 vs 9477,65±3112,31) en el número de pasos diarios contabilizados.

III.2. Composición corporal

Existen diferencias significativas en el análisis estadístico univariado de la MLG (P<0,01), la MME (P<0,01), el PC (P<0,05) y el IMME (P<0,05) en relación con la variable tiempo. Sin embargo no se encontraron diferencias significativas en relación con el tiempo y EE, pero los valores estuvieron cerca de ser significativos en la MG (P=0,055), la MLG (P=0,054), el PC (P=0,060) y el IMG (P=0.075). También se hallaron diferencias significativas en la media (P=0,015) entre la RM (25,86±11,66 vs. 24,95±10,41) y el MM (18,89±6,15 vs 20,24±7,83) para la MG. Por último, hubo diferencias significativas en la media (P=0,007) entre la RM (43,83±8,71 vs. 45,62±10,30) y el MM (49.49±8.49 vs 49.87±8.31) para la MLG.

III.3. Condición física

Existen diferencias significativas en el análisis estadístico univariado en la PRFMD (P<0,01), la PRFMI (P<0,01) y la FMI (P<0,01) en relación con la variable tiempo. Hubo diferencias significativas en relación con el tiempo y el EE en la FMI (P<0,01). De nuevo, diferencias significativas fueron detectadas entre el tiempo y el género en la PRFMD (P<0,05) y en la PRFMI (P<0,005). En la media hubo diferencias significativas (P=0,005) que se encontraron entre la RM (27,04±8,51 vs 29,48±9,71) y el MM (32,38±9,16 vs 34,12±9,58) para la PRFMD y también se hallaron diferencias significativas (P=0,002)

entre la RM (29,92±8,63 vs. 25,47±7,88) y el MM (35.83± 5.08 vs 38.08±4.78) para la FMI. Diferencias significativas fueron halladas en la media (P=0,042) entre la RM (86,92±25,22 vs. 87,50±20,02) y el MM (106,65±19,39 vs. 95,41±16,92) para FMI. Finalmente, hubo diferencias significativas en la media (P=0,003) entre la RM (31.21±8.26 vs 31.87±9.38) y el MM (38,63±6,55 vs. 36,37±11,51) en cuanto al VO_2 Max.

IV. CONCLUSIONES

El principal hallazgo de este estudio fue que los EE PM y RM utilizados en diferentes clases de EF durante el año académico no promovieron una diferencia significativa en los patrones diarios de AF. Sin embargo, el grupo PM destaca por el aumento en la cantidad total de AF diaria (AFL, AFM, AFV, AFMV y pasos) a lo largo del tiempo, mientras que el grupo RM se mantuvo bastante estable a excepción de un pequeño aumento en la AFL. Se encontraron diferencias significativas en la media entre los EE de la RM y el MM en AFV, AFMV y número de pasos por día. La conclusión de nuestros resultados sobre el aumento en los patrones totales de AF diaria al utilizar el EE de PM, aunque no se haya encontrado una diferencia significativa respecto a los otros EE, es una cuestión que debería ser investigada con más estudios longitudinales, utilizando muestras más grandes y diferentes centros educativos.

En cuanto a las variables de CC no hubo diferencias significativas en relación con el EE, pero hubo diferencias significativas en la MLG, la MME, el PC y el IMME en relación con la variable temporal. Esto puede deberse al efecto de la maduración que puede tener influencia en la CC. Se encontraron diferencias significativas en la media entre RM y MM en la MG con valores superiores en RM y en la MLG con valores más altos en MM pero con una evolución diferente de ambos grupos.

Considerando la CF hubo diferencias significativas encontradas entre la PRFMD, la PRFMI y la FMI en relación con la variable tiempo. Podría ser explicado nuevamente por el efecto de la maduración, el cual puede tener influencia en la CF. Hubo diferencias significativas en relación con el tiempo y el EE en la FMI: disminuyó notablemente en los tres grupos por lo que se ha considerado como una posible causa que el instrumento de evaluación no fue adecuado. Cabe destacar que se encontraron diferencias significativas entre el tiempo y el género en la PRFMD y la PRFMI, y finalmente se detectaron

nuevamente diferencias significativas en la media entre RM y MM de la PRFMD, la PRFMI y la FMI.

Para terminar, en relación con los contenidos escolares, resultaron significativas las diferencias en todos los patrones de AF entre EC y EFS, a excepción de la AFV. Es más, se encontraron diferencias entre la EC y los JD en AFM, así como entre EFS y JD en AFL.