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Impact of the ludotechnical model on motivational variables in elementary school: perceptions and gender differences

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Laura Kluge fighting for the puck in the match between Germany and Hungary during the Eishockey Deutschland Cup, in Landshut, Germany, on November 9, 2024
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Abstract

The aims of the present study were: 1) to analyse the effects of the ludotechnical model (LTM) on the students' perceived interpersonal style of autonomy support teaching (SAS), performance in athletics events, fun and intention to continue practicing athletics and gender differences, and 2) to know the teacher's and students' perception of this methodology after the intervention. A quasi-experimental design was applied to a sample of 59 students (30 girls and 29 boys) with a mean age of 11-13 years. The results showed significant differences in favour of boys in the LTM group (M = 3.78) compared to the traditional methodology (M = 4.19) at the end of the intervention on the SAS (p = .0020). In terms of athletic test performance, significant improvements were obtained over time in both groups in the 10 x 10 m sprint and javelin throw tests. Specifically, the LTM group showed improvements in the 10 x 10 m test for boys (M pretest = 32.25 and M posttest = 31.44; p = .005) and girls (M pretest 33.78 and M posttest 33.07; p = .019) and for boys in the javelin throw (M pretest = 9.22 and M posttest = 10.27; p = .027). For the traditional group, the significant improvements in the 10 x 10 m sprint test were for girls (M pretest 34.43 and M posttest 33.33; p < .001) and in the javelin throw for girls as well (mean pretest 6.88 and mean posttest 8.18; p = .007). In the traditional group, significant improvements were obtained in the triple jump for girls (pretest mean = 3.85 and posttest mean = 4.10; p = .017). Both the teacher and the students perceived the LTM as more motivating for the young people; however, these results could not be supported by the questionnaire on fun and intention for future athletics practice. The use of LTM in the initiation of athletics in physical education is suggested, since students acquire motor skills in the same way as with traditional methodologies, but both students and teachers prefer LTM because of its greater support for autonomy and its potential positive physical and psychosocial consequences, although further and longer studies are needed to contrast these ideas and the possible differences according to gender.

Keywords: individual sport, interpersonal style, motivation, pedagogical models, physical education.

Introduction

A decrease in physical activity in children and adolescents leads to negative physical, cognitive and psychosocial consequences (Guthold et al., 2020; Tapia-Serrano et al., 2022), and the main reasons for sport dropout are lack of fun and a feeling of low motor competence (Crane & Temple, 2015).

Physical education has great potential for the acquisition of a wide range of goals, values and competences, and contributes to the physical, cognitive, affective and social development (Bayley et al., 2009; Kirk, 2013), with sport content being of particular relevance in this subject. However, this potential is undermined if the orientation of sport is not educational and is more performance or competition oriented. For this reason, different forms of sports teaching are proposed, in order to maximise the positive results that can be provided to students (Guijaro & González-Víllora, 2023).

Following these ideas, authors such as Haerens et al. (2011) approach the term "pedagogical models" with the idea of providing relevant, interesting and enjoyable activities that help to promote an active and healthy lifestyle. Pedagogical models are theoretical structures for teachers to develop practical teaching units in order to provide a comprehensive and coherent teaching plan for the achievement of specific learning objectives in relation to a specific context and content (Fernández-Río et al., 2021).

In the educational context, physical education teachers are using teaching models such as comprehensive teaching and sports education for the teaching of collective sports (Fernández-Río & Iglesias, 2024). These methodologies make it possible to achieve higher levels of self-determined motivation and increased satisfaction, as well as a wide range of positive consequences such as fun, learning, intention to be physically active, etc. (Merino-Barrero et al., 2020; Pérez-González et al., 2019; Vasconcellos et al., 2020) thanks to a structured session plan and methodological strategies systematised over a medium- and long-term implementation (Fernández-Río & Iglesias, 2024).

In individual sports such as athletics, teachers who continue to adopt a traditional methodology (TM) tend to perfect technique through repetition of technical gestures during childhood (Calderón et al., 2014), which leads to boredom among children (Murrie, 1997) and a way of teaching based on direct instruction with little support for autonomy (Metzler, 2017).

In response to this approach, new proposals have emerged for the teaching of athletics, such as the ludotechnical model (LTM) (Valero-Valenzuela & Conde-Caveda, 2003), which uses modified forms of play and games that include rules that allow them to acquire athletic technique (Valero-Valenzuela et al., 2019). Previous research has shown evidence of benefits in technique and performance (Valero-Valenzuela et al., 2012), higher intrinsic motivation values (Valero-Valenzuela et al., 2009) and increased fun (Sánchez-Morales et al., 2016).

In terms of gender, research has revealed differences in perceptions and beliefs held, with boys more likely to hold beliefs of greater ability and success, while girls tend to feel more competent and interested in tasks traditionally perceived as feminine such as dancing and gymnastics (Lee et al., 1999; Shen et al., 2003). However, Xiang et al. (2006) showed that racing content, which is not as stereotyped as football or dance, did not reveal gender differences. For men, fun is the main variable predicting task orientation, as it is for women, although effort is another relevant variable for the latter (Abraldes et al., 2013). On the other hand, authors such as Sánchez-Hernández et al. (2018; 2022) focus more on how the content is presented and the way it is taught than on the content itself, with the aim of approaching PE from a gender perspective and making gender stereotypes visible, due to the strong presence of performance discourse and androcentrism in PE sessions.

The main objectives of this study were: 1) to find out the effects of LTM versus TM on students' perception of the teacher's autonomy-supportive style, fun, intention to be physically active and performance in the different events of the "Playing athletics" competition, as well as by gender, and 2) to find out the teacher's and students' perception of LTM as a new methodology for initiation into athletics.

Methodology

Research design

This is a quasi-experimental (Thyer, 2012) repeated-measures study with a mixed-method research approach based on a predominantly quantitative integrated design (Castañer Balcells et al., 2013).

Participants

The study population consisted of schoolchildren from a public primary school located in the rural area of the province of Zaragoza, Spain. The teacher who took part in the study taught Physical Education in 4 groups (2 in 5th and 2 in 6th grade). He was a 41-year-old permanent staff member with more than 14 years of teaching experience. He had previously used other active methodologies. The sample of students was selected on the basis of accessibility and convenience, and finally consisted of a total of 59 students (30 girls and 29 boys) aged between 11 and 13 years. Of these participants, 29 were in the traditional group (13 boys and 16 girls) and 30 in the experimental group (16 boys and 14 girls). The teacher randomly assigned which was the experimental group and which was the control group.

Measurements and instruments

Fidelity of implementation

(1) Checklist for assessing the implementation of the LTM. To analyse whether the LTM sessions were reproduced as per the established model, a checklist was used where the items to be assessed were based on the strategies that LTM has throughout a session (Valero-Valenzuela et al., 2012). Subsequently, an outsider familiarised with the use of the LTM was trained in the use of the checklist. This person then analysed two randomly selected sessions (one from the TM and one from the LTM) and these same sessions were analysed again. The quality of the recording was assessed by calculating intra-observer reliability concordance using Cohen's kappa coefficient (Cohen, 1960). A value of .813 was obtained for the traditional session and .852 for the LTM session.

Technical skills

Several of the physical tests from the "Playing athletics" battery were used to assess the different motor skills of the students.

- *10 x 10 m race*: timed race over a distance of 10 m, to be run 10 times. The distance was delimited by cones that had to be circled from behind to turn around. Time was measured in seconds.

- *Soft javelin throw*: from a standing position, without previous run. Two attempts where only the best scored. It was not considered invalid if one foot went over the line after throwing. Distance was measured in metres.

- *Triple jump from a standing position*: behind the starting line and with the feet parallel, three consecutive jumps were performed, alternately landing on each foot without interruption and landing mandatorily on both feet. Distance was measured in metres.

- *Forward medicine ball throw*: with a 2 kg ball, overhead forward throw, standing upright. Two attempts where only the best scored. Distance was measured in metres.

- *Lateral jumping with a low obstacle*: continuous jumps with feet together on either side of a foam rubber or cardboard obstacle (approximately 20 cm high) were performed in 20 seconds, with both feet necessarily having to pass over the obstacle in all jumps. Each participant made one attempt. The number of jumps made was recorded.

Psychosocial variables

A questionnaire was used to assess different psychosocial variables. Different scales were provided in the presence of the principal researcher and the PE teacher in the computer room, in a calm atmosphere and lasting between 20 and 35 minutes.

(1) Scale of Autonomy Support (SAS) in Physical Education: instrument validated by Moreno-Murcia et al. (2020). It consists of 11 items that participants have to answer about the teacher's or trainer's style in the classroom (e.g., "With his/her explanations, he/she helps us to understand what the activities we do are for"). This is expressed on a Likert scale from 1 (Strongly disagree) to 5 (Strongly agree). The scale showed the following internal consistency values: $\alpha = .85$ pretest and $\alpha = .78$ posttest.

(2) Fun: the 8-item athletics fun questionnaire validated by Valero-Valenzuela et al. (2004) was included. This is expressed on a Likert scale from 1 (Very much) to 4 (Not at all), e.g. "I usually have fun when I do athletics". The scale showed the following internal consistency values: $\alpha = .80$ pretest and $\alpha = .82$ posttest.

(3) Intention to be Physically Active (IPA): the Spanish validated version of the 5-item questionnaire by Arias et al. (2013) was included. This is expressed on a Likert scale from 1 (Strongly disagree) to 7 (Strongly agree) preceded by the sentence: "Regarding your intention to practice any physical-sports activity...". The internal consistency for Cronbach's alpha was .77 at pretest and .73 at posttest.

Participants' perceptions

Semistructured interviews were used to assess participants' (students' and teacher's) perceptions of the intervention programme.

(1) Semistructured interviews with students. The tutors in each group interviewed their students ($n = 13$) in their reference classroom, lasting around 10-15 minutes. The interview questions covered different topics: (a) opinion on

the development of the sessions (e.g. How did you enjoy the sessions? How would you describe them?); (b) improvement in the "Playing athletics" competition (e.g. Do you think the sessions have helped you improve in "Playing athletics"?); and (c) lessons learnt (e.g. What did you learn about the phases of the tests?).

(2) Semistructured teacher interview. Once the study was completed, a member of the research team met with the teacher to get his impressions of the students' evolution throughout the implementation of the LTM, both in physical and psychosocial variables. The interview lasted approximately 45 minutes. The questions were structured in different sections: a) impact of the intervention on physical and psychosocial variables (e.g. Do you think there have been changes in the marks obtained and in the psychosocial variables after the sessions applied to one group and the other?); b) comparison between the traditional and the ludotechnical group (e.g. Do you think there were differences between the group that followed a traditional methodology and the group that followed the LTM?); c) training and support during the intervention (e.g. Did you feel the need for any support or feedback about whether you were implementing the LTM correctly?); d) duration of the intervention (e.g., Do you think that 5 sessions were enough to see changes between the LTM and the traditional one in the variables under study?); e) weaknesses and difficulties in the implementation (e.g., What weaknesses or difficulties did you find during the intervention?); and f) proposals for improvement and future-oriented proposals (e.g., What would you change in this study? Would you implement the LTM in the future? Why?).

Procedure

The study was approved by the Ethics Committee of the University of Murcia (code 4325/2022). The teacher conducted one session for the traditional group and another one for the ludotechnical group. Both sessions were filmed and analysed through observational analysis, evaluating the implementation of the pedagogical model and complementing it with the interpretation of the teacher's and students' perception at the end of the intervention through semistructured interviews. Informed consent was requested from the families after explaining the study to be carried out and a message was sent via Tockapp explaining how the recorded images would be used.

Data collection

The data collection process was carried out at different points during the intervention. Prior to the intervention, one session was devoted to carry out the pretest, consisting of the physical tests, followed by the administration of the questionnaires. The physical tests were carried out by all the students in the same order in which the "Playing athletics" tests would be carried out later, i.e. 10 x 10 metre run, javelin throw, triple jump and side jumping, medicine ball throw, obstacle course and Grand Prix. The students had previous experience with this type of tests, as it is an activity that 4th, 5th and 6th grade students do every year, but there was no attempt prior to the data collection. Once completed, the students, during the tutoring hour, filled in the questionnaires online in the computer room. In the posttest, the same physical tests and questionnaires were repeated, with the addition of the teacher and student interviews. In the case of the students, the interviews were conducted by their respective tutors during break time and lasted approximately 10 minutes. As for the teacher, the interview was conducted online by one of the researchers of this study, once the intervention and the posttest data collection had been completed.

Intervention programme

TM and LTM were implemented during 5 sessions of 50 minutes. In each session, priority was given to one test of the "Playing athletics" competition in this order: 10 x 10 metres race, javelin throw, triple jump and side jumping, medicine ball throw and, finally, the obstacle course and Grand Prix. The contents of this section are related to block A, dimension 1 according to the primary curriculum in Aragon (Order ECD/1112/2022, of 18 July).

As for the ludotechnical group sessions, they had the characteristics of LTM (Valero-Valenzuela, 2007; Valero-Valenzuela & Conde-Caveda, 2003), i.e., the session was divided into 4 parts: 1- Challenge question; 2- Ludotechnical proposals; 3- Overall proposal; 4- Debriefing. In the debriefing, the challenge question was answered; then the technical actions that made up the gesture and the key elements learned were recalled. Table 1 specifies the content and technical actions, as well as the challenge question. Furthermore, for this table, an equivalent exercise between the LTM session and the TM has been chosen.

The traditional group sessions were structured as follows: (a) a warm-up phase; (b) a main part characterised by a direct command and task assignment teaching style; and (c) a cooldown phase (Valero-Valenzuela, 2006). This approach promoted high teacher control of the session and low student autonomy, limiting their cognitive involvement (Metzler, 2017). Analytical exercises aimed at improving performance technique and a final competition situation were used (Valero-Valenzuela, 2006).

Table 1
Description of the sessions implemented in the experimental group.

		Ludotechnical model				Traditional methodology		
		Example of an activity				Example of an activity		
Session	Content and phases	Challenge question	Ludotechnical proposal	Overall proposal	Sharing	Warm-up	Main part	Cooldown
1	Triple jump and lateral jumping - Technical action 1: Take-off: assume a tandem position. - Technical action 2: Flight: the body tucks in, aiming to form a C shape. - Technical action 3: Landing: initial contact with both feet at the same height.	What are the movements of a jumper in the air used for? Which part of the foot is used during the take-off?	Log jumping: the first player will lie down. The second jumps with one leg over him/her and lies down. The third player jumps over the first and second players and lies down, and so on.	Triple jump competition.	To balance oneself. With the entire sole.	Joint mobility + game (crossing the river).	Jumping between markers at different distances. Stairs.	Stretching and reflection.
2	Javelin throw - Technical action 1: Starting position: javelin parallel to the ground and supporting leg in front and the same of the throwing hand behind. - Technical action 2: Final throwing action: extension of the throwing arm and advancement of the leg of the throwing arm, with both feet on the ground. - Technical action 3: Recovery: throwing leg comes forward to stop the body's forward movement.	Is the throw performed with one or two feet on the ground, or with feet in the air?	Clay target: In pairs. A player standing behind a line in a throwing position shouts "Pull!", at which point his/her team-mate, standing in front of him/her at a given distance, throws upwards a cardboard which must be hit with a ball by the team-mate who is in the throwing position.	Javelin throwing competition trying to make it land on the tip.	The throw is performed with both feet on the ground to anchor the body and transmit all the speed to the javelin. The trunk is flexed to slow down the forward movement of the body and avoid fouling.	Joint mobility + game (cleaning my house).	Placed in the arm preparation phase, throwing with the wrist only, elbow + wrist, shoulder + elbow + wrist.	Stretching and reflection.

Table 1 (Continued)
Description of the sessions implemented in the experimental group.

		Ludotechnical model				Traditional methodology		
		Example of an activity				Example of an activity		
Session	Content and phases	Challenge question	Ludotechnical proposal	Overall proposal	Sharing	Warm-up	Main part	Cooldown
3	Medicine ball - Technical action 1: Starting position: standing with the back turned, the ball close to the ground, knees slightly bent, trunk leaning forward, and arms not fully extended. - Technical action 2: Stretching: the knees are extended and the trunk is lifted, taking advantage of the start of the upright position to move both arms at the same time, using all the energy of the kinetic chain (legs-trunk-arms). - Technical action 3: Final release action: the ball is released when it is at its maximum height. - Technical action 4: Recovery: the thrower will move his arms to regain his/her balance and even tilt his/her trunk forward.	Why do we move our arms at the end of the throw?	Aim... fire! With a foam rubber ball ready above the head, stand upright, throw the ball and try to get it to land in front of your partner, who will stand facing away from you (the throwing distance will be varied).	Throwing competition.	The arm movement is aimed at being able to regain balance.	Joint mobility + game (the triple of champions).	Positioning to throw as high as possible. Contrasts: sitting, kneeling, standing. Forward, chest, backward, twist. Trajectories: descending, ascending, flat, parabolic.	Stretching and reflection.

Table 1 (Continued)
Description of the sessions implemented in the experimental group.

		Ludotechnical model				Traditional methodology		
		Example of an activity				Example of an activity		
Session	Content and phases	Challenge question	Ludotechnical proposal	Overall proposal	Sharing	Warm-up	Main part	Cooldown
4	10 x 10 m - Technical action 1: Starting position: metatarsal contact. - Technical action 2: Propulsion in tandem position. - Technical action 3 Upper body: trunk upright, slightly bent forward, elbows at 90°. - Technical action 4: Coordination: lower and upper body.	Why do long-distance runners step on their heels?	The technical rider: In pairs, one partner will wrap a 3-metre rubber band around his/her partner's waist and stand behind him/her. The partner acting as the 'horse' will perform skipping in front, aided by intensive arm movement and keeping their gaze forward, until the band becomes taut. At that point, the 'rider' will begin faster skipping in front.	10 x 10 competition.	The tension generated in the calf area does not allow this gesture to be prolonged for more than a few minutes.	Joint mobility + game (crazy relays).	Within 5 m (mark with cones): - Start with heels to buttocks and trunk forward. - Take the minimum number of strides. - Changes of direction between cones.	Stretching and reflection.
5	Relays - Technical action 1: Recipient: waits with one leg forward and one leg back, runs at full speed as his/her partner passes by the signal and extends his/her arm on hearing his/her signal. - Technical Action 2: Wearer: Gives the "go" signal at a distance of 2.5 meters. - Technical Action 3: Exchange: Up-down and down-up motions.	Who is responsible for the exchange in the 4 x 100 and 4 x 400 race? Why?	Free delivery. Light jogging around the area (semicircle). Those who carry the baton must pass it to a teammate without a baton in less than 10".	Relay race without obstacles and with a low hurdle.	In the 4 x 400 race, the recipient, due to accumulated wearer fatigue.	Joint mobility + game (the 4 corners).	Baton relay: A participant moves to the end of the line and hands the baton to a teammate from behind.	Stretching and reflection.

Statistical Analysis

The IBM SPSS 28.0 statistical programme was used for the analysis of the variables. Descriptive statistics were obtained for all the dimensions under study and internal consistency was assessed with Cronbach's alpha coefficient. The vast majority of the coefficients exceeded the reliability values of .70 that are considered acceptable for psychological scales, and a few were around .60, also considered acceptable according to Hu and Bentler (1999). To determine the effect of implementation, a repeated-measures multivariate analysis (MANOVA) was carried out on the different variables according to time (pre-post) and group (TM vs. LTM). In addition, gender was taken into account as a variable that could influence participants' responses. A significance level of $p < .05$ was established.

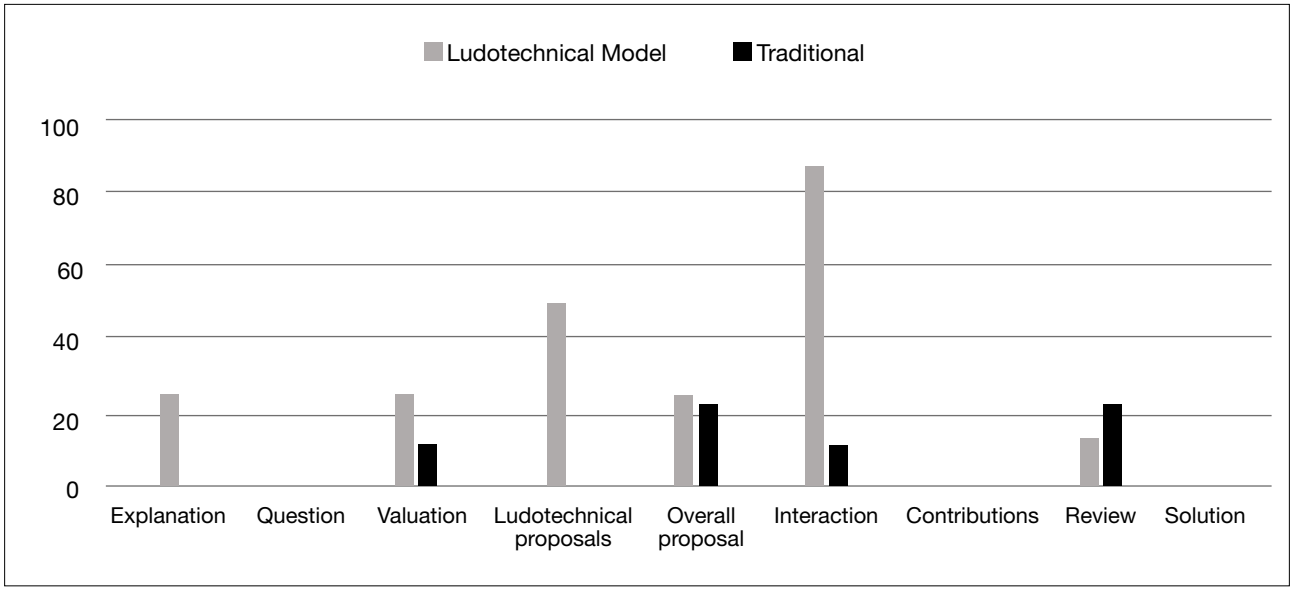
The analysis of the qualitative data was carried out following the stages of thematic analysis proposed by Braun and Clarke (2006), a process that allowed the researchers to explore participants' perceptions of the intervention programme in greater depth. The process was led by the second author and supervised by the fourth one. Before starting the analysis, the interviews, which had previously been audio-recorded, were transcribed verbatim. The analysis process began with the second author immersing himself in the data, reading and re-reading the interview transcripts. This initial familiarisation step allowed the researchers to identify recurring patterns and relevant aspects in the answers. Subsequently, in the initial coding phase, the second author highlighted segments of text that represented key aspects related to the participants' experience. Codes such as "perceived fun", "phased learning" and "motivation" were identified and served as a basis for the creation of broader themes. In the next phase, the search for themes began, grouping the codes into thematic categories that captured the shared experiences of the participants. Emerging themes were reviewed for internal consistency and refined to ensure that they accurately reflected student and teacher perceptions. Finally, these themes were defined and named in an interpretative and reflexive way, seeking an authentic and meaningful representation of the qualitative data, and clear connections were made to the quantitative results of the study.

Results

Fidelity of implementation results

The frequency of occurrence of each item, differentiated by model (LTM vs. TM), is presented in Figure 1. Throughout the 9 items that make up the checklist, the frequencies observed were always higher for the LTM session, except for the item "the technical aspects learnt have been reviewed" (12.5% vs. 22.2%) in favour of the TM. Another item with a very similar score was "At least one overall proposal has been made" (25% for LTM vs. 22.2% for TM). In addition, the lack of frequency of occurrence of the item question, input and solution stands out with 0% in both the ludotechnical and traditional groups.

Figure 1
Frequency of the different strategies specific to the ludotechnical model applied in the traditional and ludotechnical group.



Quantitative results of the inferential analysis

The results show that there are significant differences in the intraparticipant time factor (Wilks' lambda = 0.45, F [7.32] = 8, p = .001) and in the interparticipant gender factor (Wilks' lambda = 0.55, F [4.83] = 8, p = .001). These results were then analysed at the univariate level to see which variables showed significant differences. As for the time factor, the 10 x 10 m race (F = 29.499, p = .001), the javelin throw (F = 13.364, p = .001) and the lateral jumping (F = 5.048, p = .001) were the ones with significant differences. With respect to the time-group interaction, significant differences were only found for the lateral jumping (F = 6.754, p = .012).

Table 2 shows the means and standard deviations of the differences between the pre- and posttest, according to group and gender. Also included are the values of p values obtained by comparing these estimated means (using the Bonferroni correction). Focusing on the significant differences at the gender level, in boys, the group that received LTM obtained better values at the end of the intervention in the javelin throw (p = .027) and in the 10 x 10 m test (p = .005), and worse in the lateral jumping (p = .007). In contrast, the girls' results were different, with more physical variables showing significant differences (race, throw and triple jump) in the TM group compared to the LTM group, where there were only significant improvements in the race (p = .019) and, again, a lower performance in the lateral jumping (p = .040), just as happened with the boys. While assessing the differences between groups (TM vs. LTM), in the javelin throw it was found that the boys started from different values (p = .025) and ended with similar values (p = .146), and in the SAS, after the intervention, the LTM group showed higher values compared to the TM group (p = .02).

Table 2
Pre- and posttest differences by gender and group.

		PRETEST		POSTTEST		Pre- and posttest differences	
		Boys	Girls	Boys	Girls	Boys	Girls
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Value of p	Value of p
10 x 10 (s)	Control	31.86 (3.08)	34.43 (2.86)	31.34 (2.98)	33.33 (3.26)	.097	**.001*** **
	Experimental	32.25 (3.13)	33.78 (3.98)	31.44 (3.12)	33.07 (3.89)	**.005****	**.019***
	Value of p	.752	.595	.940	.832		
Javelin throw (m)	Control	11.54 (2.76)	6.88 (2.01)	1.79 (2.14)	8.18 (2.73)	.622	**.007****
	Experimental	9.22 (3.65)	6.94 (1.83)	10.27 (3.44)	7.87 (2.37)	**.027***	.065
	Value of p	**.025***	.950	.146	.760		
Triple jump (m)	Control	4.31 (0.46)	3.85 (0.88)	4.40 (0.57)	4.10 (0.69)	.485	**.017***
	Experimental	4.15 (0.74)	3.71 (0.54)	4.10 (0.90)	3.70 (0.72)	.587	.910
	Value of p	.537	.587	.296	.150		
Medicine ball throw (m)	Control	5.18 (1.46)	4.00 (0.86)	5.63 (1.56)	4.20 (0.83)	.164	.503
	Experimental	5.36 (1.18)	4.21 (1.28)	4.96 (1.28)	4.13 (1.36)	.170	.792
	Value of p	.681	.643	.166	.878		
Lateral jumping (rep.)	Control	28.15 (9.15)	24.44 (8.82)	27.77 (9.20)	25.31 (8.73)	.796	.514
	Experimental	24.81 (9.93)	26.57 (8.73)	21.06 (13.07)	23.57 (11.20)	**.007****	**.040***
	Value of p	.334	.528	.100	.660		
SAS	Control	3.97 (0.52)	4.11 (0.77)	3.78 (0.48)	4.23 (0.47)	.249	.417
	Experimental	4.08 (0.57)	4.17 (0.52)	4.19 (0.44)	4.30 (0.45)	.463	.409
	Value of p	.622	.806	**.020***	.697		
IPA	Control	4.15 (0.69)	4.24 (0.58)	4.18 (0.77)	4.11 (0.60)	.882	.503
	Experimental	4.34 (0.70)	4.01 (0.75)	4.46 (0.60)	4.30 (0.50)	.503	.155
	Value of p	.473	.374	.234	.411		
Fun	Control	4.13 (0.68)	3.83 (0.67)	4.10 (0.73)	4.10 (0.71)	.857	.170
	Experimental	4.20 (0.67)	3.95 (0.79)	4.24 (0.56)	4.20 (0.84)	.839	.243
	Value of p	.796	.645	.585	.717		

Note: rep. = repetitions; m = metres; SAS = interpersonal style of autonomy support; IPA = intention to be physically active
*p < .05; **p < .01; ***p < .001

Qualitative results of the thematic analysis

From the thematic analysis, 5 themes were developed that provide an in-depth interpretation of participants' experiences throughout the intervention: (1) play as a driver of motivation and fun; (2) fragmented versus meaningful learning; (3) the paradox of perceived learning and physical performance; (4) the classroom as a space of connection; and (5) perceived weaknesses and the roads ahead.

Play as a driving force for motivation and fun. This theme explores how the LTM sessions generated enthusiasm among the students. The answers reflected that LTM activities were perceived as more engaging, dynamic and motivating than TM ones. One LTM student described the sessions as "a lot of fun", while another TM student said that "at times they were boring while waiting in line". This is evidence that the play component of the LTM not only kept the students physically active, but also captured their interest and desire to participate. In turn, the teacher corroborated this perception, stating that the LTM exercises "were more dynamic" and that "the students were more motivated" with this model because "they enjoyed it a lot more".

Fragmented versus meaningful learning. This theme highlights how LTM promoted deeper and more structured learning by breaking down athletic techniques into specific phases to enable students to better understand each of the components of athletic movement. The LTM students stated that they had learned the technique "in phases", suggesting that this methodology helped to consolidate technical knowledge in a more effective and meaningful way. In contrast, TM students did not recall learning the phases of the technique, reflecting that the repetitive and analytical approach of this methodology may have limited learning retention. The students' responses were in line with the perception of the teacher, who stated that "those who have worked with the traditional method will have to start all over again", referring to the fact that this methodology does not generate significant learning. The difference between the approaches led the teacher to perceive greater strengths in LTM, highlighting that it is "very appropriate for working on the technique in the world of education because it adapts much more to the characteristics of the students and humanises the learning of the technique, which has usually been worked on using traditional methodologies and analytical strategies".

The paradox of perceived learning and physical performance. This theme addresses the difference between perceptions of improvement and actual performance results. Although the LTM students enjoyed the sessions more and perceived significant learning, the differences in the physical test results were not as evident. This creates a paradox, as the feeling of improvement (perceived satisfaction) does not always translate into higher performance in physical tests (measurable results). The teacher mentioned that, although the LTM was more motivating, "I don't know which ones have actually improved a lot". While there were improvements in both groups, performance in physical tests was comparable between the two, raising the question of whether a more playful methodology can balance, or even overcome, traditional approaches when it comes to physical improvement and technical teaching.

The classroom as a space for connection. This theme refers to how the classroom climate was transformed into a more positive and collaborative space in the group that followed the LTM. The teacher mentioned: "I think the classroom climate is more positive", suggesting that the play methodology not only benefited individual performance, but also interpersonal relationships between students. By placing the student at the heart of the learning process, LTM promotes an environment where students felt more comfortable and connected, which contrasted with the more controlled and rigid environment of TM. The classroom climate facilitated by LTM contributed to the teacher feeling more comfortable with this approach: "I feel more comfortable with the ludotechnical model, which is more related to humanising..."

Perceived weaknesses and roads ahead. This theme addresses the weaknesses and difficulties that emerged during the intervention, as well as the roads ahead for future research to improve study design and development. The teacher identified that time constraints could significantly affect the potential impact of LTM on students. He explicitly mentioned that "five sessions may not have been enough to bring about significant changes". This reflection highlights one of the main limitations of the study, namely the brevity of the intervention. Although students showed increased enjoyment and motivation during the LTM sessions, the time spent on each test and phase was too short to produce profound and lasting effects. The teacher himself pointed out: "We would have needed perhaps two or three sessions for each of the tests". This observation suggests that a longer duration would have allowed the different stages of technical learning to be worked through in more detail, thus allowing for greater consolidation of knowledge.

Another challenge identified was the lack of continuous feedback during the application of the LTM. The teacher expressed that it would have been useful to receive external

support: "Having feedback would have been interesting in order to improve". This lack of feedback prevented adjustments in real time, which would have optimised the implementation of the sessions and improved the adaptation of the activities to the level of the students. The introduction of a rigorous observation process by experts, with continuous feedback on the implementation of the LTM, would have made it possible to adapt the methodology according to the needs and responses of the students, as well as to avoid some of the difficulties experienced. Another issue that emerged as a difficulty was the lack of coordination and time in the design of the study. According to the teacher, the planning of the LTM was rushed, resulting in sessions that did not always meet pedagogical expectations. Some activities were not aligned with the technical objectives of the tests and, in some cases, were received by the teacher "the afternoon or evening before being put into practice". This may have affected not only the quality of the sessions, but also the teacher's confidence in applying the methodology, as he himself pointed out: "I did not feel completely at ease". This lack of preparedness may have affected the ability to maximise the potential of the LTM.

Discussion

This study examined the effects of LTM versus TM on the athletic performance of both male and female students in various sporting events. The results indicate that, while the LTM participants showed improvements in their performance in the specific 10 x 10 m test, this improvement was parallel to that observed in the TM group, where significant gains were only recorded among the males in the same test. In the javelin test, improvements were seen in the girls under TM, and in the LTM it was the boys who showed progress. However, only in the TM and the triple jump were improvements reported exclusively for girls. These observations suggest that both methodologies have comparable effectiveness in terms of physical performance, which corroborates findings from previous studies (Valero-Valenzuela et al., 2005, 2012).

In addition, a positive impact of LTM on the teacher's interpersonal style of autonomy support was detected, particularly in boys. This finding is consistent with the cross-sectional study carried out by Valero-Valenzuela et al. (2019), which analysed the profiles of more than 250 young people practising athletics in terms of their level of motivation. In this study, it was observed that those with a higher self-determined motivation perceived a more autonomy-supportive style from their coach and had a higher intention to continue playing athletics. The study by Abraldes et al. (2013) indicated that it was men who showed higher levels of autonomy support, because fun was the variable that best predicted the task orientation of male lifesavers.

In relation to the improvement of fun, although the questionnaires have not reported improvements, the statements made by both teacher and students do show indications of increased satisfaction through the use of the LTM. These results are consistent with previous research that showed benefits of LTM on the satisfaction of primary school students who were learning different athletic disciplines (Valero-Valenzuela et al., 2009).

The intention to be physically active did not vary between students in the two groups. It is striking that, despite the association between autonomy-supportive style and intentions to be physically active (Valero-Valenzuela et al., 2019), this association was not found in this study. This could be attributed, in part, to the limited number of sessions conducted (only 5), in contrast to other studies that reported increases in intention to be physically active (Merino-Barrero et al., 2020). In addition, the partial implementation of LTM strategies, as evidenced by the non-application of some of them (e.g. question, input and solution) and the similar application of strategies in both groups (e.g. overall proposals and review), may have contributed to the absence of differences. Previous research has discussed various ways of applying the pedagogical models (Curtner-Smith et al., 2008), and the "watered-down" version of the model may be one of the reasons for the partial results obtained in terms of fun and intention to be physically active. The lack of ongoing training to complement initial training possibly prevented teachers from identifying and effectively applying LTM strategies in their teaching practice (Lee & Choi, 2015).

In relation to the second objective, qualitative results reveal the impact of LTM on students' motivation and perceived fun. However, the quantitative results related to the variable of fun and intention to practice in the future failed to capture this perceived difference. This discrepancy may be due to several factors such as the short duration of the intervention, which may have been insufficient for the observed psychosocial improvements to be consolidated into measurable outcomes through questionnaires (Rubio-Castillo & Gómez-Mármol, 2016). In addition, the questionnaires may not have accurately captured the immediate and dynamic experiences that the students experienced during the sessions. These findings underline the importance of using measurement tools that can more sensitively capture the subjective experience of students (Bautista, 2022), especially in short-term interventions.

The dissonance between immediate subjective experience and measurable outcomes was also present in other variables such as perceived technical learning and athletic performance outcomes, as although students reported a greater acquisition of knowledge of athletic technique, this did not translate into superior performance in the physical tests. These findings suggest that LTM enhances technical learning and does not compromise physical performance against TM. Despite this, it is necessary to take into account factors that may have influenced the results, such as the short intervention period, which may have influenced the development of physical skills and abilities that play a key role in physical test performance (Valero-Valenzuela et al., 2012). These findings also have important implications, as they show that it is possible to acquire greater technical knowledge and balance physical performance with a more playful and motivating approach, a combination that could be particularly valuable for teaching sports at an early age, when fun and enjoyment are key to sport adherence. In the absence of previous studies in athletics, other works such as sailing and team sports indicate greater knowledge when active methodologies such as comprehensive sport teaching were used (Hortigüela Alcalá & Hernando Garijo, 2017; Morales-Belando & Arias-Estero, 2017). Research in physical education didactics suggests that pedagogical models, such as LTM, can promote deeper and more meaningful learning (Valero-Valenzuela et al., 2012), but this type of learning may not always translate immediately into measurable improvements in physical tests.

Another qualitative highlight was the transformation of the classroom climate into a space for connection and interaction. This finding suggests that LTM not only has an impact on technical learning or motivation, but also positively affects interpersonal relationships and group dynamics. Although this variable was not measured quantitatively, participants' perceptions suggest that LTM contributes to a more humanised learning environment, facilitating collaboration and reducing the individualistic competition characteristic of more traditional pedagogical approaches. This observation is consistent with the findings of Valero-Valenzuela et al. (2009), whose teachers perceived LTM as creating a better classroom climate. By adopting a more humanised and student-centred approach, LTM appears to have the potential to foster a more positive and collaborative environment. This positive climate could be a precursor to improvements in other psychosocial variables (Manzano-Sánchez et al., 2021) which, over time, could have shown significant differences in terms of motivation or intention to continue with sport practice. The student-centred approach and the collaborative environment promoted by LTM were determining factors for the teacher to show a greater preference for this pedagogical model for the technical teaching of athletics. However, the teacher also expressed weaknesses throughout the intervention, such as the need for more pedagogical support during LTM implementation to increase their confidence in applying the model, which links to Hastie and Casey's (2014) recommendations and the need for ongoing training (Lee & Choi, 2015).

As for the limitations of the study, it is important to highlight the importance of implementing the pedagogical models over a longer period of time in order to obtain the expected results with the use of these methodologies. Furthermore, the absence of feedback to improve the loyalty rate in the implementation of the LTM may have led to a watered-down or *à la carte* use of the model's strategies. Another limitation might be that the same teacher implemented the two methodologies in different groups, which could have sometimes led to interference between one methodology and the other, making it difficult at times to distinguish which type of tasks to apply with one group of students and not with the other. Important strategies such as the challenge question, the evaluation of the session and the solution to the challenge question were not carried out in the session analysed with the LTM. Other interesting variables to assess in future studies would be motivation, satisfaction of basic psychological needs or classroom climate. Although certain opinions have been collected about these concepts in the teacher and student interviews, they could be measured by means of validated questionnaires.

Conclusion

The study revealed that LTM induced beneficial effects on students' perceptions, especially in boys, of the teacher's interpersonal style of autonomy support in primary school athletics teaching. This methodology is comparable to TM in terms of athletic performance improvements, and also promotes increased student motivation, a more positive classroom environment and greater enjoyment of the activities. Despite these benefits, confirmation of these results is beyond the scope of this study, possibly due to the comparable effectiveness of both methodologies or the need for a larger number of sessions for changes to be detectable through the self-assessment instruments used. In light of these findings, it is suggested that physical educators consider the use of playful pedagogical strategies such as LTM for teaching individual sports such as athletics, given its ability

to foster a motivational style of teaching that supports student autonomy and its potential positive effects on motivation and intention to continue sport practice in the future.

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