Studies in Educational Evaluation 89 (2026) 101597

Contents lists available at ScienceDirect

Studies in Educational Evaluation

journal homepage: www.elsevier.com/locate/stueduc

Evaluating longitudinal, reciprocal, and cross-sectional effects of (de)motivating teaching styles on students' psychological and educational outcomes in physical education

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ARTICLE INFO

Keywords:
(de)motivating teaching approaches
Basic psychological needs
Self-Determination Theory
Physical Education
Longitudinal structural equation model
Reciprocal effects

ABSTRACT

Grounded in Self-Determination Theory and the circumplex model of teaching behaviors, this three-wave study (N = 637 secondary students) analyzed longitudinal, reciprocal, and cross-sectional relations among (de)motivating teaching styles, basic psychological needs (BPN), and student outcomes using a structural equation model. Perceived autonomy-supportive and structuring styles at Time 1 (T1) predicted higher BPN satisfaction at Time 2 (T2), which, in turn, related to more positive experiences and perceived learning in class and greater intention for physical activity beyond class at Time 3 (T3). Conversely, controlling and chaotic styles at T1 were linked to BPN frustration at T2 and poorer outcomes at T3. BPN satisfaction (frustration) at T2 also showed a longitudinal associations with higher (lower) perceptions of autonomy-supportive/structuring, and lower (higher) controlling/chaotic styles at T3. Findings highlight long-term, bidirectional dynamics with implications for teacher education. The findings indicate that teacher training programs should foster autonomy-supportive and structuring styles while reducing controlling and chaotic ones to promote adaptive motivational patterns and improve student outcomes.

1. Introduction

Teaching style is defined as "the set of interpersonal feelings and behaviors upon which teachers rely to motivate students to engage in and benefit from learning activities" (Reeve et al., 2014, p. 94). In the Physical Education (PE) context, teaching style can have a positive impact to varying degrees, acting as a guide and mentor for students (Patall et al., 2024), and shaping the quality of their experiences (Slingerland & Borghouts, 2011). In PE, where learning tasks often involve public performance, peer comparison, and evaluative feedback about bodily competence, students may be particularly sensitive to the interpersonal style adopted by teachers. In such conditions, demotivating styles may be especially harmful because they can intensify feelings of pressure, confusion, and inadequacy, whereas motivating styles may be especially protective by supporting students' motivational processes during challenging learning situations (Cheon & Reeve, 2015; Leo et al., 2022; Vasconcellos et al., 2020).

Over the past six years, the circumplex model (Aelterman et al., 2019b), a new theoretical approach grounded in Self-Determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2017, 2020), has provided a more detailed and refined framework for categorizing the various (de)motivating teaching styles used by teachers in their lessons.

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https://doi.org/10.1016/j.stueduc.2026.101597
Received 11 November 2025; Received in revised form 18 February 2026; Accepted 12 March 2026
Available online 17 March 2026

This model introduces four distinct (de)motivating teaching styles (i.e., autonomy support, structure, control, and chaos) organized along two axes: one reflecting whether teachers support or thwart students' basic psychological needs (BPN; autonomy, competence, and relatedness), and the other indicating the degree of teachers' directiveness in their interactions with students. As a result, this perspective has led several researchers to investigate how different (de)motivating teaching styles may influence students' motivational process and result in a wide range of distinct outcomes (Burgueño et al., 2024; Diloy-Peña et al., 2024; Escriva-Boulley et al., 2021; García-Cazorla et al., 2025; Van Doren et al., 2023).

Although previous research has provided valuable insights into the immediate effects of (de)motivating teaching styles, most studies have relied on cross-sectional designs, which limit the ability to draw conclusions about the temporal impact of these teaching styles on students' motivation and long-term outcomes (Diloy-Peña et al., 2024). Longitudinal studies are essential to understand how (de)motivating teaching styles influence students' motivational processes and outcomes over time (Bartholomew et al., 2014). A study by Behzadnia et al. (2024) demonstrated that different (de)motivating teaching styles (although not using the circumplex model) have long-term effects on students' motivational processes and outcomes. However, as noted by some studies (e.g., Diloy-Peña et al., 2024), there is a lack of longitudinal research that has analyzed the effects of (de)motivating teaching styles using the circumplex model framework over time. Therefore, the present study aims to bridge this gap by examining the long-term effects of (de) motivating teaching styles—based on the circumplex model—on students' BPN and key outcomes, such as the quality of their experiences and perceived learning within PE, as well as their intention to be physically active outside PE. This longitudinal design provides a more comprehensive understanding of how teaching styles influence students not only at a single point in time but across multiple stages of the academic year.

1.1. (De)Motivating Teaching Styles Through the Circumplex Model

To better understand (de)motivating teaching styles, the circumplex model proposed by Aelterman et al. (2019b), and later adapted to PE (Burgueño et al., 2024; Escriva-Boulley et al., 2021), distinguishes four teaching styles: autonomy support, structure, control, and chaos. These are categorized into two motivating styles (i.e., autonomy support and structure), which support students' BPN, and two demotivating ones (i.e., control and chaos), which thwart them, represented along the horizontal axis. Additionally, the model distinguishes these styles based on the degree of teacher directiveness, with high-directive styles (i.e., structure and control) and low-directive ones (i.e., autonomy support and chaos) aligned along the vertical axis. Each of these teaching styles is further divided into two specific (de)motivating teaching approaches, resulting in eight approaches: participative, attuning, guiding, clarifying, demanding, domineering, abandoning, and awaiting.

In the autonomy-supportive style, PE teachers aim to identify students' interests, preferences, and emotions, fostering their voluntary participation in classroom learning activities (Escriva-Boulley et al., 2021). Within this motivating style, teachers may empower students by giving them a voice and involving them in a shared decision-making process (i.e., participative approach). Additionally, teachers can foster students' personal interests, acknowledge their negative emotions and resistance, and provide a meaningful rationale for learning activities (i.e., attuning approach) (Aelterman et al., 2019b; Cheon et al., 2020; Reeve, 2009). In the structuring style, PE teachers provide supportive strategies and guidance tailored to each student's capabilities, ensuring that students feel competent in mastering classroom learning activities (Burgueño et al., 2024). Within this motivating style, teachers may express confidence in students' abilities, encourage them constructively, and offer supportive feedback to help them progress (i.e., guiding approach). Additionally, they can provide clear expectations and goals while scaffolding students' progress (i.e., clarifying approach) (Aelterman et al., 2019b; Jang et al., 2010; Mouratidis et al., 2008).

Conversely, in the controlling style, PE teachers adopt a tunnel-vision, insisting on students thinking, feeling, and behaving in a prescribed manner, imposing their own agenda and requirements on students, regardless of their perspectives (Escriva-Boulley et al., 2021). Within this demotivating style, teachers can use behavior-based control strategies, emphasizing students' duties and responsibilities, often employing forceful language, threats of sanctions, or the contingent use of rewards (i.e., demanding approach). Additionally, they can use personal manipulation strategies, involving power-assertive practices such as excessive personal control, intimidation, guilt induction, and shaming (i.e., domineering approach) (Aelterman et al., 2019b; Assor et al., 2005; Soenens et al., 2012). Ultimately, in the chaotic style, PE teachers leave students to their own affairs, creating confusion about what they are expected to do, how they are expected to behave, and how they can develop their skills (Burgueño et al., 2024). This demotivating style may be used either because teachers feel unable to help or because, after several attempts, they have given up providing the necessary information or support (i.e., abandoning approach). Additionally, teachers can fail to provide clear expectations, guidelines, or rules, expecting students to be independent and take initiative on their own, merely waiting to see what will happen (i.e., awaiting approach) (Aelterman et al., 2019b; Burgueño et al., 2024; Escriva-Boulley et al., 2021).

1.2. Influence of (De)Motivating Teaching Styles on Students' BPN

Several studies have examined the relationship of (de)motivating teaching styles and students' need-based experiences, particularly in relation to autonomy and competence (Burgueño et al., 2024; Van Doren et al., 2023). Within the framework of the circumplex model, moderate to strong relationships have been reported between autonomy satisfaction and autonomy-supportive style, as well as between autonomy frustration and control. Similarly, competence satisfaction has been linked to structuring behaviors, while competence frustration is associated with chaotic ones (Aelterman et al., 2019b; Burgueño et al., 2024; Curran & Standage, 2017; García-González et al., 2023).

Grounded in SDT (Ryan & Deci, 2017), autonomy satisfaction refers to the sense of volition and freedom students experience when making decisions and acting during PE lessons, whereas autonomy frustration involves feelings of coercion or pressure to behave in a prescribed way (Ryan & Deci, 2020; Vansteenkiste et al., 2020). Competence satisfaction reflects the sense of effectiveness students feel when performing tasks, while competence frustration relates to feelings of failure or inadequacy (Ryan & Deci, 2020; Vansteenkiste et al., 2020). Notably, need satisfaction (i.e., bright side) and need frustration (i.e., dark side) are not simply opposing poles of a continuum: the absence of satisfaction does not imply frustration, although it may increase its likelihood (Bartholomew et al., 2014; Vansteenkiste et al., 2020).

These empirical associations support the idea that specific (de) motivating teaching styles play a differential role in shaping students' psychological need experiences. However, this process is not simply unidirectional (see Fig. 2). The "classroom" is increasingly recognized as a reciprocal social context in which teachers and students mutually influence each other's motivation and behaviors (Abós et al., 2018a). As Matos et al. (2018) further suggest, this reciprocal cycle emphasizes the dynamic interplay between teachers' actions and students' responses, reinforcing the ongoing influence both parties have on each other's motivation and engagement. This cyclical and reciprocal sequence was later expanded within the educational context by Jang et al. (2012) and further developed by Pelletier and Rocchi (2016) within the framework of SDT (Ryan & Deci, 2017). In this theoretical framework, the use of certain (de)motivating teaching styles will directly influence students' motivational processes (e.g., students' BPN) and indirectly affect different outcomes within and outside of PE. In turn, these students' motivational processes and outcomes will also directly impact teachers,

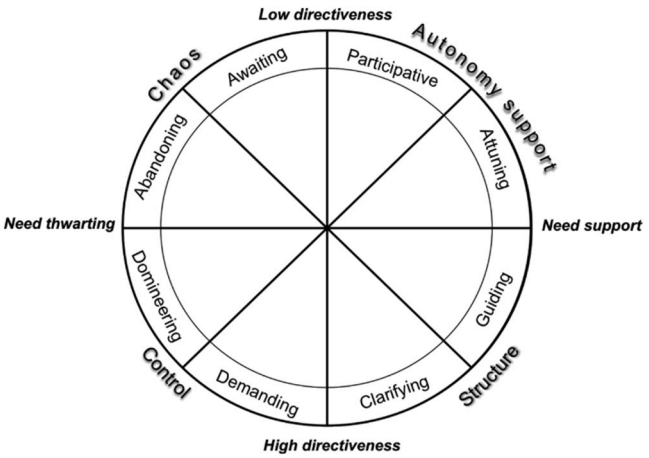

Fig. 1. (De)motivating teaching styles based on the circumplex model. Note. Taken from Aelterman et al. (2019b).

affecting their motivational processes (i.e., teachers' BPN) and their teaching styles (Pelletier et al., 2002; Pelletier & Rocchi, 2016; Ryan & Deci, 2017), thus creating a dynamic cycle that has been underexplored over time.

1.3. Outcomes Within and Outside of PE Based on SDT

Similarly to how different (de)motivating teaching styles influence students' BPN, these latter also affect various outcomes for students, both within and outside of PE context (Vasconcellos et al., 2020). More precisely, previous SDT-based studies have shown that students' BPN satisfaction in PE is associated with adaptive outcomes (e.g., positive experiences in PE), while BPN frustration is related to negative outcomes (e.g., physical inactivity in leisure time) (Vasconcellos et al., 2020). Similarly, prior cross-sectional (e.g., Diloy-Peña et al., 2024) and longitudinal (e.g., Cheon et al., 2020) research has demonstrated the influence of (de)motivating teaching styles on more or less positive outcomes for students. Thus, on the one hand, students who perceive their teachers as more autonomy-supportive and structured tend to have better experiences, as well as greater perceived learning (within PE classes), and a stronger intention to engage in physical activity (PA) (outside of PE classes) (Cheon et al., 2020; Diloy-Peña et al., 2024). On the other hand, students who perceive their teachers as more controlling or chaotic typically report worse emotional and behavioral outcomes (Leo et al., 2022), as well as less satisfactory experiences, lower perceived learning (within PE classes), and a weaker intention to engage in PA (outside of PE classes) (Cheon & Reeve, 2015; Diloy-Peña et al., 2024).

1.4. The Value of Longitudinal Approaches in Physical Education Research

Despite the increasing body of research on the impact of (de)motivating teaching styles on students, most of the studies reviewed, to the best of our knowledge, have employed cross-sectional designs. Cross-sectional studies primarily capture short-term effects, but they do not allow for the establishment of causal effects among the variables (Jang, Basarkod, et al., 2023). Thus, longitudinal research is essential to capture the enduring impact of teaching styles on students' BPN, as well as on critical outcomes such as the quality of students' experiences, perceived learning in PE, and PA intention outside of PE.

To date, several studies grounded in SDT have utilized longitudinal designs to explore the effects of teaching styles (although not using the circumplex model). For instance, Bartholomew et al. (2018) demonstrated that controlling teaching styles were associated with increased BPN frustration over time. Similarly, Cheon et al. (2020) found that structuring behaviors had a positive long-term effect on students' BPN satisfaction. Jang et al. (2016) further showed that autonomy support positively influenced BPN satisfaction and classroom engagement, while controlling styles contributed to frustration and disengagement. More recently, Behzadnia et al. (2023) confirmed that need-supportive teaching styles (i.e., autonomy support and structure) foster positive affect and engagement throughout the lessons. Additionally, Leo et al. (2025) revealed that students who perceived their PE teachers as autonomy-supportive or structured experienced long-term benefits, including greater perceived usefulness of PE and improved academic performance.

Moreover, longitudinal research can guide the development of teacher training programs by identifying the teaching styles that contribute to students' long-term growth and success. Understanding the long-term effects of these teaching styles is crucial for developing strategies that not only enhance immediate outcomes but also promote sustainable, long-term improvements in students' motivational process and academic performance both within and outside the PE context. Despite the advances made by these studies, no research has yet applied the circumplex model to explore how (de)motivating teaching styles affect students' motivational processes and outcomes over time—either within or outside the PE context—highlighting a significant gap in the current literature (Bartholomew et al., 2014; Diloy-Peña et al., 2024; Soenens et al., 2012). This gap underscores the need for further longitudinal studies using the circumplex model framework to deepen our understanding of how teaching styles shape students' motivational processes and outcomes across the academic year.

1.5. The Present Study

Accordingly, the present study addressed the following research

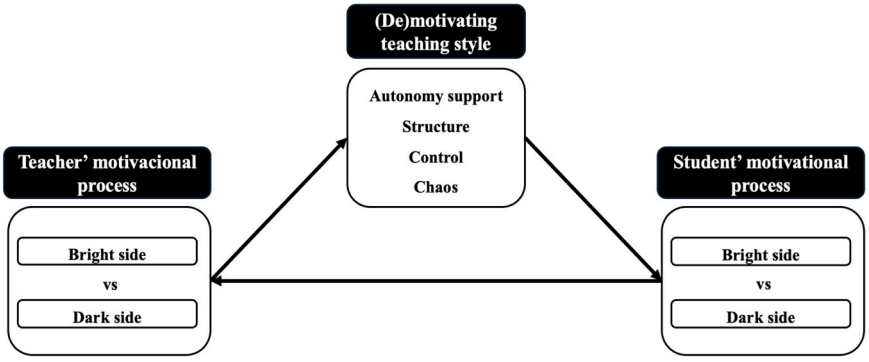

Fig. 2. *Reciprocal influence between teachers' and students' motivational processes, mediated by (de)motivating teaching styles, within the SDT framework. Note.* (De) Motivating teaching styles —From autonomy support and structure to control and chaos— influence students' motivational processes (bright vs. dark side), which in turn reciprocally affect teachers' motivational experiences, creating a dynamic feedback loop.

questions: (RQ1) Do students' perceptions of (de)motivating teaching styles at Time 1 predict students' outcomes at Time 3 through students' BPN satisfaction and frustration at Time 2? (RQ2) Do students' BPN satisfaction and frustration at Time 2 prospectively relate to students' subsequent perceptions of (de)motivating teaching styles at Time 3, consistent with a reciprocal motivational cycle? (RQ3) To what extent are students' perceptions of (de)motivating teaching styles concurrently associated with key outcomes at Time 3?

Building upon existing literature, the primary aim of the present study was to examine the long-term effects of (de)motivating teaching styles, as perceived by students at Time 1 (T1), on three key outcomes measured at Time 3 (T3): the quality of students' experiences in PE, perceived learning in PE, and their intention to engage in PA outside of school. These effects were hypothesized to be mediated by students' BPN satisfaction and frustration, assessed at Time 2 (T2). Drawing from prior longitudinal research grounded in SDT (Bartholomew et al., 2018; Behzadnia et al., 2023; Cheon et al., 2020; Jang et al., 2016) and cross-sectional studies utilizing the circumplex model (Burgueño et al., 2024; Diloy-Peña et al., 2024), we hypothesized that autonomy-supportive and structuring teaching styles (T1) would positively predict students' autonomy and competence satisfaction over time (T2), which in turn would lead to more favorable outcomes at T3. In contrast, controlling and chaotic teaching styles (T1) were expected to positively predict students' autonomy and competence frustration (T2), which would be associated with less favorable outcomes at T3 (H1; see hypothesized model in Fig. 3).

The second aim of this study was to investigate the reciprocal effects between students' BPN and their subsequent perceptions of their PE teachers' (de)motivating teaching styles. Specifically, we tested whether students' BPN satisfaction and frustration at T2 predicted their perceptions of autonomy support, structure, control, and chaos at T3. In line with the cyclical model of SDT (Pelletier & Rocchi, 2016; Pelletier et al., 2002; Ryan & Deci, 2017), we expected BPN satisfaction (T2) to predict higher levels of perceived motivating teaching styles (T3), while BPN frustration (T2) would predict higher levels of perceived demotivating teaching styles (T3) (H2; see hypothesized model in Fig. 3).

The third aim was to explore the cross-sectional associations at T3 between students' perceptions of their PE teacher's (de)motivating teaching styles and the quality of their experiences in PE, perceived learning in PE, and PA intention outside of PE. Although prior SDT-based studies have primarily focused on examining the relationship between teaching styles and students' need-based experiences or motivation, fewer have investigated how these teaching styles directly relate to tangible educational and behavioral outcomes (de Cocker et al., 2025). Addressing this gap, we hypothesized that motivating teaching styles would be positively associated with better quality experiences, greater perceived learning, and higher PA intention, whereas demotivating teaching styles would be negatively associated with these outcomes (H3; see hypothesized model in Fig. 3).

2. Method

2.1. Design, Participants, and Procedure

This study employed a three-wave longitudinal design. The sample comprised 637 secondary school students (M_{age} = 14.61; 53.8% girls) from 12 secondary schools in a Spanish region [omitted for peer review]. Only students who completed all three waves of data collection (T1, T2, and T3) were included in the final sample. Those who missed any measurement point or provided incomplete responses were excluded from the analyses. *Of the students initially invited to participate, 87.43% completed all three waves of data collection and were included in the final analytical sample.* Class sizes ranged from 20 to 30 students. All PE teachers held identical professional qualifications, including a BSc in Sports and Exercise Sciences and a teaching-oriented MSc in PE. In Spain, secondary students typically receive two weekly PE sessions of approximately 55 min each, across a 9-month academic year (from September to June) divided into three terms (with holiday breaks in December-January and March-April).

Participants were recruited through various digital communication platforms (e.g., WhatsApp, Facebook, X, LinkedIn, and email). Once the schools and PE teachers agreed to participate and signed the relevant ethical documentation, families were informed of the study objectives and invited to provide written informed consent for their children's participation. The study was approved by the Ethics Committee of [omitted for review process] and conducted following the principles of the Declaration of Helsinki. Participation was voluntary and anonymous, and students could withdraw at any time without any

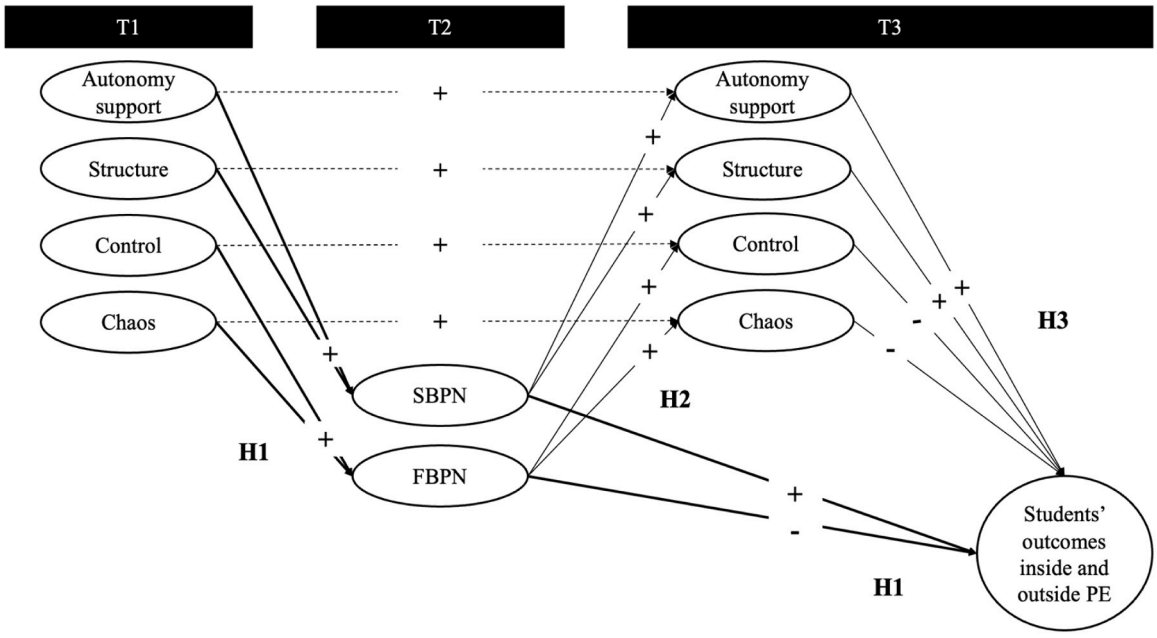

Fig. 3. *Hypothesized structural equation model with longitudinal (H1), reciprocal (H2), and cross-sectional paths (H3). Note*. All variables represented students' perceptions. SBPN= BPN satisfaction; FBPN = BPN Frustration.

consequences.

Data were collected via paper-based questionnaires completed in a quiet classroom environment under the supervision of the principal investigator. To minimize social desirability bias, the PE teacher was not present during administration. Each student completed the questionnaires at three time points over a six-month period (i.e., T1 = December; T2 = March; T3 = June). This timeline was aligned with the natural structure of the academic year to capture change across meaningful instructional periods. Following data collection, all paper-based questionnaires were manually entered into an electronic database by the first author. To ensure data fidelity, a second researcher conducted random consistency checks by comparing selected paper questionnaires with their corresponding electronic records, and no systematic discrepancies were identified.

2.2. Instruments

2.2.1. Socio-Demographic Variables

At T1, students provided self-reported data on their age, gender, and school grade level.

2.2.2. (De)motivating Teaching Styles and Approaches

At T1 and T3, students provided self-reported data on their perception of the (de)motivating teaching approaches used by their PE teachers. The Spanish version for students of the Situations-in-School Questionnaire in Physical Education (SIS-PE; Burgueño et al., 2024) was employed (adapted from Aelterman et al., 2019b). This questionnaire comprises 12 typical teaching scenarios, each containing four items, totaling 48 items. Autonomy supportive items are divided into participative (four items) and attuning (eight items) approaches. Structuring items are grouped into guiding (seven items) and clarifying (five items) approaches. Controlling items are categorized into demanding (seven items) and domineering (five items) approaches. Chaotic items are described as abandoning (eight items) and awaiting (four items) approaches. For instance, in the scenario "When the PE teacher prepares a lesson, their priority is…": "To propose challenging tasks to the best students and provide sufficient support to students who struggle throughout their learning" (guiding), "Does not plan the classes in much detail" (awaiting), "To offer enjoyable, interesting, and engaging tasks" (attuning), or "To conduct a class that all students must follow. There are no exceptions or excuses" (demanding). Responses were recorded on a 7-point Likert scale, where 1 indicates "does not describe my PE teacher at all" and 7 "describes my PE teacher perfectly". At T1 (and T3), McDonald's omega coefficients for the (de)motivating teaching approaches were as follows:.64 (.63) for participative,.82 (.75) for attuning,.80 (.80) for guiding,.64 (.67) for clarifying,.68 (.62) for demanding, .71 (.61) for domineering,.80 (.87) for abandoning, and.62 (.80) for awaiting.

2.2.3. Students' Autonomy and Competence Satisfaction and Frustration in PE

At T2, students provided self-reported data on their autonomy and competence satisfaction and frustration. The Spanish version (Zamarripa et al., 2020) of the BPN Satisfaction and Frustration Scale (Chen et al., 2015) was employed (although only the autonomy and competence items were used). This scale is composed of 16 items, with four items dedicated to each factor, introduced by the phrase "In my PE lessons…". The items measure autonomy satisfaction (e.g., "I engage in activities that interest me"), autonomy frustration (e.g., "I feel overwhelmed by too many demands"), competence satisfaction (e.g., "I can accomplish challenging tasks"), and competence frustration (e.g., "I feel incompetent due to the errors I make"). Responses were recorded on a 5-point Likert scale, where 1 indicates "strongly disagree" and 7 "strongly agree." At T2, McDonald's omega coefficients for the satisfaction and frustration of the BPN were.88 and.86, respectively.

2.2.4. Students' PE Experiences

At T3, students self-reported on the quality of their experiences in PE lessons. Consistent with prior research (Diloy-Peña et al., 2024), the question posed was, "What are your experiences like in PE lessons?". The responses were recorded on a 5-point Likert scale, where 1 indicates "awful" and 5 "very good."

2.2.5. Students' Perceived Learning in PE

At T3, students self-reported on the learning perceived in PE lessons. Consistent with prior research (Diloy-Peña et al., 2024), the question posed was, "How much do you learn in PE?". The responses were recorded on a 5-point Likert scale, where 1 indicates "nothing" and 5 "a lot."

2.2.6. Students' Intention to be Physically Active

At T3, students self-reported on their intention to be physically active outside of PE. The Spanish version of the Theory of Planned Behavior Questionnaire (Tirado-González et al., 2012) was employed. This scale is composed of three items (e.g., "I intend to do active sports and/or physical activities during my leisure time in the next 5 weeks…"). Responses were recorded on a 7-point Likert scale, where 1 indicates "strongly disagree" and 7 "strongly agree". At T3, McDonald's omega for the intention to be physically active was.92.

2.3. Data Analysis

Preliminary, descriptive statistics and McDonald's omega reliability coefficients were computed for all study variables. While the conventional threshold for acceptable reliability is often cited as.70, recent research recommends a more nuanced interpretation of these values. According to George and Mallery (2003) and Hernaez (2015), reliability coefficients are best viewed on a continuum: scores ranging from.90 to.95 indicate excellent reliability, scores of.80 or higher suggest good reliability, scores of.70 or above are considered acceptable, scores of.60 or higher are deemed reasonable, scores of.50 or higher are regarded as fair, and scores below.50 are considered unacceptable. Moreover, before conducting the main analysis, a correlation analysis was performed to examine the relationships between the study variables across the three time points.

Additionally, a longitudinal structural equation modeling (SEM) (three time points: T1, T2, and T3) was conducted. This three-wave SEM tested the hypothesized pathways between students' perceptions of their PE teachers' (de)motivating teaching styles at T1, students' autonomy and competence satisfaction and frustration at T2, and their outcomes at T3 (i.e., quality of experiences, perceived learning, and PA intention). This approach also aimed to examine the cyclical effects (i.e., BPN satisfaction and frustration at T2 → (de)motivating teaching styles at T3) and the cross-sectional effects (i.e., (de)motivating teaching styles at T3 → outcomes within and outside of PE at T3). Gender and grade level were used as covariates. A two-step procedure was followed (Kline, 2018). First, the measurement model was assessed by allowing all latent constructs to correlate freely. Second, the structural model was tested to examine the hypothesized predictive paths. The SEM was estimated using the MLR (maximum likelihood robust) estimator, chosen for its ability to provide fit indices and standard error estimates that are robust to non-normality. This is particularly relevant for data derived from Likert-type scales with five or more response categories (Muthén & Muthén, 1997–2018). Values up to 5 for the χ^2/df coefficient, over.90 for the comparative fit index (CFI) and the Tucker-Lewis index (TLI), and below.08 for the standardized root mean square residual (SRMR) and the root mean square error of approximation (RMSEA) represent an acceptable fit (Kline, 2018). Lastly, parcels were utilized for several reasons: despite potential drawbacks such as reduced item one-dimensionality within each parcel, they offer benefits including reduced bias, improved parsimony, and enhanced model stability (Kline, 2010). Parcels were created within each approach of each (de)

motivating teaching style (e.g., participative-participative, demanding-demanding), grouping related items to form composite indicators that represent the broader constructs. In line with Haerens et al. (2015), this approach underscores the usefulness and efficacy of item parcels in educational settings. All analyses were conducted using SPSS 29.0 and Mplus 8.4 (Muthén & Muthén, 1997–2018).

3. Results

3.1. Primary analysis

Table 1 presents the descriptive statistics and bivariate correlations among all study variables across the three time points (T1, T2, and T3). As shown, most of the correlations were significant and aligned with the hypothesized associations proposed in this study.

3.2. Long-term Relationships Between (De)Motivating Teaching Styles, BPN, and Outcomes Within and Outside of PE

3.2.1. General Results of the Hypothesized Model

The measurement model (χ^2 [df = 1406] = 3531.82, $p < .001$, χ^2/df = 2.51; CFI =.90; TLI =.90; SRMR =.071; RMSEA =.049, 90% CI [.047,.051]) and the structural model (χ^2 [df = 1414] = 3134.48, $p < .001$, χ^2/df = 2.21; CFI =.91; TLI =.90; SRMR =.076; RMSEA =.044, 90% CI [.042,.046]) obtained acceptable fit-indices according to established criteria (Kline, 2018). Importantly, the structural model did not worsen model fit relative to the measurement model (ΔCFI = +.01; ΔRMSEA = −.005; ΔSRMR = +.005), supporting the adequacy of the hypothesized structural specification.

3.2.2. Long-Term Effects of (De)Motivating Teaching Styles on Students' Outcomes via BPN (H1)

As shown in Fig. 4, autonomy-supportive teaching at T1 positively predicted BPN satisfaction (β =.35, $p < .001$), and negatively predicted BPN frustration (β = −.49, $p < .001$) at T2. Conversely, controlling style at T1 positively predicted BPN frustration (β =.23, $p < .001$), and negatively predicted BPN satisfaction (β = −.22, $p < .001$) at T2. Chaotic style at T1 positively predicted BPN frustration (β =.22, $p = .002$) at T2. In turn, BPN satisfaction at T2 positively predicted PE experiences (β =.20, $p = .022$), perceived learning (β =.19, $p = .037$), and PA intention (β =.27, $p = .003$) at T3. Conversely, BPN frustration at T2 negatively predicted PE experiences (β = −.35, $p < .001$), perceived learning (β = −.30, $p < .001$), and PA intention (β =.35, $p = .008$) at T3. Direct effects from T1 teaching styles to T3 outcomes were tested but found to be nonsignificant and thus are not displayed in Fig. 4 (see Supplemental Material Table SM2 for more details).

3.2.3. Additional Effects: Reciprocal (H2) and Cross-Sectional Predictions (H3)

Regarding the second aim, BPN satisfaction at T2 positively predicted the students' perceptions of autonomy-supportive (β =.14, $p < .001$) and structuring (β =.16, $p < .001$) teaching styles at T3. BPN frustration at T2 positively predicted perceptions of controlling (β =.09, $p = .010$) and chaotic (β =.12, $p = .001$) teaching styles at T3.

As for the third aim, autonomy-supportive style at T3 showed significant cross-sectional associations with perceived learning (β =.49, $p < .001$) and PA intention (β =.40, $p = .003$). Further, structuring style at T3 was positively associated with PE experiences (β =.53, $p < .001$) and perceived learning (β =.80, $p < .001$). In contrast, controlling style at T3 had a negative cross-sectional association with PE experiences (β = −.13, $p = .030$).

Table 1
Descriptive Statistics and Correlations of the Hypothesized Model.

	M (*SD*)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
T1																
1. Autonomy support	4.99 (1.09)	-														
2. Structure	5.59 (0.86)	.79**	-													
3. Control	4.21 (0.96)	.04	.14**	-												
4. Chaos	2.21 (0.97)	-.48*	-.53**	.23**	-											
T2																
5. BPN satisfaction	3.61 (0.84)	.22**	.21**	-.03	-.22**	-										
6. BPN frustration	2.59 (1.33)	-.14**	-.16**	.02	.22**	-.53**	-									
T3																
7. Autonomy support	4.98 (1.16)	.43**	.40**	-.13*	-.20**	.31**	-.35**	-								
8. Structure	5.14 (1.49)	.22**	.31**	.27**	-.17**	.28***	-.55**	.73**	-							
9. Control	3.82 (0.96)	-.13**	.21**	.24**	.07	-.04	-.07	-.05	.18**	-						
10. Chaos	2.40 (1.15)	-.17**	-.20**	.14**	.36**	-.26**	.48**	-.53**	-.70**	.08*	-					
11. PE experiences	4.07 (0.85)	.23**	.20**	-.05	-.23**	.35**	-.25**	.34**	.27**	-.07	-.29**	-				
12. Perceived learning	3.85 (0.90)	.31**	.27**	-.05	-.27**	.36**	-.24**	.36**	.20**	-.08*	-.24**	.61**	-			
13. PA intention	5.61 (1.50)	.13**	.09*	-.02	-.05	.26**	-.19**	.16**	.11**	-.03	-.06	.39***	.31**	-		
Sociodemographic variables																
14. Gender	-	-.03	-.03	-.05	-.12**	.13**	-.02	-.05	-.04	-.02	.12**	-.02	-.04	.12**	-	
15. Academic year	-	-.03	.03	.06	-.01	-.12**	.08*	-.08*	.05	.20**	.01	.03	-.12**	-.02	-.07	-

Note. ***$p < .001$. **$p < .01$. *$p < .05$. Teaching styles and PA intention were rated on a scale from 1 to 7. BPN, PE experiences, and perceived learning were assessed on a scale from 1 to 5.

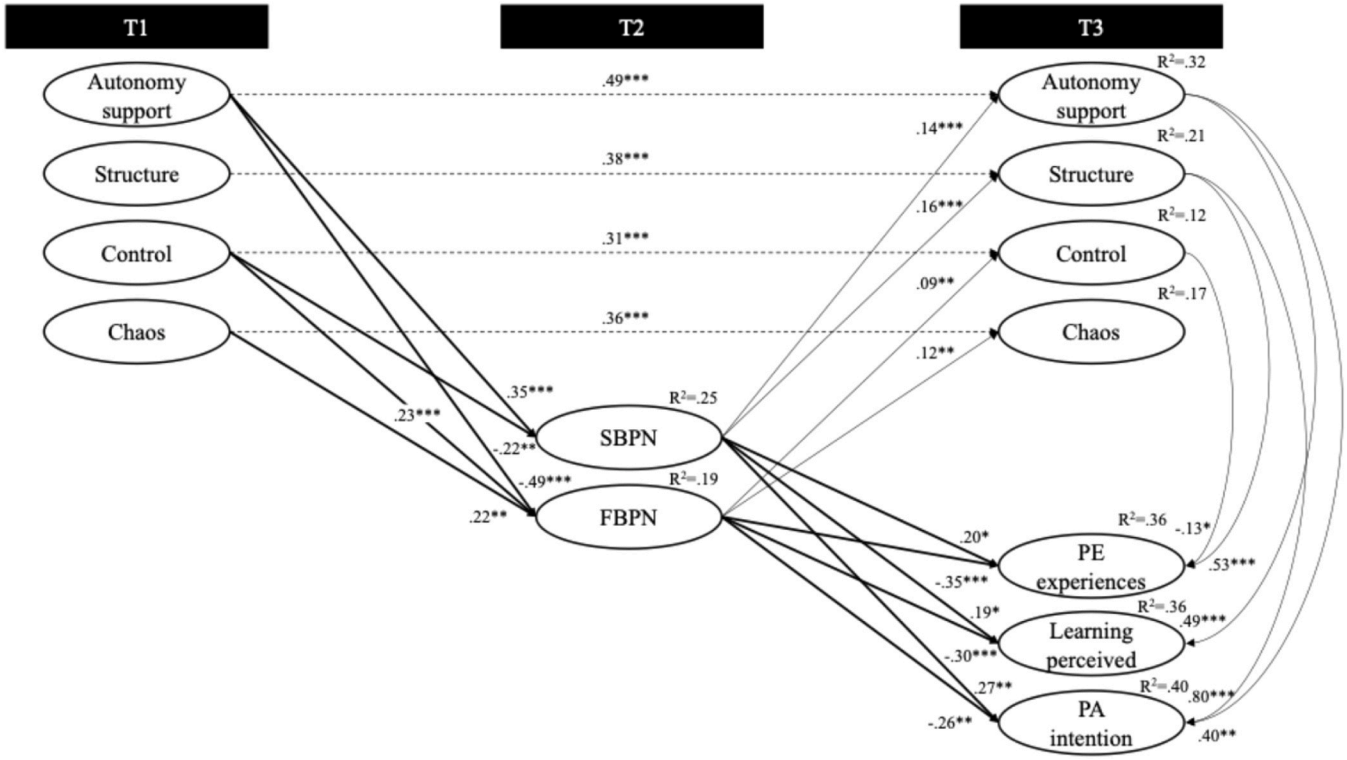

Fig. 4. *Longitudinal SEM from (de)motivating teaching styles to students' outcomes, via BPN, and the reciprocal and cross-sectional relationships over time. Note*. Only significant relationships are shown in Fig. 4 for clarity. A complete list of estimated effects is provided in the Supplementary Material (Table SM2). $^{***}p < .001$. $^{**}p < .01$. $^{*}p < .05$.

4. Discussion

The present research aimed to examine for the first time the longitudinal effects (T1 → T2 → T3) of (de)motivating teaching styles on students' outcomes within and outside of PE, via students' BPN, using the circumplex model. In addition, the study explored reciprocal relationships (T2 → T3) and cross-sectional associations (at T3) within the hypothesized model. The main findings revealed that: (a) autonomy-supportive teaching at T1 positively predicted BPN satisfaction at T2, which in turn positively predicted students' positive PE experiences, perceived learning, and PA intention at T3. In contrast, controlling and chaotic styles at T1 positively predicted BPN frustration at T2, which in turn negatively predicted those same outcomes at T3; (b) students' BPN satisfaction at T2 positively predicted their subsequent perceptions of autonomy-supportive and structuring teaching styles at T3, while BPN frustration at T2 positively predicted later perceptions of controlling and chaotic styles; and (c) at T3, autonomy-supportive and structuring styles were positively associated with students' positive PE experiences, perceived learning, and PA intention, whereas controlling style was negatively associated with PE experiences. Together, these findings provide novel evidence for a dynamic, reciprocal motivational process unfolding across the academic year.

4.1. From (De)Motivating Teaching Style to Students' Outcomes via BPN: A Longitudinal Perspective (H1)

First, consistent with our hypothesis (H1) and previous longitudinal studies (e.g., Jang et al., 2016), students who perceived their PE teachers as offering opportunities for decision-making and responsibility, while showing genuine interest in their preferences (i.e., autonomy support), exhibited higher BPN satisfaction and lower BPN frustration over time. These strategies not only have an immediate positive effect on students' motivational processes (Burgueño et al., 2024), but, throughout the academic year, they foster a greater sense of self-importance over their learning (i.e., autonomy satisfaction), as well as higher levels of mastery (i.e., competence satisfaction), allowing students to take the initiative and feel confident in completing tasks. In parallel, autonomy-supportive teaching mitigates the frustration of these needs, contributing to students' motivational development over time through a dual positive pathway (Burgueño et al., 2024).

However, it is important to note that structuring style did not predict BPN satisfaction or frustration over time, which contrasts with findings from previous longitudinal research (Cheon et al., 2020), cross-sectional studies utilizing the circumplex model (Burgueño et al., 2024), and our own hypothesis (H1). One possible explanation lies in the high collinearity between autonomy support and structure ($r = .79$, $p < .001$), which may have produced a suppression effect that reduced the unique longitudinal contribution of structure when both styles were modeled simultaneously. When two predictors are strongly correlated, particularly when both are conceptualized as motivating and need-supportive, it becomes difficult to isolate their unique contributions (Vatcheva et al., 2016). This interpretation is supported by the near-identical bivariate correlations of autonomy support and structure with BPN satisfaction and frustration. Prior studies have similarly noted that such statistical overlap can lead to reduced predictive power for each construct (Jang et al., 2016; Pelletier et al., 2002). A second explanation may relate to the temporal and structural complexity of the proposed model (Chennamaneni et al., 2016). The inclusion of three measurement waves, reciprocal pathways, and multiple outcomes may have attenuated the longitudinal predictive capacity of structure relative to autonomy support, which may play a more central motivational role over time. Moreover, due to the model's complexity, this study focused on the four general (de)motivating teaching styles and did not differentiate between the eight specific teaching approaches, potentially differentiated effects of guiding versus clarifying behaviors could not be fully captured. Nevertheless, correlation analyses (see Table 1) revealed that structure measured at T1 was positively associated with BPN satisfaction ($r = .21, p < .01$) and negatively with BPN frustration ($r = -.16, p < .01$)

at T2. Likewise, as shown in the Supplemental Material (Table SM1), the guiding approach at T1 displayed the strongest positive correlations with BPN satisfaction ($r = .23$, $p < .01$) and the weakest correlations with BPN frustration ($r = -.17$, $p < .01$) at T2. Although the clarifying approach also showed a positive relationship with BPN satisfaction ($r = .13$, $p < .01$) and a negative one with BPN frustration ($r = -.10$, $p < .01$), these associations were weaker compared to the participative, attuning, and guiding approaches. These findings suggest that, although not predictive in the longitudinal SEM, the structuring style—particularly the guiding approach—may still play a meaningful role in supporting students' need-based experiences. Its absence from the final model likely reflects statistical or methodological constraints rather than a lack of theoretical relevance.

Conversely, consistent with previous longitudinal studies (e.g., Bartholomew et al., 2018) and our hypothesis (H1), controlling style positively predicted BPN frustration over time. Specifically, students who perceived their PE teachers as employing pressure-based strategies (i.e., controlling style), whether through behavior-oriented methods (e.g., coercive language, threats of sanctions, contingent rewards) or personal manipulation tactics (i.e., disapproving gestures, guilt induction, authoritative tone), reported, over time, a heightened sense of coercion and pressure (i.e., autonomy frustration) and increased feelings of failure and incompetence in PE (i.e., competence frustration). Additionally, in contrast to autonomy support, the controlling style negatively predicted both autonomy and competence satisfaction (Burgueño et al., 2024), highlighting the critical importance of minimizing pressuring teaching strategies to support students' motivational development throughout the academic year. Although some studies have shown that controlling teaching strategies may yield short-term benefits (e.g., Diloy-Peña et al., 2024), our findings are aligned with longitudinal research indicating that these practices clearly have detrimental long-term effects on students (Bartholomew et al., 2018). While cultural factors, such as the Spanish or the broader European context, might initially buffer the negative perception of controlling behaviors (Diloy-Peña et al., 2025), our results reveal that, over time, these pressure-based and manipulative practices ultimately undermine students' BPN satisfaction. These results confirm that even when the short-term perception of control is neutral or slightly positive, the long-term consequences clearly remain harmful, as also observed by Bartholomew et al. (2018).

Finally, in line with previous cross-sectional studies based on the circumplex model (Burgueño et al., 2024) and our hypothesis (H1), the chaotic style positively predicted BPN frustration over time. Specifically, when students perceive their PE teachers as inattentive to their questions or concerns, they report greater BPN frustration. This is particularly evident when teachers neglect students needing additional support, fail to provide clear structure, or intervene only when problems arise. Over time, this chaotic style was associated with a diminished sense of autonomy (i.e., autonomy frustration) and growing feelings of incompetence (i.e., competence frustration) during PE lessons.

Second, in line with our hypothesis (H1) and previous cross-sectional studies grounded in SDT and the circumplex model (Diloy-Peña et al., 2024; Leo et al., 2022; Vasconcellos et al., 2020), students' BPN satisfaction at T2 (autonomy and competence) positively predicted more favorable outcomes at T3, including better PE experiences, higher perceived learning, and stronger PA intention outside of school. Conversely, BPN frustration predicted less adaptive outcomes across all variables. Taken together, these findings suggest that fostering a sense of autonomy (e.g., by helping students feel involved and valued in the learning process) and supporting competence (e.g., by enabling them to feel capable of achieving their goals) are both essential to promoting sustained engagement and well-being. This combination of need satisfaction appears to facilitate not only beneficial outcomes within PE but also broader lifestyle benefits, such as increased intentions to be physically active (Vasconcellos et al., 2020; White et al., 2021). These results underscore the value of professional development programs designed to equip PE teachers with motivating teaching strategies (e.g., García-Cazorla et al., 2024). Such programs can foster students' psychological well-being and promote the adoption of healthy, active lifestyles beyond the school setting (Burgueño et al., 2024; Vasconcellos et al., 2020).

4.2. Reciprocal Effects Between BPN and (De)Motivating Teaching Style: A Cyclical Analysis (H2)

Consistent with our second proposed hypothesis (H2), the results showed that students' BPN satisfaction (autonomy and competence) positively predicted, over time, their subsequent perceptions of motivating teaching styles (i.e., autonomy support and structure), whereas BPN frustration positively predicted later perceptions of demotivating teaching styles (i.e., control and chaos).

These findings reinforce the idea that the motivational process in PE is not unidirectional, but reciprocal and socially co-constructed between teachers and students (Abós et al., 2018a; Pelletier et al., 2002; Pelletier & Rocchi, 2016). Teaching behaviors perceived by students not only shape their motivational processes and PE/PA experiences at a given moment, but these students' experiences may also function as meaningful feedback that influences how PE teachers interpret, feel, and act over time. Given that students' motivation and outcomes emerge and are expressed in the same space and time as teachers' professional activity (i.e., the PE classroom), these outcomes do not remain isolated. Instead, they seem to become key antecedents of teachers' motivational processes and their subsequent (de)motivating teaching styles.

In this way, our results suggest that the PE classroom operates as a shared motivational ecosystem: need-supportive teaching (i.e., autonomy support and structure) promotes students' positive PE experiences, perceived learning, and PA intention (mediated by students' BPN), which in turn nourishes teachers' BPN, reinforcing their willingness to teach in more autonomy-supportive and structured ways. For example, when students show enjoyment, engagement, and predisposition in class tasks, PE teachers may perceive their efforts as effective and feel encouraged to maintain or even increase their need-supportive behaviors. This notion is fully aligned with Jang, Basarkod, et al. (2023), who recently confirmed that autonomy-supportive teaching and student agentic engagement are mutually reinforcing over time, creating positive feedback loops that enhance both student outcomes and teaching behaviors.

However, it seems that this cycle also operates with dark-side variables. This study shows that when students perceive need-thwarting teaching (i.e., control or chaos), their BPN are subsequently frustrated, leading to negative experiences in PE over time (Diloy-Peña et al., 2024, 2025). These maladaptive experiences, in turn, may be perceived by teachers as student disengagement or oppositional defiance, potentially thwarting teachers' own motivational needs and increasing the likelihood of using more controlling or chaotic practices (Burgueño et al., 2024; García-Cazorla et al., 2025).

This bidirectional process may help explain the observed pathway from students' need-based experiences at T2 to their perceptions of (de) motivating teaching style at T3 (Pelletier & Rocchi, 2016; Ryan & Deci, 2017). To our knowledge, this is the first longitudinal study to empirically demonstrate this reciprocal motivational cycle in PE using the circumplex model of teaching styles, offering a novel contribution to the understanding of how teacher-student dynamics evolve over time. Altogether, these findings underscore the value of teacher training initiatives rooted in SDT and the circumplex model, which can help interrupt maladaptive motivational cycles and promote sustained, mutually reinforcing need-supportive loops in PE (Reeve & Cheon, 2024).

4.3. (De)Motivating Teaching Style and Student Outcomes: Cross-Sectional Insights at T3 (H3)

In addition to the longitudinal (H1) and reciprocal processes (H2)

discussed above, our model also revealed cross-sectional associations at T3 between (de)motivating teaching styles and outcomes within (i.e., PE experiences and perceived learning) and outside of PE classes (i.e., PA intention). Consistent with our third hypothesis (H3), prior research based on the circumplex model (Diloy-Peña et al., 2024) and meta-analytic evidence involving over 20,000 students (Vasconcellos et al., 2020), our findings showed that perceived motivating teaching styles (i.e., autonomy support and structure) were positively associated (i.e., cross-sectional effect) with PE experiences, perceived learning, and PA intention, while the controlling style negatively predicted PE experiences.

More specifically, when students perceive their teachers as interested in their preferences, encouraging self-expression, and promoting responsibility (i.e., autonomy support), they are more likely to perceive greater learning, as they feel more engaged in the process, while also developing a greater PA intention (Vasconcellos et al., 2020). This sense of autonomy, coupled with alignment of lessons with students' interests, may also help students internalize the broader value of PA outside the school context (Cheon et al., 2020). Similarly, in line with Cheon et al. (2020), students who perceive their teachers providing clear expectations, individual feedback, and appropriate task adaptation (i.e., structure) immediately experience better PE lessons. These strategies not only enhance perceived competence but also signal that PA is accessible and valuable for all students, regardless of ability level.

In addition, results show that students who perceive their teachers using pressure-based strategies (i.e., control) report worse PE experiences. This aligns with previous literature indicating that such behaviors may elicit tension, anxiety, and disengagement in students (Bartholomew et al., 2018). Finally, although the chaotic style did not significantly predict outcomes in the SEM model, it was negatively correlated with PE experiences and perceived learning, both longitudinally and cross-sectionally. These associations, which could have been masked in the structural model, possibly due to statistical constraints, suggest that chaotic teaching may still have detrimental effects (Aelterman et al., 2019b; Burgueño et al., 2024).

Taken together, these findings reinforce the importance of adopting motivating teaching styles (i.e., autonomy support and structure) not only for their immediate benefits, but also as foundational practices for promoting positive outcomes and fostering sustained motivation. Conversely, controlling and chaotic styles should be minimized, given their consistently detrimental associations with students' BPN frustration and poorer educational outcomes at short and long term. Importantly, by testing these cross-sectional relationships within the circumplex framework, this study addresses a notable gap in the literature, providing empirical support for how (de)motivating teaching styles are linked to key student outcomes within and outside of PE. These insights not only advance theoretical understanding but also highlight clear, evidence-based directions for teacher education and professional development programs aiming to enhance motivation, engagement, and learning in PE contexts.

5. Practical implications

From a theoretical standpoint, the present study has several implications for both SDT and the circumplex model. First, the findings provide support for the circumplex model as a meaningful organizing framework by showing that autonomy-supportive and structuring styles, as well as controlling and chaotic styles, operate in line with their theorized need-supportive versus need-thwarting functions across time. This reinforces the conceptual validity of the circumplex structure beyond cross-sectional associations. Second, the observed reciprocal associations between students' BPN satisfaction and frustration and their later perceptions of teaching styles align with SDT's cyclical perspective, suggesting that motivational processes in PE are dynamically co-constructed through ongoing teacher-student interactions. Rather than viewing teaching styles as fixed antecedents, these findings support a process-oriented view in which students' need-based experiences may shape how instructional behaviors are perceived over time. Together, these findings suggest that the circumplex model and SDT can be fruitfully integrated within longitudinal designs to capture the dynamic and reciprocal nature of motivational processes in authentic educational settings.

From a practical perspective, findings of this study highlight the significant long-term (H1), reciprocal (H2), and cross-sectional (H3) impact of (de)motivating teaching styles on students' motivational processes and outcomes, both within and outside of the PE context. These results underscore the need to promote motivating teaching behaviors, such as autonomy-supportive and structuring strategies, while minimizing demotivating ones, including controlling and chaotic styles.

To support students' BPN, PE teachers can adopt practical strategies that foster autonomy and competence. For example, gradually giving students responsibility during lessons (e.g., choosing activities, adjusting difficulty levels, or managing time) and adapting content to their interests (e.g., asking what they want to learn or explore) can strengthen their sense of ownership and engagement. These strategies are central to autonomy-supportive teaching and, as previous research has shown (Vasconcellos et al., 2020), are linked to more positive experiences in PE, higher perceived learning, and greater PA intention. Likewise, structuring strategies, such as setting clear expectations, providing individualized guidance, and offering constructive feedback, are essential for helping all students feel capable and supported. Conversely, teachers should be encouraged to reduce the use of controlling practices (e.g., coercion, guilt, threats) and avoid chaotic classroom climates marked by disorganization or lack of clear guidance. These behaviors undermine students' BPN and are associated with disengagement, lower perceived learning, and diminished intention to be physically active (Vasconcellos et al., 2020). Reinforcing such negative motivational cycles may also damage the student-teacher relationship over time.

In practical terms, this process can be understood as a gradual transition rather than an abrupt change. For instance, across an academic term, a teacher who initially relies on controlling strategies (e.g., strict commands, uniform task demands, limited student input) may progressively shift toward a more autonomy-supportive and structured approach by first clarifying learning goals and success criteria, then offering differentiated task options, and finally inviting students to take partial responsibility for decision-making and self-regulation. Such a gradual transition allows teachers to maintain instructional clarity and structure while increasingly supporting students' autonomy, thereby fostering more adaptive motivational cycles over time.

While structured teacher training programs are a powerful and scalable method to foster change, meaningful development can also emerge through autonomous engagement. Teachers can improve their motivational style by reading pedagogical research, engaging in reflective practice, collaborating with peers, or observing effective teaching models. A blended approach, combining structured support with self-initiated development, may be the most sustainable route to long-lasting change (García-Cazorla et al., 2024). Post-training resources (e.g., follow-up seminars, mentoring, collaborative teaching sessions) and autonomous strategies (e.g., practical guides, peer exchanges) can further support the consistent application of motivating practices across the school year (García-Cazorla et al., 2024). Beyond individual teaching practice, these findings also underscore the role of educational administrators and curriculum designers in shaping teacher training and policy. By integrating autonomy-supportive and structuring principles, as well as reducing controlling and chaotic approaches, into teacher education curricula, professional development frameworks, and school-level policies, educational leaders can create institutional conditions that facilitate the sustained implementation of motivating teaching practices. In this sense, alignment between teacher training, ongoing professional support, and institutional expectations appears crucial for fostering motivationally supportive learning environments. As suggested by Reeve and Cheon (2024), both continuous professional

development and teacher self-reflection are key to creating a motivational climate aligned with students' psychological needs.

6. Limitations and future research directions

Despite the valuable insights provided by this longitudinal study, several limitations should be acknowledged. First, the use of self-reported measures to assess students' perceptions of (de)motivating teaching styles and motivational outcomes may have introduced response biases, such as social desirability or recency effects. Future studies could benefit from multi-method approaches, including observational assessments or teacher self-reports, to triangulate findings and provide a more comprehensive understanding of teaching behaviors. Second, the sample was drawn from 12 schools in a specific region of [omitted for peer review], which may limit the generalizability of the findings to other educational settings or cultural contexts. Nevertheless, although the sample is context-specific, the motivational mechanisms examined in this study, namely the distinction between need-supportive and need-thwarting teaching styles and their reciprocal dynamics, are grounded in SDT and the circumplex model, both of which have demonstrated robustness across educational contexts. Therefore, the observed patterns may be cautiously transferable to similar PE settings, while empirical replication remains necessary. To enhance external validity, future research should replicate this design in different regions and countries with more diverse populations. Third, while the study focused on the four (de)motivating teaching styles, it did not differentiate between the eight specific teaching approaches (e.g., participative, guiding, demanding, among others). This lack of granularity may have limited the ability to capture the nuanced ways in which specific approaches within each style influence students' motivational outcomes. However, as an intermediate step prior to future longitudinal SEM that includes all eight approaches, correlation analyses were conducted using each individual approach. These analyses offered valuable insights into their potential influence and highlighted the importance of distinguishing among them. Future studies should build on this by analyzing these approaches separately to gain a more detailed understanding of how each contributes to BPN satisfaction or frustration. In addition, although the present study statistically controlled for prior levels of (de)motivating teaching styles by including autoregressive paths across time (i.e., T1 → T3), in line with recommendations from previous longitudinal research (e.g., Jang, Basarkod, et al., 2023; Reeve & Cheon, 2024), future studies should explicitly test longitudinal measurement invariance across waves. Doing so would further strengthen causal interpretations and ensure that teaching style constructs are interpreted equivalently over time. Moreover, while autonomy and competence were prioritized due to their clear conceptual alignment with the circumplex model, future research could examine whether including relatedness satisfaction and frustration adds incremental explanatory value to reciprocal motivational models in PE. Finally, it is important to note that students' experiences in PE and perceived learning were assessed using single-item measures. Although this approach has been used in previous studies, future research would benefit from using more comprehensive, multi-item scales to better capture these constructs.

7. Conclusions

This study contributes to the growing body of research on (de)motivating teaching styles by providing longitudinal evidence of their influence on students' motivational processes and outcomes within and outside the PE context. Specifically, autonomy-supportive and structuring teaching styles perceived by students positively predict BPN satisfaction and, in turn, more adaptive outcomes such as enhanced PE experiences, perceived learning, and PA intention. In contrast, controlling and chaotic teaching styles positively impact students' BPN frustration, which longitudinally relates to less favorable outcomes. In addition, this study identifies a reciprocal dynamic between students' need-based experiences and their perceptions of subsequent teaching styles. Students who report greater BPN satisfaction over time are more likely to perceive autonomy-supportive and structuring styles later on, whereas those who experience frustration are more likely to perceive controlling and chaotic styles. These results support the idea that teacher-student motivation unfolds in a cyclical, mutually influential manner, within the shared social space of the PE classroom. Finally, by exploring cross-sectional associations at T3, this study also extends existing literature by showing how students' perceptions of teaching styles are directly linked to key outcomes—such as learning, PE experiences, and PA intention—at a single time point. This contributes to addressing a gap in prior research, where direct links between (de)motivating teaching styles and student outcomes have been less frequently examined. Altogether, these findings reinforce the need to promote motivating teaching strategies that support students' BPN. At the same time, they highlight the potential consequences of demotivating practices—not only for students' immediate experiences, but also for the long-term evolution of the motivational climate in PE.

Funding detail

This study has been funded by the Government of Aragon for the development of I+D+i projects in priority and multidisciplinary lines for the period 2024–2026. Project code: PROY S01_24.

CRediT authorship contribution statement

Luis García-González: Writing – review & editing, Project administration, Funding acquisition. **Rafael Gargurevich:** Writing – review & editing, Methodology. **Lennia Matos:** Writing – review & editing, Conceptualization. **Ángel Abós:** Writing – review & editing, Supervision. **Javier García-Cazorla:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors report there are no competing interests to declare.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.stueduc.2026.101597.

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