**Citation:**

Cronin, L., Marchant, D., Kosteli, M., Johnson, L., Varga, J., Huntley, E., & Ellison., P. (in press). Life skills development in physical education: A self-determination theory-based investigation across the school term. *Psychology of Sport and Exercise*.

# Life Skills Development in Physical Education: A Self-Determination Theory-Based Investigation Across the School Term

Lorcan Cronin, David Marchant, Laura Johnson, Emma Huntley, Maria Christina Kosteli, Joseph Varga, and Paul Ellison

Author Note

Department of Sport & Physical Activity, Edge Hill University, Ormskirk, United Kingdom.

Correspondence concerning this article should be addressed to Lorcan Cronin, Department of Sport & Physical Activity, Edge Hill University, Ormskirk, L39 4QP, United Kingdom.

Email: Lorcan.Cronin@edgehill.ac.uk; Telephone: +44 01695584109

Abstract

Objectives: Grounded in self-determination theory (SDT), the main aim of this study was to examine the longitudinal associations between teacher autonomy support, students' basic psychological need satisfaction and life skills development in physical education (PE).

Design: This study employed a two-wave longitudinal research design.

Method: Students ($N$ = 266, $M$age = 12.94 years, $SD$ = 0.70) completed measures assessing perceived autonomy-supportive teaching, need satisfaction (autonomy, competence, and relatedness), and life skills development in PE (teamwork, goal setting, social skills, problem solving and decision making, emotional skills, leadership, time management, and interpersonal communication). Data collections took place during week 6 (timepoint 1; T1) and week 15 (timepoint 2; T2) of the autumn school term.

Results: Cross-lagged panel analyses showed that T1 teacher autonomy support did not significantly predict students' three basic psychological needs, total need satisfaction or life skills development at T2. Students' T1 total need satisfaction positively predicted their development of all eight life skills at T2. Additionally, students' T1 autonomy satisfaction positively predicted their teamwork, social skills, emotional skills, leadership, and interpersonal communication skills at T2, T1 competence satisfaction positively predicted students' teamwork skills at T2, and students' T1 relatedness satisfaction positively predicted their social skills at T2.

Conclusions: Providing partial support for SDT, the findings highlighted that satisfaction of students' three basic psychological needs had some positive effects on students' life skills development in PE. As such, a climate that satisfies students' basic psychological needs should help to develop their life skills in PE.

*Keywords:* PE teaching; positive youth development; psychosocial skills; cross-lagged panel model.

Life skills are defined as "those skills that enable individuals to succeed in the different environments in which they live such as school, home and within their neighbourhoods" (Danish, Forneris, Hodge, & Heke, 2004, p. 40). Examples of life skills include leadership, interpersonal communication, problem solving and decision making, and teamwork. It is important to note that life skills must be transferable across life domains (e.g., schoolwork, home life, and relationships) to be truly considered life skills (Pierce, Gould, & Camiré, 2017). In this regard, educational and governmental organisations have highlighted that transferable life skills are important for adolescent's health, well-being, and their educational and occupational success (Artess, Hooley, & Mellors-Bourne, 2016; United Nations International Children's Emergency Fund, 2012).

But where exactly do young people acquire life skills? Settings which are purported to develop young peoples' life skills include extracurricular activities such as music, drama, and sport (Holt et al., 2017; Larson, Hansen, & Moneta, 2006). Several studies have also highlighted physical education (PE) as a setting that can enhance students' life skills (e.g., Goudas, 2010; Holt, Sehn, Spence, Newton, & Ball, 2012; Jenny & Rhodes, 2017). Moreover, a recent review by Opstoel et al. (2019) illustrated that students develop a range of different life skills in PE. There are several reasons why PE may promote students' life skills. In his review article, Bailey (2018) proposed that the popularity, attractiveness, and motivational aspects of PE are key features for promoting youth development. A study by Jacobs, Knoppers, and Webb (2013) found that Dutch PE teachers believed that the collaborative and interactive aspects of lessons promote students' social and moral development. Other studies have illustrated different teaching approaches that promote students' life skills. For example, researchers have shown that student-centred models of learning (e.g., Sport Education Model, Siedentop, 1994; Cooperative Learning, Slavin, 1995) help PE students develop their teamwork, communication, problem solving and decision

making, leadership, and social skills (Casey & Goodyear, 2015; Smither & Zhu, 2011). Likewise, the teaching personal and social responsibility model (Hellison, 2010) has been successful in developing students' goal setting, leadership, teamwork, and social skills (Escartí, Gutiérrez, Pascual, & Marín, 2010; Wright & Burton, 2008). Goudas and Giannoudis (2008) also showed that a life skills programme implemented in PE can teach students goal setting and problem solving skills. Similarly, Pesce et al. (2016) found that a life skills programme incorporated into a multisport PE context developed students' goal setting, cooperation, and decision making skills. Nonetheless, given that few of these studies incorporated relevant psychological theory, there remains a need for theory-based studies to investigate and further explain how young people develop their life skills in PE.

One theory which holds great promise for exploring life skills development is self-determination theory (SDT; Ryan & Deci, 2017). This is the case as at its core SDT is a theory of human development and wellness (Ryan & Deci, 2017). One key aspect of SDT is the level of teacher autonomy support which impacts upon students' learning and development (Reeve, 2006), and has been associated with students' life skills development in PE (Cronin, Allen, Russell, & Mulvenna, 2018). Autonomy-supportive behaviours involve the teacher adopting a student's perspective, providing choice in the activities, acknowledging students' feelings, promoting the use of initiative and problem solving, encouraging students to work together and independently, and providing a rationale for tasks (De Meyer et al., 2016; Mageau & Vallerand, 2003). Numerous intervention studies have shown that a teacher's level of autonomy support can be increased through training and positive student outcomes result from such training (Cheon, Reeve, & Song, 2016, 2019a; Cheon, Reeve, & Ntoumanis, 2018).

A second key aspect of SDT is the degree to which PE students' three basic psychological needs for autonomy, competence, and relatedness are satisfied (Haerens,

Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015). Autonomy satisfaction involves the student feeling empowered and self-directed in her/his behaviour, competence satisfaction refers to the student feeling effective in the PE environment, and relatedness satisfaction involves the student having warm and caring relationships with other students and the teacher/s (Cheon et al., 2016). Regarding the three basic needs, it is important to note that researchers can adopt both a specific-factor approach (i.e., where autonomy, competence, and relatedness satisfaction are examined separately) and a general-factor approach (i.e., where total need satisfaction is examined) in their investigations (Brunet, Gunnell, Teixeira, Sabiston, & Bélanger, 2016). Basic psychological needs theory, one of six mini theories of SDT, suggests that social contexts which satisfy peoples' basic psychological needs are necessary for optimal development to occur (Ryan & Deci, 2017). Supporting such a proposition, several studies have highlighted that satisfaction of students' three basic needs is positively related to adaptive student outcomes in PE (for a review, see Vasconcellos et al., in press) including life skills development (Cronin et al., 2019).

Combining teacher autonomy support and basic need satisfaction, several researchers have suggested that autonomy support fosters an individual's development because it nurtures their three basic needs (Mageau & Vallerand, 2003; Vansteenkiste & Ryan, 2013). In this regard, Hodge and colleagues (Hodge, Danish, Forneris, & Miles, 2016; Hodge, Danish, & Martin, 2012) specified via their conceptual model for life skills development that these aspects of SDT could be used to investigate and promote peoples' life skills. Through their model, Hodge and colleagues (2012, 2016) proposed the following set of relationships: need-supportive climate –> basic need satisfaction –> life skills development. Specifically, these researchers outlined how various SDT-based variables (e.g., an autonomy-supportive climate and satisfaction of the needs for autonomy, competence and relatedness) may be related to the development of peoples' life skills. For example, Hodge et al. (2012) explained

how perceptions of autonomy satisfaction could increase opportunities for people to solve problems and make decisions, act as a leader, and set personal goals to work towards. These researchers also highlighted how competence satisfaction in any domain extends to people's social skills, interpersonal communication, and problem solving and decision making. Additionally, Hodge et al. (2012) outlined the connections between relatedness satisfaction and people's teamwork (e.g., cooperating with others) and social skills (e.g., increased social interest and responsibility). The conceptual model for life skills development (Hodge et al., 2012, 2016) is particularly important as it provides researchers with a theory-based model to investigate young peoples' life skills development in any domain.

Utilising Hodge et al.'s (2012, 2016) conceptual model for life skills development, Cronin et al. (2019) found that teacher autonomy support was positively related to the satisfaction of students' three basic needs, total need satisfaction, and life skills development in PE. Additionally, these researchers found that autonomy and relatedness satisfaction – along with total need satisfaction – was positively associated with the development of teamwork, goal setting, social skills, problem solving and decision making, emotional skills, leadership, time management, and interpersonal communication skills in PE; whereas, competence satisfaction was positively related to students' development of teamwork, goal setting, and leadership skills in PE. The unstandardized regression coefficients for these associations ranged from .12 to .85 (*M* regression coefficient = .41). In doing so, this was the first study to provide support for Hodge et al.'s (2012, 2016) conceptual model for life skills development and utilise SDT to investigate life skills development in PE. Nonetheless, given the cross-sectional nature of Cronin et al.'s (2019) findings, it was important for the present study to conduct a longitudinal investigation of students' life skills development in PE. Using cross-lagged panel models (CLPMs), this study would allow for an assessment of

potential longitudinal associations between students' perceptions of teacher autonomy support, basic psychological need satisfaction and life skills development in PE.

**The Present Study**

Using SDT (Ryan & Deci, 2017) as a theoretical framework, the novel purpose of this study was to investigate students' life skills development in PE over the course of a school term, with data collections taking place during week 6 (T1) and week 15 (the final week) of the autumn school term (T2). Figure 1 contains the first CLPM tested, which included the three basic needs separately. A second CLPM was also tested and included total need satisfaction. The first study aim was to investigate if students' perceptions of teacher autonomy support at T1 would positively predict their need satisfaction and life skills development at T2. Based on SDT (Ryan & Deci, 2017) and previous longitudinal and cross-sectional studies (Cheon et al., 2018; Cronin et al., 2019), it was hypothesised that T1 teacher autonomy support would positively predict students' need satisfaction and life skills development at T2. The second aim was to assess if students' need satisfaction at T1 would positively predict their life skills development at T2. Based on Hodge et al.'s (2012, 2016) conceptual model for life skills development and past cross-sectional studies (Cronin et al., 2019), it was hypothesised that satisfaction of students' three basic needs and total need satisfaction at T1 would positively predict their life skills development at T2. The third aim was to explore potential reciprocal effects between students' basic need satisfaction at T1 and teacher autonomy support at T2, and students' life skills development at T1 and need satisfaction at T2. Other SDT-based studies have highlighted the importance of investigating potential reciprocal effects (e.g., Cheon et al., 2018; Jang, Reeve, Cheon, & Song, 2019) and given the mixed findings of these studies no specific hypotheses were made for this exploratory aim. The final aim was to assess the stability of the study variables across the school term and investigate whether there were mean score differences for the study variables

across the two timepoints. Based on past SDT-based studies involving other positive outcomes (e.g., Cheon et al., 2018, 2019a), it was hypothesised that there would be significant stability within each variable across the school term (i.e., $p < .05$ for the autoregressive effects). Given that no intervention was to take place in the present study, it was also hypothesised that there would be no significant differences between T1 and T2 scores for the study variables (i.e., $p > .05$ for the repeated-measures MANOVA).

## Method

### Participants

The study included 266 PE students ($M_{age}$ = 12.94 years, $SD$ = 0.70, range = 11–14) and comprised of female ($n$ = 145) and male ($n$ = 118) students (three students failed to indicate their gender) from two schools in England. The schools were both non-denominational public schools that catered for pupils aged 11–18 years from the surrounding areas. Participants were predominantly English (93.6%), with a few other ethnicities included in the sample (e.g., mixed race, French, and Chinese). The students took part in PE for an average of 2.03 hours per week ($SD$ = 0.31) and 34.2% of the sample were taking PE as an exam subject. Overall, 86.8% of students took part in sports outside of PE for an average of 5.34 hours per week. Additionally, 67.3% of students engaged in other forms of exercise (e.g., walking, cycling, and going to the gym) for an average of 3.07 hours per week. In total, 14 teachers and 17 classes were included in the sample, with an average of 15.6 students per class (range = 7–29). Although the pedagogical approach of the teachers was not assessed, none of the PE departments indicated that their teachers focused on life skills in their lessons. In PE lessons, students participated in a range of different sports (e.g., soccer, gymnastics, and basketball) and exercise activities (e.g., gym-based cardiovascular and muscular exercise). This is typical of PE in England where the curriculum aims to ensure that students develop competencies in a broad range of sport and exercise domains so that

they can lead active and healthy lives (Department of Education, 2014). According to the national curriculum (Department of Education, 2014), PE lessons in England involve teaching students: skills and techniques for sports and exercise, sport-specific tactics and strategies, the ability to analyse one's own performance, and the skills needed for long-term physical activity.

## Measures

**Teacher autonomy support.** Students' perceptions of teacher autonomy support were assessed using a 10-item scale previously used and described by Cronin et al. (2019). The item stem of the scale is "My PE teacher…" and example items include: "Gives students a chance to input into class content" and "Encourages students to use their initiative". Students respond to items on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronin et al. (2019) previously evidenced the factorial validity and internal consistency reliability of this scale with PE students. For the current sample, the alpha values for the scale were above the .70 criteria (Nunnally & Bernstein, 1994) for adequate internal consistency reliability: T1 ($\alpha = .93$) and T2 ($\alpha = .94$).

**Basic need satisfaction.** Need satisfaction in PE was assessed using 12 items from the PE version (Haerens et al., 2015) of the Basic Need Satisfaction and Frustration Scale (Chen et al., 2015). The item stem for the scale is "During PE lessons..." and four items assess autonomy satisfaction ("I feel that the exercises reflect what I really want"), competence satisfaction ("I feel capable at what I am doing"), and relatedness satisfaction ("I feel that the class members I care about also care about me"). Students respond to items on a scale ranging from 1 (*not true at all*) to 5 (*completely true*). Haerens et al. (2015) provided evidence for the validity and reliability of this scale with PE students. In the current study, the alpha values for the three subscales and total need satisfaction at T1 and T2 ranged from .86–.93.

**Life skills development.** The 43-item Life Skills Scale for PE (LSSPE; Cronin et al., 2018; Cronin et al., 2019) was used to measure students' perceived life skills development in PE. The item stem for this scale is "PE classes have taught me to…" and example items include: teamwork (7 items; "work with others for the good of the team/group"), goal setting (7 items; "set specific goals"), social skills (5 items; "interact in various social settings"), problem solving and decision making (4 items; "evaluate a solution to a problem"), emotional skills (4 items; "know how to deal with my emotions"), leadership (8 items; "set high standards for the team/group"), time management (4 items; "control how I use my time"), and interpersonal communication (4 items; "communicate well with others"). Students respond to items on a scale ranging from 1 (*not at all*) to 5 (*very much*). The factorial validity and internal consistency reliability of the scale has been supported with PE students (Cronin et al., 2019). In the present study, the alpha values for the eight subscales at T1 and T2 ranged from .84–.93.

## Procedures

Following approval from the university's ethics committee, schools were recruited via email and subsequent face-to-face meetings with head PE teachers of the two schools. The data collection took place in PE lessons during weeks 6 and 15 (the final week) of the autumn school term. Data was collected during week 6 to ensure that students received enough PE lessons to be able to provide an accurate judgement of the teacher, the climate, and their life skills development in PE. The T2 data was collected during week 15 (i.e., nine weeks later) as the students were due to change PE teacher at the beginning of the next school term. Importantly, the nine-week time-lag was in line with other studies which have found associations between need satisfaction and positive outcomes in PE (e.g., Cheon et al., 2019a). Parent or guardian passive consent (via an opt out form) was obtained as requested by the participating schools. In addition, each participant signed an informed consent form

before taking part in the research. Students completed the survey after the researcher gave an introductory statement which explained the purpose of the study, that the survey was anonymous, there were no right or wrong answers, and all information would be kept confidential. The researcher also explained that students were to answer the questions based on their experiences of their current PE lessons and teacher during the autumn school-term. The survey took approximately 15–20 minutes to complete on each occasion.

**Statistical Analyses**

SPSS Version 25.0 (IBM Corporation, 2017) was used for the preliminary analyses, descriptive statistics, and the correlations between study variables. Confirmatory factor analysis was conducted in Amos Version 25 (IBM Corporation, 2017) to assess the factorial validity and invariance of the models using the following fit indices: chi-square statistic divided by degrees of freedom ($\chi^2/df$), root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker Lewis index (TLI), and the standardised root mean square residual (SRMR). A chi-square value relative to *df* ratio of 3:1 or lower was indicative of adequate model fit (Tabachnick & Fidell, 2013). In line with Marsh, Hau, and Wen's (2004) recommendations, an RMSEA value of less than .08 or .05 represented a reasonable or close fit to the data respectively; whereas, CFI and TLI values greater than .90 or .95 indicated acceptable and excellent fit respectively. An SRMR value of .08 or below indicated satisfactory fit (Hu & Bentler, 1999). It is important to note that the models in the current study were both complex and sizable as 10 to 12 factors and 65 scale items were included at both timepoints. Therefore, in line with the advice of several researchers (e.g., Marsh, 2007; Shi, Lee, & Maydeu-Olivares, 2019), the complexity and size of the model was taken into account when judging model fit. This approach was taken as the model size effect suggests that it can be very difficult to achieve adequate fit with complex models that include a large number (i.e., > 30) of observed variables (Marsh, 2007; Moshagen, 2012; Shi et al., 2019).

The invariance of the complete measurement model across T1 and T2 was assessed as a prerequisite to assessing the relationships between variables and mean score differences across timepoints (Putnick & Bornstein, 2016). Testing measurement invariance involves comparing a series of increasingly constrained nested models and assessing whether differences between the models are significant (Van de Schoot, Luptig, & Hox, 2012). Specifically, five forms of invariance were tested: configural invariance (i.e., invariance of model form), metric invariance (i.e., equivalence of the item loadings on the factors), scalar invariance (i.e., equivalence of item intercepts), factor covariance invariance (i.e., equivalence of the factor relationships across time), and residual invariance (i.e., equivalence of item residuals). The following changes in fit indices were used for judging the measurement model to be invariant across timepoints: changes in the RMSEA values of less than .010, differences in the CFI values of less than -.005, changes in the TLI values of less than .05, and differences in the SRMR values of less than .005 (Chen, 2007; Little, 1997).

The CLPMs were analysed in Amos Version 25.0 (IBM Corporation, 2017) using maximum likelihood estimation. A simplified illustration of the first CLPM is contained in Figure 1. The CLPMs were constructed based on the guidance provided for the multiple indicator variable approach by Stenling, Ivarsson, and Lindwall (2016). Specifically, cross-lagged, reciprocal, and autoregressive effects were included in the models to test the hypotheses. Cross-lagged effects refer to the effect of T1 variables on other T2 variables and corresponds to the direction of the effects. Reciprocal effects refer to the effect of variable X at T1 on variable Y at T2, in combination with the effect of variable Y at T1 on variable X at T2 (i.e., assessing potential reverse effects). Autoregressive effects refer to each variable at T1 being allowed to predict itself at T2. Larger coefficients for the autoregressive effect indicate a smaller change in the variable over time (Stenling et al., 2016). $R^2$ values (i.e., the variance explained) for each outcome variable in the CLPMs were converted to Cohen's $f^2$

(an effect size measure) using the following formula ($R^2$ divided by 1 - $R^2$) and can be judged as small ($f^2 \geq .02$), medium ($f^2 \geq .15$), or large ($f^2 \geq .35$) based on Cohen's (1988) guidelines. Lastly, SPSS Version 25.0 (IBM Corporation, 2017) was utilised to conduct a repeated-measures MANOVA to assess potential mean score differences for T1 to T2 scores.

## Results

### Preliminary Analyses

Of the 369 students who completed the survey at T1, 266 students completed the survey at T2 (i.e., a 72.1% response rate). A MANOVA showed that there were no differences between the dropout students and those who persisted in the study on all variables measured at T1: $F$ (12, 356) = 1.25, Wilk's $\lambda$ = .96, $p$ = .25. With the sample of 266 students, missing value analysis indicated that each individual item was left blank an average of 1.18 times ($SD$ = 1.4) and the data was missing at random. As the percentage of missing data was very low (0.4%) and to minimise lost data, a mean substitution was performed. According to Tabachnick and Fidell (2013), mean substitution is a valid approach when a small percentage of data (< 5%) is missing from a moderately sized sample, as was the case in the current study. The main study variables were then assessed for normality, with skewness values ranging from -0.60 to 0.14 and kurtosis values ranging from -1.15 to 0.54, indicating reasonable normality (Tabachnick & Fidell, 2013). Potential gender differences were assessed and results showed gender differences for the study variables (see supplementary materials). Therefore, gender was controlled for in each of the CLPMs.

### Descriptive Statistics

Table 1 presents the mean scores, standard deviations, reliability coefficients, and correlations for the study variables. The mean scores for perceived teacher autonomy support at T1 and T2 were 3.73 and 3.61 respectively on the 1–5 response scale. The mean scores for the three basic needs on the 1–5 response scale at each time point were as follows: autonomy

satisfaction (T1 = 3.13, T2 = 3.08), competence satisfaction (T1 = 3.56, T2 = 3.54), and relatedness satisfaction (T1 = 3.11, T2 = 3.22). Mean scores for life skills development on the 1–5 response scale at the two timepoints were as follows: teamwork (T1 = 3.71, T2 = 3.58), goal setting (T1 = 3.41, T2 = 3.27), social skills (T1 = 3.16, T2 = 3.06), problem solving and decision making (T1 = 3.07, T2 = 2.97), emotional skills (T1 = 2.70, T2 = 2.66), leadership (T1 = 3.37, T2 = 3.28), time management (T1 = 3.05, T2 = 2.97), and interpersonal communication (T1 = 3.25, T2 = 3.12). The correlations between the study variables at T1 and T2 (see Table 1) ranged from .22 to .68 (all $p$ values were < .001).

**Model Fit and Invariance Testing**

Prior to conducting the main statistical analyses, the following were assessed: the fit of the measurement scales, the invariance of the complete measurement model across the timepoints, and the model fit of the CLPMs. The results of the CFA analyses are contained in Table A of the supplementary materials. The results showed that the individual measurement scales provided an adequate fit at both timepoints. It must be noted that although the autonomy support scale at T2 had two fit indices marginally above the outlined criteria, this scale could be viewed as displaying adequate fit as the three other fit indices suggested an adequate fit and all items displayed ‘excellent’ factor loadings according to Comrey and Lee’s (1992) criteria. The complete measurement models also provided an adequate fit at both timepoints, with the only fit index outside the adopted criteria being the .89 TLI value for the complete measurement model at T1. Table B of the supplementary materials contains the results of the invariance testing. These results show that little change was evident when comparing the RMSEA, CFI, TLI, and SRMR values across the five models tested. Specifically, the changes in the fit indices across the models were less than the criteria adopted for the complete measurement model to be invariant across the timepoints. Lastly, the results showed that the CLPMs at both timepoints provided an

adequate fit based on the $\chi^2/df$, RMSEA and SRMR fit indices (see Table A). Given the complexity and size of the models tested for the cross-lagged panel analyses, it was unsurprising that the CFI and TLI values were below the .90 criteria outlined earlier. This was likely the case as research (e.g., Shi et al., 2019) has highlighted that these fit indices are downwardly biased in models with a large number of observed variables (> 30) and past studies have shown that it is difficult to satisfy acceptable fit standards when testing such complex and large models (Marsh, 2007; Moshagen, 2012; Shi et al., 2019).

## Cross-Lagged Panel Analyses

Figure 2 displays the statistically significant regression coefficients for the CLPM which included the three basic needs. Figure 3 displays the statistically significant regression coefficients for the CLPM that included total need satisfaction. All other paths in the models were non-significant and therefore not displayed in Figures 2 and 3.

**Cross-lagged effects.** Figures 2 and 3 show that students' perceptions of teacher autonomy support at T1 did not significantly predict their autonomy satisfaction, competence satisfaction, relatedness satisfaction, total need satisfaction, or life skills development at T2 (i.e., these cross-lagged paths were not statistically significant). Figure 2 illustrates that students' T1 autonomy satisfaction positively predicted their development of teamwork, social skills, emotional skills, leadership, and interpersonal communication skills at T2, T1 competence satisfaction positively predicted students' development of teamwork skills at T2, and students' T1 relatedness satisfaction positively predicted their development of social skills at T2. All other cross-lagged paths involving the three needs were not statistically significant and therefore not displayed in Figure 2. Figure 3 illustrates that students' T1 total need satisfaction positively predicted their development of all eight life skills at T2.

**Reciprocal effects.** Figure 2 shows that students' T1 autonomy satisfaction positively predicted their perceptions of T2 teacher autonomy support. Conversely, students' T1

competence satisfaction negatively predicted their perceptions of T2 teacher autonomy support. Of the eight life skills, only students' T1 social skills development positively predicted their T2 competence satisfaction.

**Autoregressive effects and mean differences.** Figures 2 and 3 show that the autoregressive effects were statistically significant from T1 to T2 for all variables. Overall, larger autoregressive effects (i.e., coefficients that were greater in size) were evident for teacher autonomy support and the three basic needs as compared to the eight life skills. A repeated-measures MANOVA evaluating changes in scores on the 12 study variables over time was significant: $F(12, 254) = 2.37$, Wilk's $\lambda = .90$, $p = .007$, $\eta 2 = .10$. Bonferroni-corrected pairwise comparisons of T1 and T2 scores revealed statistically significant decreases in the following variables: teacher autonomy support, $M_{\text{difference}} = -0.12$, $p = .013$; teamwork, $M_{\text{difference}} = -0.13$, $p = .005$; goal setting, $M_{\text{difference}} = -0.15$, $p = .005$; and interpersonal communication skills, $M_{\text{difference}} = -0.13$, $p = .045$.

**Variance explained.** Figures 2 and 3 show that the CLPMs explained a considerable portion of the variance in the outcome variables at T2 ($R^2$ range = .29–.61). After converting the $R^2$ values to Cohen's $f^2$ values ($f^2$ range = 0.41 to 1.56), these effect sizes were judged as large in magnitude according to Cohen's (1988) guidelines.

## Discussion

The novel purpose of the present study was to assess students' life skills development in PE across a school term using SDT (Ryan & Deci, 2017) as a theoretical framework. Addressing the first study aim, contrary to the hypothesis students' perceptions of teacher autonomy support at T1 did not positively predict their basic psychological need satisfaction or life skills development at T2. The latter finding contrasts with Cronin et al.'s (2019) cross-sectional study which found positive associations between teacher autonomy support and students life skills development in PE. Moreover, the former finding does not support

the propositions of SDT (Ryan & Deci, 2017) and contrasts with Vasconcellos et al.'s (in press) meta-analysis of the SDT in PE literature which found positive correlations between teacher autonomy support and satisfaction of students' three basic psychological needs. The finding may differ from the meta-analyzed correlations of Vasconcellos et al. (in press) as the CLPMs in the current study controlled for T1 correlations between variables and autoregressive effects when assessing whether T1 teacher autonomy support predicted T2 students' basic need satisfaction. In this regard, Adachi and Willoughby (2015) found that controlling for T1 correlations between variables and autoregressive effects greatly reduces the magnitude of the effect of a T1 predictor variable on a T2 outcome variable. In terms of longitudinal PE studies, several intervention studies in Korea have found that teacher autonomy support measured during week 1 of the school term positively predicted students' need satisfaction during week 10 of the school term, although the size of the effects are small (Cheon et al., 2018; Jang et al., 2019). The findings from the present study may contrast with these studies because the study did not include an intervention that would alter teachers' levels of autonomy support and students' subsequent ratings of need satisfaction. As the findings differ from the research literature, further longitudinal studies involving naturalistic PE classes (i.e., where no intervention takes place) are needed to confirm or disconfirm the lack of longitudinal associations between teacher autonomy support and students' need satisfaction in the current study.

In terms of the second aim, the present study showed that students' total need satisfaction at T1 positively predicted their development of the eight life skills at T2. This is the first study to provide longitudinal evidence that the three needs combined (i.e., total need satisfaction) play a key role in predicting students' life skills development in PE. Such a finding aligns with past cross-sectional studies (e.g., Cronin et al., 2019) and supports Hodge et al.'s (2012, 2016) proposition that satisfaction of the three needs combined is important for

people to develop their life skills. Based on Vallerand's (1997) SDT-based motivational sequence, a student's motivation may be the mechanism that explains the longitudinal associations between need satisfaction and life skills development in PE. That is, greater basic need satisfaction predicts higher levels of self-determined motivation; which, in turn, predicts greater life skills development in PE.

Regarding students' three basic needs, the findings showed that students' T1 autonomy satisfaction positively predicted teamwork, social skills, emotional skills, leadership, and interpersonal communication skills at T2. This finding supports the propositions that autonomy is a key factor influencing young peoples' development (Soenens, Vansteenkiste, & Van Petegem, 2018) and autonomy satisfaction is the most central aspect of SDT (Cheon et al., 2019b). It also supports Hodge et al.'s (2012, 2016) proposed links between autonomy satisfaction and people's leadership skills; whereas, it does not support their proposed links between autonomy satisfaction and people's problem solving, decision making, and goal setting skills. Students' T1 competence satisfaction positively predicted their leadership skills at T2. This may be the case as feeling competent in one's abilities provides students with the confidence to lead others in PE. In contrast to Hodge et al.'s (2012, 2016) propositions, T1 competence satisfaction did not significantly predict T2 teamwork, social skills, problem solving, and interpersonal communication skills. Lastly, T1 relatedness satisfaction only positively predicted students' social skills at T2. This is not a surprising finding given the close links between having warm and caring relationships with others and one's social skills. Moreover, such a finding supports Hodge et al.'s (2012, 2016) idea that relatedness satisfaction ought to be associated with people's social skills; whereas, the findings did not support the idea that relatedness satisfaction ought to be related to people's teamwork skills (Hodge et al., 2012, 2016).

Overall, the findings related to the second study aim provided partial support for the

hypothesis that satisfaction of students' three needs at T1 would positively predict their development of the eight life skills at T2. Of the three needs measured in the current study, T1 autonomy satisfaction had the most consistent effects on life skills development at T2. Importantly, the findings indicate that to optimally develop their students' life skills in PE, teachers should aim to satisfy students' three basic needs combined whilst paying particular attention to satisfying their need for autonomy.

From an applied standpoint, several researchers have suggested practical ways that PE teachers can satisfy students three basic needs (e.g., Ntoumanis, 2012; Reeve, 2016). To increase students' autonomy satisfaction, teachers can provide students with choice (e.g., different activities or game rules they can choose from), promote their initiative and problem solving (e.g., by asking students to set up the sports hall and equipment for the lesson), empathise with students' perspectives (e.g., I understand that you may not enjoy all the drills), and explain the rationale for certain activities (e.g., you need to learn the basic skill of passing before moving to game situations). In addition, PE teachers could promote students' autonomy satisfaction by empowering them to take ownership of life skills such as teamwork (e.g., what formation their team will adopt in a game), goal setting (e.g., what personal goals they will set for skill development), social skills (e.g., how will they ensure that every student participates in the social group), emotional skills (e.g., allow students' to discuss how to manage their emotions when faced with a poor refereeing decision), time management (e.g., encourage students' to plan the amount of time they spend on different activities), and interpersonal communication (e.g., task students with ensuring that each team member is allowed to speak during a break in the game).

To increase students' competence satisfaction, teachers ought to set challenges that are at the correct skill level for students, provide positive feedback that is both constructive and informative, and encourage students to adopt self-referenced as opposed to competitive

standards. Specific to the eight life skills, teachers could enhance students' competence for particular life skills by defining and describing the life skill being taught during the lesson (e.g., define interpersonal communication and list its components on a white board), creating game-based scenarios that focus on developing a specific life skill (e.g., removing a player from one team to allow them to develop their problem solving and decision making skills), and asking students to reflect on what they have learned about a specific life skill during a lesson (e.g., advising students to keep a diary to reflect on how they developed their competence for a particular life skill during PE).

To increase relatedness satisfaction, teachers can use small group activities in lessons, allow for peer-learning groups, encourage students to adopt group level goals that they work together to achieve, communicate in a friendly manner, and show that they value and care for their students. Additionally, teachers could allow time for group discussions of life skills (e.g., discuss how leadership skills developed in PE could be transferred to other settings), promote empathy amongst students (e.g., by encouraging them to reflect on how consistently not passing to a student might affect their emotions), and setting the group task of planning next week's PE lesson (e.g., to help students plan how to manage the time for different activities during a lesson). Overall, by satisfying students' three basic psychological needs combined, teachers should have a positive effect on the development of students' life skills in PE. Intervention studies training PE teachers to satisfy all three of their students' basic needs should look to further investigate this proposal.

Addressing the third study aim which was exploratory in nature, only three reciprocal effects were found in the present study. Students' T1 autonomy satisfaction positively predicted T2 teacher autonomy support, T1 competence satisfaction negatively predicted T2 teacher autonomy support, and students' T1 social skills development positively predicted their T2 competence satisfaction. The positive reciprocal effects suggest that higher scores

on autonomy satisfaction and social skills development will lead to higher later perceptions of teacher autonomy support and competence satisfaction respectively. Conversely, it seems that higher scores on competence satisfaction will lead to lower later perceptions of teacher autonomy support. Interestingly, in their path analyses (as opposed to their meta-analyzed correlations), Vasconcellos et al. (in press) also found a negative association between students' competence satisfaction and PE teachers' autonomy support. Given the unexpected nature of these results, future research is needed to further investigate such findings in another sample of PE students. Overall, the low number of reciprocal effects, as compared to the numerous cross-lagged effects, suggests that the direction of the effects align with the propositions of SDT (Ryan & Deci, 2017) and the conceptual model for life skills development (Hodge et al., 2012, 2016). For instance, satisfaction of students' three basic needs at T1 had 10 positive predictions of students' life skills development at T2; whereas, only students' social skills at T1 positively predicted their competence satisfaction at T2.

Regarding the final study aim, the findings from the present study showed that the variables assessed remained significantly stable across the school term. In line with other studies (Cheon et al., 2018, 2019a), this supported the hypothesis that T1 and T2 scores would remain stable from week 6 to 15 of the school term. Interestingly, a novel trend was that scores for the eight life skills showed lesser stability across the school term as compared to scores for the other variables. This finding indicates that teacher's autonomy-supportive behaviours and students' basic need satisfaction may be more stable across the school term as compared to students' perceptions of their life skills development in PE. The lesser degree of stability means that life skills development may be quite malleable during the school term and consequently teachers should regularly work towards promoting students' life skills in their PE lessons. Additionally, future longitudinal studies are needed to investigate fluctuations in life skills development that may occur across the school term. Contrary to the

study hypothesis, analysis of T1 to T2 mean scores revealed an overall decrease in scores across all study variables combined, along with specific decreases in teacher autonomy support, teamwork, goal setting, and interpersonal communication skills. An awareness of declining student ratings across the school term means that teachers could amplify their efforts to display autonomy supportive behaviors, satisfy students' three basic needs, and support their life skills development as the term progresses. Declining student scores may have occurred in the study due to the PE environment marginally changing for the worse during the school term. Possible causes for such a phenomenon could be that the teachers started the term with good intentions (which resulted in higher T1 scores), but such intentions decreased across the school term due to accumulating levels of teacher stress and/or a changing focus on preparing students for upcoming end-of-term assessments. Interestingly, the same phenomenon of decreasing levels of students' outcomes has been seen in previous studies of naturally occurring PE lessons where no intervention took place (Bartholomew et al., 2018). Additionally, longitudinal studies of burnout in soccer and dance have shown decreases in autonomy support and basic need satisfaction over time (Balaguer et al., 2012; Quested & Duda, 2011). Clearly more research is required to see why students' perceptions of teacher autonomy support, basic need satisfaction, and life skills development may decrease across a school term.

**Limitations and Future Directions**

The current study provided some interesting and novel findings but had several limitations that need to be discussed. To begin, student self-report was used in the study, but this approach has limits in terms of response accuracy and social desirability (Brenner & DeLamater, 2014; Donaldson & Grant-Vallone, 2002). Given that student, teacher and observer reports of SDT variables can differ (Aelterman, Vansteenkiste, Van den Berghe, De Meyer, & Haerens, 2014), future studies should utilise independent classroom observers to

corroborate students' ratings. A second limitation of the study was the use of CLPMs to analyse the data, as there has been some criticism of CLPMs in the research literature (e.g., Hamaker, Kuiper, & Grasman, 2015; Herzog & Nesselroade, 2003). For example, Hamaker, et al. (2015) pointed out that CLPMs do not account for trait-like time-invariant stability of a construct in the analyses and that three waves of data should be gathered for longitudinal analyses of variables over time. Additionally, it is important to note that two of the five fit indices (i.e., the CFI and TLI) in the current study did not display an adequate fit for the CLPMs. Given these limitations, any results from the CLPMs should be interpreted with caution. A third limitation was that the mediational aspect of SDT (Mageau & Vallerand, 2003) was not assessed in the present study (i.e., basic need satisfaction mediating potential relationships between teacher autonomy support and students' life skills development in PE). This was the case as data was only gathered at two time points; whereas, three time points are necessary to conduct longitudinal mediation analysis (Cole & Maxwell, 2003; Ntoumanis & Appleton, 2016). A fourth limitation of the present study was the sole focus on teacher autonomy support. Addressing Vasconcellos and colleagues (in press) suggestion that additional aspects of need support should be investigated, future research ought to assess how teacher competence support (e.g., structure) and relatedness support (e.g., interpersonal involvement) – along with peer need support – affect students' need satisfaction and life skills development in PE. In this regard, further knowledge of the mechanisms by which students develop their life skills in PE will be an important development for the research literature (Bailey, 2018). A final limitation was that aspects of the dark side of SDT (Cheon et al., 2016) such as controlling teaching and need frustration were not assessed in this study. Although this decision was taken due to the lack of relationships between the dark side variables and life skills development in past cross-sectional studies (Cronin et al., 2019), future studies could endeavor to assess the combined effect of bright and dark side variables

on students' life skills development in PE.

## Conclusion

Utilising SDT (Ryan & Deci, 2017) and Hodge et al.'s (2012, 2016) conceptual model for life skills development, this is the first longitudinal study to show that students' need satisfaction early in the school term positively predicted their end of term perceptions of life skills development in PE. Such a finding demonstrates the potential for future SDT-based interventions to target the three basic psychological needs of autonomy, competence, and relatedness to optimise students' life skills development in PE. In practice, the findings suggest that PE teachers interested in students' life skills development should endeavour to create a climate that fosters students' three basic psychological needs. Ultimately, further theory-based studies investigating and promoting students' life skills development in PE ought to lead to evidence-based practices for PE teachers to adopt to develop their students' life skills.

600 References

601 Adachi, P., & Willoughby, T. (2015). Interpreting effect sizes when controlling for stability
602 effects in longitudinal autoregressive models: Implications for psychological
603 science. *European Journal of Developmental Psychology*, *12*(1), 116–128.
604 Aelterman, N., Vansteenkiste, M., Van den Berghe, L., De Meyer, J., & Haerens, L. (2014).
605 Fostering a need-supportive teaching style: Intervention effects on physical education
606 teachers' beliefs and teaching behaviors. *Journal of Sport & Exercise Psychology,*
607 *36*(6), 595–609.
608 Artess, J., Hooley, T., & Mellors-Bourne, R. (2017). *Employability: A Review of the*
609 *Literature 2012–2016*. Retrieved from https://www.heacademy.ac.uk/knowledge-
610 hub/employability-review-literature-2012-2016
611 Bailey, R. (2018). Sport, physical education and educational worth. *Educational Review,*
612 *70*(1), 51–66.
613 Balaguer, I., González, L., Fabra, P., Castillo, I., Mercé, J., & Duda, J. L. (2012). Coaches'
614 interpersonal style, basic psychological needs and the well-and ill-being of young
615 soccer players: A longitudinal analysis. *Journal of Sports Sciences, 30*(15), 1619–
616 1629.
617 Bartholomew, K. J., Ntoumanis, N., Mouratidis, A., Katartzi, E., Thøgersen-Ntoumani, C., &
618 Vlachopoulos, S. (2018). Beware of your teaching style: A school-year long
619 investigation of controlling teaching and student motivational experiences. *Learning*
620 *and Instruction*, *53*, 50–63.
621 Brenner, P. S., & DeLamater, J. D. (2014). Social desirability bias in self-reports of physical
622 activity: Is an exercise identity the culprit? *Social Indicators Research, 117*(2), 489–
623 504.

Brunet, J., Gunnell, K. E., Teixeira, P., Sabiston, C. M., & Bélanger, M. (2016). Should we be looking at the forest or the trees? Overall psychological need satisfaction and individual needs as predictors of physical activity. *Journal of Sport & Exercise Psychology, 38*(4), 317–330.

Casey, A., & Goodyear, V. A. (2015). Can cooperative learning achieve the four learning outcomes of physical education? A review of literature. *Quest, 67*(1), 56–72.

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal, 14*(3), 464–504.

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J.,... Ryan, R. M. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*, *39*(2), 216–236.

Cheon, S. H., Reeve, J., Lee, Y., Ntoumanis, N., Gillet, N., Kim, B. R., & Song, Y. G. (2019b). Expanding autonomy psychological need states from two (satisfaction, frustration) to three (dissatisfaction): A classroom-based intervention study. *Journal of Educational Psychology, 111*(4), 685–702.

Cheon, S. H., Reeve, J., & Ntoumanis, N. (2018). A needs-supportive intervention to help PE teachers enhance students' prosocial behavior and diminish antisocial behavior. *Psychology of Sport and Exercise, 35*, 74–88.

Cheon, S. H., Reeve, J., & Song, Y. G. (2019a). Recommending goals and supporting needs: An intervention to help physical education teachers communicate their expectations while supporting students' psychological needs. *Psychology of Sport and Exercise, 41*, 107–118.

Cheon, S. H., Reeve, J., & Song, Y. G. (2016). A teacher-focused intervention to decrease PE students' amotivation by increasing need satisfaction and decreasing need frustration. *Journal of Sport & Exercise Psychology, 38*(3), 217–235.

649 Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*. Hillsdale, NJ:
650 Erlbaum.
651 Cole, D. A., & Maxwell, S. E. (2003). Testing mediational models with longitudinal data:
652 Questions and tips in the use of structural equation modeling. *Journal of Abnormal*
653 *Psychology, 112*, 558–577.
654 Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis* (2nd ed.). Hillsdale, NJ:
655 Erlbaum.
656 Cronin, L., Allen, J., Russell, P., & Mulvenna, C. (2018). Life skills development and well-
657 being in physical education: The importance of the teaching climate and the 'pile-up'
658 effect of total life skills. *Physical Education and Sport Pedagogy, 23*(2), 181–196.
659 Cronin, L., Marchant, D., Allen, J., Mulvenna, C., Cullen, D., Williams, G., & Ellison, P.
660 (2019). Students' perceptions of autonomy-supportive versus controlling teaching and
661 basic need satisfaction versus frustration in relation to life skills development in
662 physical education. *Psychology of Sport and Exercise, 44*, 79–89.
663 Danish, S., Forneris, T., Hodge, K., & Heke, I. (2004). Enhancing youth development
664 through sport. *World Leisure*, *46*(3), 38–49.
665 Donaldson, S. I., & Grant-Vallone, E. J. (2002). Understanding self-report bias in
666 organizational behavior research. *Journal of Business and Psychology, 17*(2), 245–
667 260.
668 De Meyer, J., Soenens, B., Vansteenkiste, M., Aelterman, N., Van Petegem, S., & Haerens,
669 L. (2016). Do students with different motives for physical education respond
670 differently to autonomy-supportive and controlling teaching? *Psychology of Sport and*
671 *Exercise, 22*, 72–82.
672 Department for Education. (2014). *The national curriculum in England: Key stages 3 and 4*
673 *framework document.* Retrieved from https://assets.publishing.service.gov.uk

/government/uploads/system/uploads/attachment_data/file/840002/Secondary_national_curriculum_corrected_PDF.pdf

Escartí, A., Gutiérrez, M., Pascual, C., & Marín, D. (2010). Application of Hellison's teaching personal and social responsibility model in physical education to improve self-efficacy for adolescents at risk of dropping-out of school. *The Spanish Journal of Psychology*, 13(2), 667–676.

Goudas, M. (2010). Prologue: A review of life skills teaching in sport and physical education. *Hellenic Journal of Psychology*, *7*, 241–258.

Goudas, M., & Giannoudis, G. (2008). A team-sports-based life-skills program in a physical education context. *Learning and Instruction*, *18*(6), 528–536.

Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B., & Van Petegem, S. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychology of Sport and Exercise, 16*, 26–36.

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods, 20*(1), 102–116.

Hellison, D. R. (2010). *Teaching personal and social responsibility through physical activity*. Champaign, IL: Human Kinetics.

Hertzog, C., & Nesselroade, J. R. (2003). Assessing psychological change in adulthood: An overview of methodological issues. *Psychology and Aging, 18*(4), 639–657.

Hodge, K., Danish, S., & Martin, J. (2012). Developing a conceptual framework for life skills interventions. *The Counseling Psychologist, 41*(8), 1125–1152.

Hodge, K., Danish, S., Forneris, T., & Miles, A. (2016). Life skills and basic psychological needs: A conceptual framework for life skills interventions. In N. Holt (Ed.), *Positive youth development through sport* (pp. 45–56). New York, NY: Routledge.

699 Holt, N. L., Neely, K. C., Slater, L. G., Camiré, M., Côté, J., Fraser-Thomas, J.,...
700 Tamminen, K. A. (2017). A grounded theory of positive youth development through
701 sport based on results from a qualitative meta-study. *International Review of Sport*
702 *and Exercise Psychology, 10*(1), 1–49.
703 Holt, N. L., Sehn, Z. L., Spence, J. C., Newton, A. S., & Ball, G. D. (2012). Physical
704 education and sport programs at an inner city school: Exploring possibilities for
705 positive youth development. *Physical Education and Sport Pedagogy, 17*(1), 97–113.
706 Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure
707 analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling,*
708 *6*, 1–55.
709 IBM Corporation. (2017). *SPSS statistics and AMOS for windows* (Version 25.0). Armonk,
710 NY: IBM Corporation.
711 Jacobs, F., Knoppers, A., & Webb, L. (2013). Making sense of teaching social and moral
712 skills in physical education. *Physical Education and Sport Pedagogy, 18*(1), 1–14.
713 Jang, H., Reeve, J., Cheon, S., & Song, Y. (2019). Dual processes to explain longitudinal
714 gains in physical education students' prosocial and antisocial behaviour: Need
715 satisfaction from autonomy support and need frustration from interpersonal control.
716 *Sport, Exercise, & Performance Psychology, 22*(41), 1–17.
717 Jenny, S. E., & Rhodes, S. (2017). Physical education professionals developing life skills in
718 children affected by poverty. *Physical Educator, 74*(4), 653–671.
719 Larson, R. W., Hansen, D. M., & Moneta, G. (2006). Differing profiles of developmental
720 experiences across types of organised youth activities. *Developmental Psychology,*
721 *42*(5), 849–863.
722 Little, T. D. (1997). Mean and covariance structures (MACS) analyses of cross-cultural data:
723 Practical and theoretical issues. *Multivariate Behavioral Research, 32*(1), 53–76.

724 Mageau, G. A., & Vallerand, R. J. (2003). The coach–athlete relationship: A motivational
725 model. *Journal of Sports Science, 21*(11), 883–904.
726 Marsh, H. W. (2007). Application of confirmatory factor analysis and structural equation
727 modeling in sport/exercise psychology. In G. Tenenbaum & R. C. Eklund (Eds.),
728 *Handbook of sport psychology* (3rd ed., pp. 774–798). Hoboken, NJ: Wiley.
729 Marsh, H. W., Hau, K. T., & Wen, Z. (2004). In search of golden rules: Comment on
730 hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in
731 overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling,*
732 *11*(3), 320–341.
733 Moshagen, M. (2012). The model size effect in SEM: Inflated goodness-of-fit statistics are
734 due to the size of the covariance matrix. *Structural Equation Modeling, 19*, 86–98.
735 Ntoumanis, N. (2012). A self-determination theory perspective on motivation in sport and
736 physical education: Current trends and possible future research directions. In G. C.
737 Roberts & D. C. Treasure (Eds.), *Motivation in sport and exercise* (Vol. 3, pp. 91–
738 128). Champaign, IL: Human Kinetics.
739 Ntoumanis, N., & Appleton, P. (2016). Mediation and moderation via regression analysis. In
740 N. Ntoumanis & N. Meyers (Eds.), *An introduction to intermediate and advanced*
741 *statistical analyses for sport and exercise scientists* (pp. 35–56). West Sussex, UK:
742 John Wiley & Sons.
743 Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory*. New York, NY: McGraw-
744 Hill.
745 Opstoel, K., Chapelle, L., Prins, F. J., De Meester, A., Haerens, L., van Tartwijk, J., & De
746 Martelaer, K. (2019). Personal and social development in physical education and
747 sports: A review study. *European Physical Education Review*, 1–17.

748 Pesce, C., Marchetti, R., Forte, R., Crova, C., Scatigna, M., Goudas, M., & Danish, S. J.
749 (2016). Youth life skills training: Exploring outcomes and mediating mechanisms of a
750 group-randomized trial in physical education. *Sport, Exercise, and Performance*
751 *Psychology, 5*(3), 232–246.
752 Pierce, S., Gould, D., & Camiré, M. (2017). Definition and model of life skills transfer.
753 *International Review of Sport and Exercise Psychology, 10*(1), 186–211.
754 Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and
755 reporting: The state of the art and future directions for psychological research.
756 *Developmental Review*, *41*, 71–90.
757 Quested, E., & Duda, J. L. (2011). Antecedents of burnout among elite dancers: A
758 longitudinal test of basic needs theory. *Psychology of Sport and Exercise*, *12*(2), 159–
759 167.
760 Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why
761 their students benefit. *The Elementary School Journal, 106*(3), 225–236.
762 Reeve, J. (2016). Autonomy-supportive teaching: What it is, how to do it. In J. C. Wang, W.
763 C. Liu & R. M. Ryan (Eds.), *Motivation in educational research: Translating theory*
764 *into classroom practice*. New York, NY: Springer.
765 Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in*
766 *motivation, development, and wellness.* London, UK: Guilford Publications.
767 Shi, D., Lee, T., & Maydeu-Olivares, A. (2019). Understanding the model size effect on SEM
768 fit indices. *Educational and Psychological Measurement*, 79(2), 310–334.
769 Siedentop, D. (1994). *Sport education: Quality PE through positive sport experiences.*
770 Champaign, IL: Human Kinetics.
771 Slavin, R. E. (1995). *Cooperative learning* (2nd ed.). Needham Heights, MA: Allyn and
772 Bacon.

Smither, K., & Zhu, X. (2011). High school students' experiences in a Sport Education unit: The importance of team autonomy and problem-solving opportunities. *European Physical Education Review*, *17*(2), 203–217.

Soenens, B., Vansteenkiste, M., & Van Petegem, S. (2018). *Autonomy in adolescent development: Towards conceptual clarity*. Oxon, UK: Routledge.

Stenling, A., Ivarsson, A., & Lindwall, M. (2016). Cross-lagged structural equation modeling and latent growth modeling. In N. Ntoumanis, & N. Myers (Eds.), *An introduction to intermediate and advanced statistical analyses for sport and exercise scientists* (pp. 131–154). London, UK: Wiley.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson Education Inc.

United Nations International Children's Emergency Fund. (2012). *Global evaluation of life skills education programmes: Final report*. Retrieved from https://www.unicef.org/evaldatabase/files/UNICEF_GLS_Web.pdf

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In P. Z. Mark (Ed.), *Advances in experimental social psychology* (Vol. 29, pp. 271–360). Cambridge, MA: Academic Press.

Van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European Journal of Developmental Psychology, 9*(4), 486–492.

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration, 23*(3), 263–280.

Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owens, K. B., Kapsal, D., … Lonsdale, C. (in press). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology*.

798 Wright, P. M., & Burton, S. (2008). Implementation and outcomes of a responsibility-based
799 physical activity program integrated into an intact high school physical education
800 class. *Journal of Teaching in Physical Education, 27*(2), 138–154.

Table 1
*Mean Scores, Standard Deviations, Reliability Coefficients and Intercorrelations for All Study Variables*

| | *M* | *SD* | α | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 21 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1. Autonomy support | 3.7 | .91 | .93 | – | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Autonomy satisfaction | 3.1 | 1.0 | .87 | .60 | – | | | | | | | | | | | | | | | | | | | | | | |
| 3. Competence satisfaction | 3.6 | 1.1 | .91 | .45 | .69 | – | | | | | | | | | | | | | | | | | | | | | |
| 4. Relatedness satisfaction | 3.1 | 1.2 | .87 | .35 | .55 | .55 | – | | | | | | | | | | | | | | | | | | | | |
| 5. Teamwork | 3.7 | .70 | .84 | .38 | .55 | .58 | .45 | – | | | | | | | | | | | | | | | | | | | |
| 6. Goal setting | 3.4 | .88 | .90 | .43 | .63 | .58 | .48 | .69 | – | | | | | | | | | | | | | | | | | | |
| 7. Social skills | 3.2 | 1.1 | .89 | .32 | .60 | .57 | .51 | .60 | .63 | – | | | | | | | | | | | | | | | | | |
| 8. Problem solving | 3.1 | .98 | .89 | .41 | .62 | .49 | .44 | .56 | .69 | .68 | – | | | | | | | | | | | | | | | | |
| 9. Emotional skills | 2.7 | 1.2 | .88 | .38 | .54 | .36 | .43 | .37 | .50 | .61 | .65 | – | | | | | | | | | | | | | | | |
| 10. Leadership | 3.4 | .89 | .90 | .42 | .67 | .63 | .55 | .65 | .69 | .72 | .71 | .59 | – | | | | | | | | | | | | | | |
| 11. Time management | 3.1 | 1.1 | .90 | .34 | .54 | .49 | .36 | .49 | .62 | .63 | .67 | .62 | .67 | – | | | | | | | | | | | | | |
| 12. Communication | 3.2 | 1.2 | .87 | .44 | .61 | .51 | .48 | .47 | .58 | .69 | .69 | .63 | .69 | .70 | – | | | | | | | | | | | | |
| Time 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13. Autonomy support | 3.6 | .89 | .94 | .62 | .47 | .22 | .22 | .28 | .34 | .31 | .33 | .32 | .34 | .35 | .40 | – | | | | | | | | | | | |
| 14. Autonomy satisfaction | 3.1 | 1.0 | .88 | .49 | .68 | .53 | .45 | .41 | .51 | .54 | .48 | .44 | .55 | .50 | .56 | .64 | – | | | | | | | | | | |
| 15. Competence satisfaction | 3.5 | 1.1 | .91 | .34 | .54 | .65 | .40 | .41 | .46 | .51 | .35 | .30 | .49 | .42 | .42 | .41 | .70 | – | | | | | | | | | |
| 16. Relatedness satisfaction | 3.2 | 1.1 | .86 | .24 | .46 | .39 | .55 | .34 | .44 | .46 | .39 | .37 | .46 | .42 | .45 | .38 | .59 | .56 | – | | | | | | | | |
| 17. Teamwork | 3.6 | .80 | .88 | .36 | .58 | .55 | .39 | .52 | .54 | .56 | .46 | .43 | .66 | .53 | .53 | .41 | .59 | .63 | .53 | – | | | | | | | |
| 18. Goal setting | 3.3 | .95 | .93 | .38 | .52 | .49 | .38 | .43 | .59 | .54 | .54 | .45 | .59 | .55 | .52 | .41 | .62 | .59 | .49 | .72 | – | | | | | | |
| 19. Social skills | 3.1 | 1.1 | .89 | .28 | .50 | .41 | .45 | .36 | .41 | .59 | .47 | .48 | .56 | .47 | .56 | .40 | .60 | .51 | .54 | .66 | .65 | – | | | | | |
| 20. Problem solving | 3.0 | .98 | .91 | .40 | .52 | .43 | .41 | .36 | .47 | .55 | .52 | .50 | .55 | .56 | .58 | .49 | .65 | .53 | .51 | .64 | .70 | .73 | – | | | | |
| 21. Emotional skills | 2.7 | 1.2 | .88 | .28 | .40 | .25 | .27 | .22 | .31 | .41 | .37 | .52 | .36 | .42 | .43 | .45 | .54 | .38 | .44 | .49 | .52 | .66 | .62 | – | | | |
| 22. Leadership | 3.3 | .96 | .93 | .38 | .59 | .53 | .47 | .46 | .49 | .59 | .51 | .43 | .68 | .55 | .57 | .44 | .69 | .66 | .61 | .78 | .73 | .76 | .73 | .58 | – | | |
| 23. Time management | 3.0 | 1.1 | .90 | .31 | .41 | .35 | .25 | .30 | .40 | .47 | .47 | .47 | .46 | .51 | .49 | .43 | .53 | .48 | .44 | .56 | .64 | .59 | .66 | .65 | .62 | – | |
| 24. Communication | 3.1 | 1.1 | .86 | .31 | .46 | .34 | .33 | .37 | .41 | .55 | .50 | .47 | .50 | .48 | .57 | .43 | .59 | .47 | .52 | .60 | .55 | .76 | .64 | .60 | .72 | .64 | – |

*Note.* $N = 266$. Problem solving = problem solving & decision making; Communication = interpersonal communication skills; *M* = mean score; *SD* = standard deviation; α = Cronbach's alpha coefficient. Mean scores and standard deviations were rounded to one decimal place. All variables were measured on a 1–5 response scale. All correlations were significant at a $p < .001$ level.

801

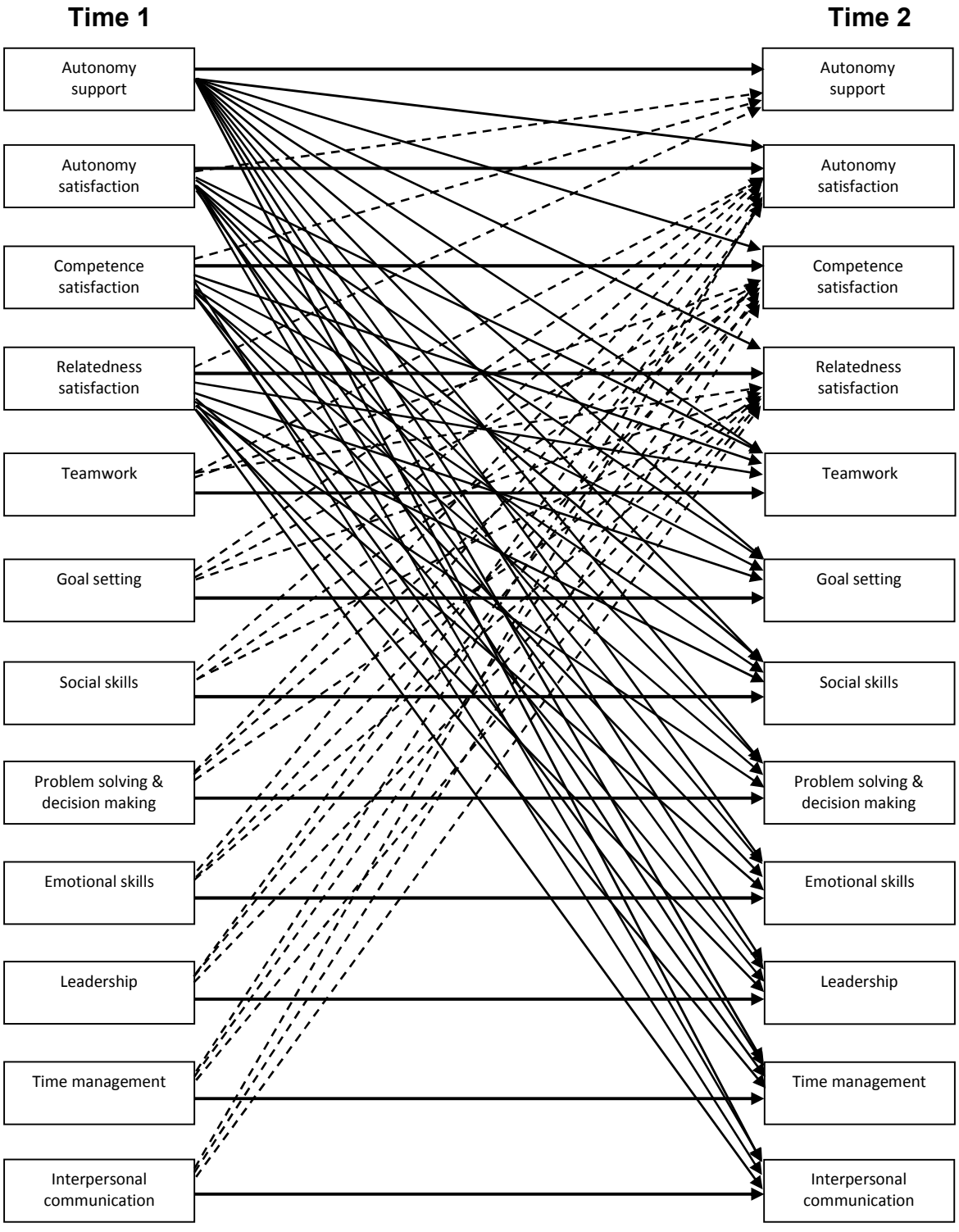


*Figure 1.* Illustration of the first cross-lagged panel model. The horizontal arrows (bolded solid lines) represent autoregressive effects, the downward sloping arrows (thin solid lines) represent cross-lagged effects, and the upward sloping arrows (dashed lines) represent reciprocal effects. The second cross-lagged panel model tested only differed in that it included total basic need satisfaction as opposed to the three basic needs. Gender differences were controlled for in each cross-lagged panel model and occasion-specific associations were included for all variables at time 1 and time 2.

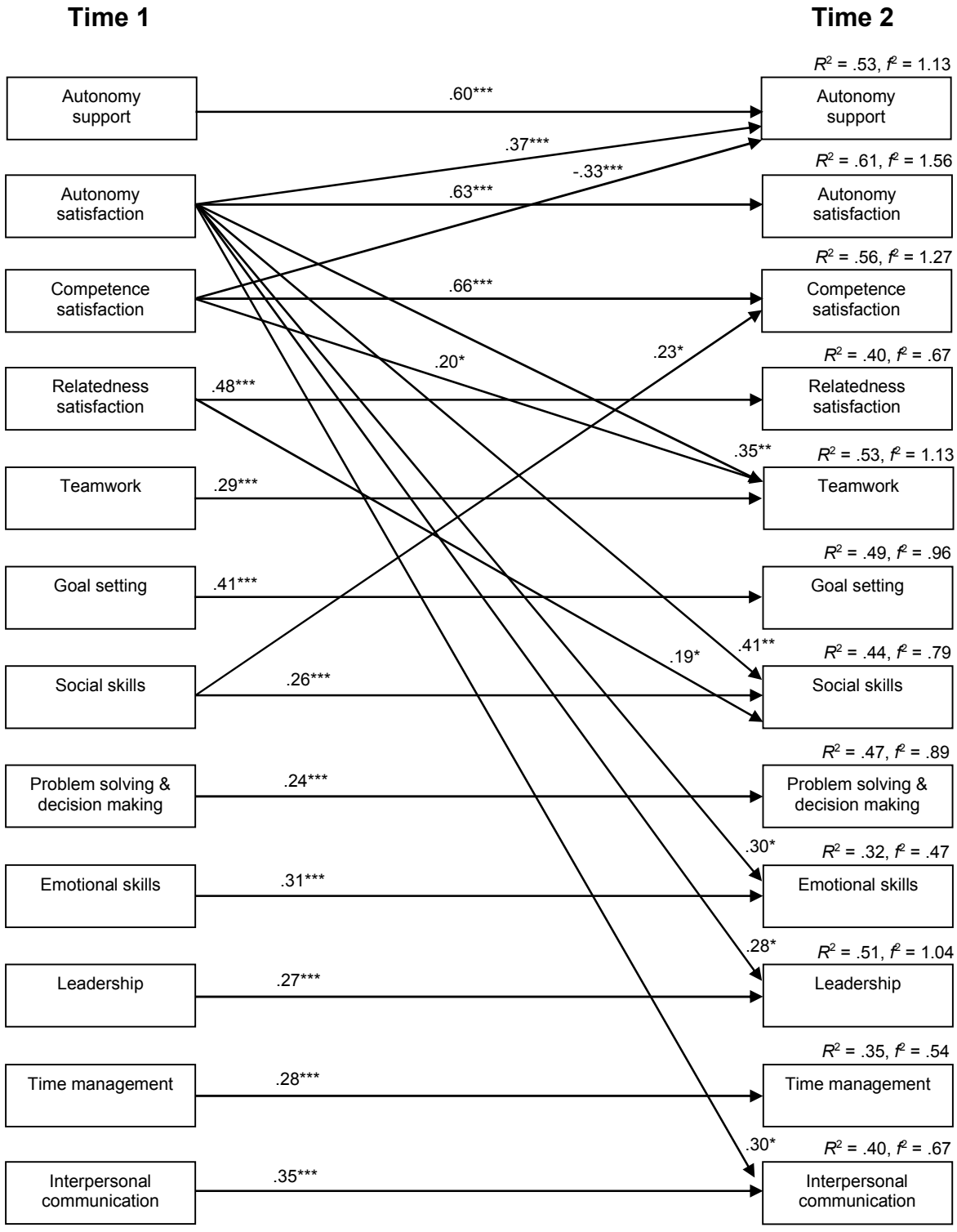


*Figure 2.* Cross-lagged panel model displaying significant results. Values signify standardised regression coefficients. Please note that only the statistically significant regression coefficients are displayed. Gender was included as a covariate in the model and occasion-specific associations were included for all variables at time 1 and time 2. $R^2$ = the proportion of the variance in the outcome variable explained; $f^2$ = Cohen's $f^2$ effect size measure.

*$p$ < .05, **$p$ < .01, ***$p$ < .001.

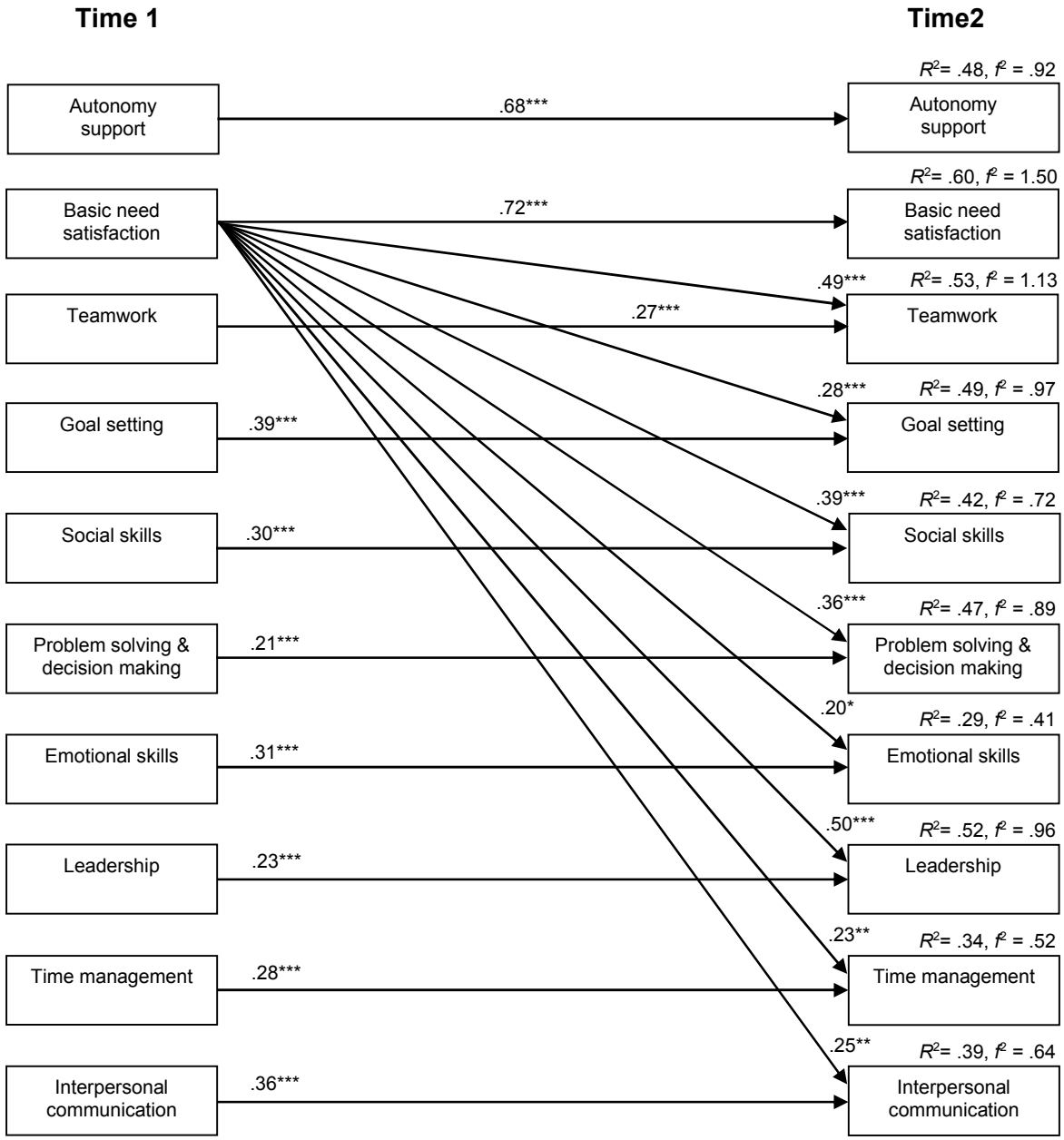


*Figure 3.* Cross-lagged panel model displaying significant results. Values signify standardised regression coefficients. Please note that only the statistically significant regression coefficients are displayed. Gender was included as a covariate in the model and occasion-specific associations were included for all variables at time 1 and time 2. $R^2$ = the proportion of the variance in the outcome variable explained; $f^2$ = Cohen's $f^2$ effect size measure.

*$p$ < .05, **$p$ < .01, ***$p$ < .001.

## Supplementary Materials

### Gender Differences

A MANOVA was conducted to test for any gender differences on the main study variables at both timepoints. Results revealed some differences for the study variables, $F$ (24, 238) = 3.52, Wilk's $\lambda = .74$, $p < .001$. When the variables were considered separately using a Bonferroni adjusted alpha level of .002, the differences between the genders to reach statistical significance were: T1 autonomy satisfaction ($M_{males} = 3.37$, $M_{females} = 2.94$), T1 emotional skills ($M_{males} = 3.01$, $M_{females} = 2.47$), T2 autonomy support ($M_{males} = 3.80$, $M_{females} = 3.45$), T2 autonomy satisfaction ($M_{males} = 3.39$, $M_{females} = 2.83$), T2 teamwork ($M_{males} = 3.79$, $M_{females} = 3.41$), T2 goal setting ($M_{males} = 3.55$, $M_{females} = 3.03$), T2 problem solving and decision making ($M_{males} = 3.33$, $M_{females} = 2.70$), T2 emotional skills ($M_{males} = 3.03$, $M_{females} = 2.37$), T2 leadership skills ($M_{males} = 3.49$, $M_{females} = 3.11$), T2 time management ($M_{males} = 3.29$, $M_{females} = 2.71$) , and T2 interpersonal communication ($M_{males} = 3.40$, $M_{females} = 2.90$). To control for these gender differences, gender was included as a covariate in the cross-lagged panel models. Across all of the statistically significant differences listed above, males scored higher than females on each variable. Given such gender differences, future studies should seek to replicate such a finding and investigate why females are scoring lower than their male counterparts on teacher autonomy support, satisfaction of the need for autonomy, and life skills development in PE.

Table A

*Indices of Model Fit for the Measurement Models and Cross-Lagged Panel Models*

| Model | $\chi^2(df)$ | $\chi^2/df$ | RMSEA | CFI | TLI | SRMR | FL Range |
|---|---|---|---|---|---|---|---|
| Time 1 | | | | | | | |
| Autonomy support | 86.53*** (35) | 2.47 | .08 | .97 | .96 | .03 | (.67–.82) |
| Need satisfaction – Higher order model | 128.84*** (51) | 2.53 | .08 | .96 | .95 | .04 | (.69–.88) |
| LSSPE – Eight factor model | 1458.23*** (832) | 1.75 | .05 | .92 | .91 | .05 | (.58–.90) |
| Time 2 | | | | | | | |
| Autonomy support | 117.64*** (35) | 3.36 | .09 | .95 | .94 | .04 | (.71–.84) |
| Need satisfaction – Higher order model | 126.77*** (51) | 2.49 | .08 | .97 | .95 | .04 | (.63–.88) |
| LSSPE – Eight factor model | 1400.62*** (832) | 1.68 | .05 | .94 | .93 | .04 | (.65–.89) |
| Complete measurement models | | | | | | | |
| Time 1 complete measurement model | 3210.08*** (1949) | 1.65 | .05 | .90 | .89 | .05 | (.58–.90) |
| Time 2 complete measurement model | 3165.16*** (1949) | 1.62 | .05 | .91 | .91 | .04 | (.63–.89) |
| Cross-lagged panel models | | | | | | | |
| Model including three basic needs | 12722.75*** (8093) | 1.57 | .05 | .84 | .83 | .05 | |
| Model including total need satisfaction | 13700.13*** (8174) | 1.68 | .05 | .81 | .80 | .06 | |

*Note.* $N = 266$. LSSPE = life skills scale for physical education; RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardised root mean square residual; FL = factor loading.
***$p < .001$.

Table B
*Indices of Model Fit for the Invariance Testing of the Complete Measurement Model Across Timepoints*

| Models | $\chi^2(df)$ | $\chi^2/df$ | RMSEA | CFI | TLI | SRMR | ΔRMSEA | ΔCFI | ΔTLI | ΔSRMR |
|---|---|---|---|---|---|---|---|---|---|---|
| Configural invariance | 6375.24*** (3898) | 1.64 | .035 | .905 | .898 | .050 | | | | |
| Metric invariance | 6412.59*** (3951) | 1.62 | .034 | .905 | .900 | .050 | -.001 | 0 | .002 | 0 |
| Scalar invariance | 6503.34*** (4016) | 1.62 | .034 | .904 | .901 | .050 | 0 | -.001 | .001 | 0 |
| Factor covariance invariance | 6573.15*** (4094) | 1.61 | .034 | .904 | .903 | .054 | 0 | 0 | .002 | .004 |
| Residual invariance | 6700.49*** (4159) | 1.61 | .034 | .902 | .902 | .057 | 0 | -.002 | -.001 | .003 |

*Note.* $N = 266$ at each timepoint. RMSEA = root mean square error of approximation; CFI = comparative fit index; TLI = Tucker Lewis index; SRMR = standardised root mean square residual.
***$p < .001$.