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Effect of Teaching Style on Academic Self-Concept in Mexican University Students of Physical Education: Multiple Mediation of Basic Psychological Needs and Motivation

Efecto del estilo docente sobre el autoconcepto académico en universitarios mexicanos de Educación Física: mediación múltiple de las necesidades psicológicas básicas y la motivación

Roberto Espinoza-Gutiérrez [1], Raúl Baños [1,2], Juan José Calleja-Núñez [1] and Antonio Granero-Gallegos [3]

[1] Faculty of Sports, Autonomous University of Baja California, Tijuana, Mexico, Research Group UABC-CA-341 Physical Performance and Health; [2] Faculty of Education Sciences, University of Granada, Ceuta, Spain; [3] Faculty of Education Sciences / Health Research Center, University of Almeria, Almeria, Spain

Abstract

The objectives were to analyze the psychometric properties of the adaptation of ASC and Interpersonal Teaching Style in Higher Education (ITSHE) scales, as well as to analyze the predictive effect of ITS on ASC, considering the multiple mediation of basic psychological need satisfaction (SBPN), basic psychological need frustration (FBPN), and academic motivation. Study 1 involved 357 subjects aged between 18 and 45 years. The psychometric properties of the ITS and ASC scales were analyzed. Study 2 involved,808 subjects aged between 18 and 45 years. Structural equation modeling was employed for the analysis. The ITSHE and ASC scales were found to be valid and reliable. SEM analysis revealed multiple mediation effects of SBPN and autonomous motivation between autonomy support and ASC, significantly increasing the total effects on ASC. The Autonomy-supportive style positively predicted SBPN, autonomous motivation, controlled motivation, and ASC, and negatively predicted FBPN and amotivation. Conversely, a controlling teaching style negatively predicted FBPN and amotivation. University students' ASC is enhanced when instructors support autonomy, thereby fostering SBPN and autonomous motivation.

Keywords: validation, autonomous motivation, controlled motivation, amotivation, controlled style, autonomy support.

Resumen

Este estudio tuvo por objetivo analizar las propiedades psicométricas de la adaptación de las escalas de Autoconcepto Académico (ASC) y Estilo Interpersonal Docente en Educación Superior (EIDES) en universitarios mexicanos, así como analizar el efecto predictivo del EIDES sobre el ASC, considerando la mediación múltiple de la Satisfacción De Necesidades Psicológicas Básicas (SNPB), la Frustración De Necesidades Psicológicas básicas (FNPB) y la motivación académica. En el estudio-1 participaron 357 sujetos de entre 18 y 45 años. Se analizaron las propiedades psicométricas de las escalas de EIDES y ASC. En el estudio-2 participaron, 808 sujetos de entre 18 y 45 años. Se empleó el modelado de ecuaciones estructurales para el análisis. Las escalas de EIDES y ASC resultaron ser válidas y fiables. El análisis de ecuaciones estructurales reveló efectos de mediación múltiple de la SNPB y la motivación autónoma entre el apoyo a la autonomía y el ASC, aumentando significativamente los efectos totales sobre el ASC. El estilo de apoyo a la autonomía predice positivamente la SNPB, la motivación autónoma, la motivación controlada y el ASC; y predice negativamente la FNPB y la desmotivación. Por el contrario, el estilo de enseñanza controlador predice negativamente la FNPB y la desmotivación.

Palabras clave: validación, motivación autónoma, motivación controlada, desmotivación, estilo controlador, apoyo a la autonomía.

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Correspondence: Raúl Baños, Faculty of Education Sciences, University of Granada, Ceuta, Spain
Email: raulfb89@gmail.com

Introduction

In recent years, teaching has undergone numerous changes in the way of conceiving several variables in the university environment (Hinck & Tighe, 2020), underscoring the importance of fostering autonomy in students to achieve learning objectives and develop professional competencies for the problems that they might face in the future (Szczepek Reed, 2017). The motivation of university students and their basic psychological needs must be analyzed in depth, given that the teaching styles exercised by the teacher can have an influence on these aspects (Granero-Gallegos, Hortigüela-Alcalá, et al., 2021; López-García et al., 2023). These variables could influence the academic self-concept (ASC), as they are a key determinant of academic performance and the achievement of success in university students (Granero-Gallegos et al., 2023).

ASC is a theoretical construct that refers to each person's perception of their own performance in the academic activities that they pursue (Marsh & Craven, 2006), therefore, it can be defined as the mental representation of the skills manifested while fulfilling school tasks (Talić et al., 2024; Zhang, 2022). Several authors have recently highlighted the importance of having university students develop an ASC, as it decreases the probability of academic dropout (Mouton et al., 2020; Rojo-Ramos et al., 2024). However, despite the high dropout rate of Mexican university students in recent years (Álvarez-Pérez & López-Aguilar, 2021); no research efforts have been found in the scientific literature that have yet analysed ASC in this specific population. Paying attention to the ASC, as well as intervening with strategies to nourish it, could be associated with the improvement of other psychological variables of interest related to academic performance, such as academic motivation (AM) in university students (Carranza & Apaza, 2015) and basic psychological needs (Ryan & Deci, 2017). Researchers have recently found that the satisfaction of basic psychological needs (SBPN) can predict the ASC in university students (Granero-Gallegos, Baena-Extremera, et al., 2023), suggesting that higher scores of competence, autonomy, and social relatedness increase ASC levels (Burgueño et al., 2023). Likewise, it has been observed that university students who score higher in academic motivation, either autonomous or controlled, also obtained higher ASC values (Isiksal, 2010), although this study by Isiksal did not analyze the relationship between these variables. In this line, Carranza & Apaza (2015) did find that academic amotivation negatively predicts the ASC, while AM predicts it positively, finding no relationship between controlled motivation and the ASC. To our knowledge, the scientific literature that analyzes the relationship between these variables in university students is limited worldwide to these studies, so we consider it pertinent to deepen the research on said relationships.

Self-Determination Theory (SDT) (Ryan & Deci, 2020) is currently one of the most embraced theories among the scientific community to explain the development and functioning of motivation when individuals make decisions or perform actions in various contexts, including education. According to SDT, motivation is formed by a continuum of self-determination. At one extreme is AM, which reflects the adoption of behaviour based on experiences guided by enjoyment and the pursuit of new horizons, at a lesser degree is controlled motivation (CM), where individuals act on experiences based on both self-imposed pressures and a sense of external obligation, and the lowest degree is amotivation, where actions can be performed without the actual willingness of individuals to perform them (Ryan & Deci, 2020).

In this regard, a substantial body of evidence from international scientific literature has demonstrated that the SBPN of students is a positive predictor of AM (Desmarais & Grenier, 2023; Granero-Gallegos, López-García, & Burgueño, 2023; Hope et al., 2019; Moreno-Murcia et al., 2015; Müller et al., 2021; Orsini, Binnie, & Tricio, 2018; Orsini, Binnie, Wilson, et al., 2018; Vergara-Morales & Del Valle, 2021) as well as ASC (Granero-Gallegos, Baena-Extremera, et al., 2023; Granero-Gallegos, Hortigüela-Alcalá, et al., 2021). Nevertheless, lower SBPN values have been linked to CM (Granero-Gallegos, López-García, & Burgueño, 2023; Holding et al., 2020; Orsini, Binnie, & Tricio, 2018) and academic amotivation (Orsini; Binnie, & Tricio, 2018). Regarding Mexico, we only found one study that has analyzed these variables on adolescents, yielding similar results to those mentioned above (Baños et al., 2023), but we found no studies conducted on Mexican university students. As can be seen, more studies have analyzed the relationship between SBPN and AM with respect to CM and academic amotivation. There are also few studies that have analyzed how frustration of basic psychological needs (FBPN) predicts the three dimensions of academic motivation, with FBPN being predictive of CM and academic amotivation (Granero-Gallegos, López-García & Burgueño, 2023; Holding et al., 2020; Müller et al., 2021; Westein et al., 2023) and even of ASC (Granero-Gallegos, Hortigüela-Alcalá, et al., 2021; Granero-Gallegos, Baena-Extremera et al., 2023). This is why Chevrier & Lannegrand (2022) underscore the need to continue studying the relationship of all dimensions of academic motivation and the satisfaction and frustration of basic psychological needs in different university stages in different geographical contexts. Despite recent studies examining the association between basic psychological needs and ASC in the university setting (Granero-Gallegos, Baena-Extremera et al., 2023), further exploration into this relationship is warranted.

On the one hand, SBPN fosters personal development, self-realization, integration, and personal well-being, representing the positive core of humanity (Vansteenkiste & Ryan, 2013). On the other hand, FBPN represents the dark core of humanity that contributes to maladaptive patterns of functioning, passivity, fragmentation and illness (Vansteenkiste & Ryan, 2013). Research has shown that SBPN and FBPN occur in the same domain and that both dimensions contribute differently to the individual's motivational processes (Burgueño et al., 2023). Each teacher's interpersonal style can influence SBPN and FBPN as well as the academic motivation of their students, variables that play an important role in learning (Buhl-Wiggers et al., 2023; Granero-Gallegos et al., 2024; Trolian & Jach, 2020).

In terms of the teaching interpersonal style, it should be noted that this can be conceptualised as a continuum ranging from a supportive approach that encourages student autonomy, which is positively related to SBPN and AM of university students, to a more controlling style, which is related to FBPN and CM (Codina et al., 2018; Granero-Gallegos, Hortigüela-Alcalá, et al., 2021; Granero-Gallegos, Escaravajal, et al., 2022 Moreno-Murcia et al., 2019; Okada, 2023; Orsini et al., 2020; Rubio-Valdivia et al., 2022). The autonomous style highly encourages the independence of the students, allowing them to manage variables not controlled by the teacher in such a way that they achieve the proposed objectives with a high degree of participation (Abós et al., 2018). On the contrary, the controlling style is characterized by a more traditional teaching, with more protagonism of the teacher, who adopts a coercive, authoritarian and controlling behavior during the teaching process (Haerens et al., 2015).

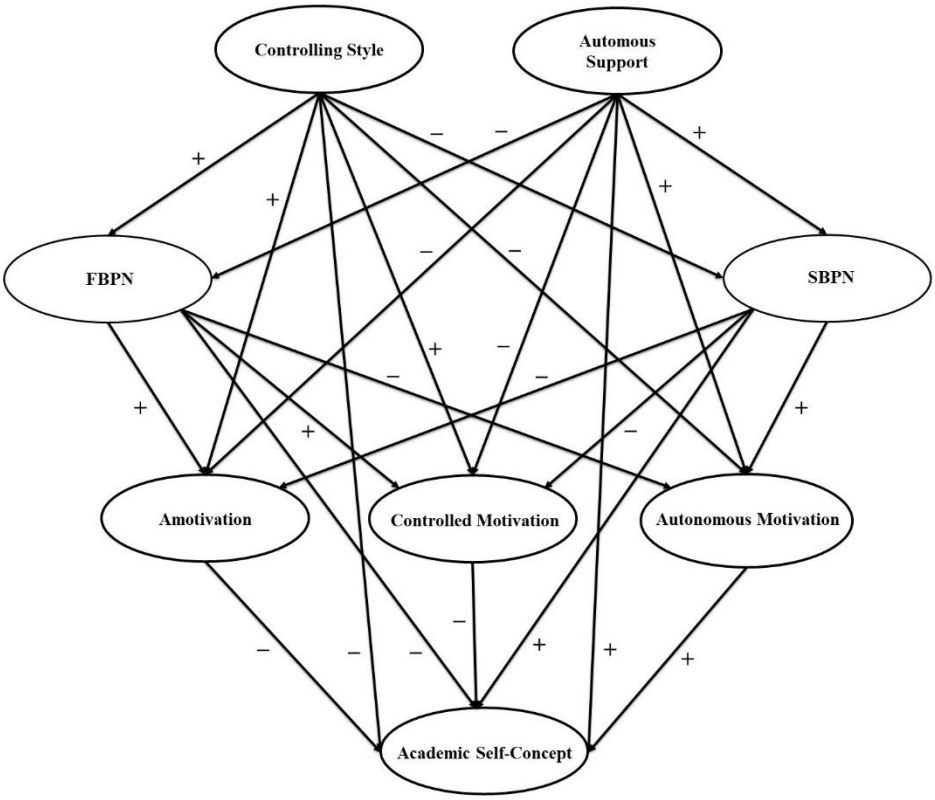
The scientific literature has thus demonstrated the correlations among the aforementioned variables. However, to the best of our knowledge, no study has yet employed a structural equation model to analyse the relation among these variables, which would facilitate a more comprehensive understanding of the psychological variables' role in the academic behaviour of university students. Furthermore, research on this subject in Mexico is lacking. To date, no questionnaires from this country have been identified as measuring ASC or the ITSHE in university students. Inquiring into this may help to elucidate the underlying causes of the high dropout rates among Mexican university students (Álvarez-Pérez & López-Aguilar, 2021).

In light of the aforementioned considerations, this research comprehends two studies. The research objective of study-1 was to analyze the psychometric properties of the adaptation of the

scales, ASC and ITSHE in Mexican university students. In study-2, the objective was to analyze the predictive effect of the ITS on ASC with multiple mediation following the SDT sequence (antecedents → psychological needs → motivation → consequences) in Mexican university students. Figure 1 shows the hypothesized model of this research to examine the aforementioned relationships. The *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) *initiative* (Von Elm et al., 2008) was used for the study's description.

Figure 1

Theoretical hypothesized model



Note: SBPN = satisfaction of basic psychological needs; FBPN = frustration of basic psychological needs.

Study-1

Method

Study Design

The design of this research was observational, descriptive and cross-sectional. The study participants were undergraduate students of the Bachelor's Degree in Physical Education at the Mexicali Campus of the Autonomous University of Baja California (Mexico). The inclusion criteria for participation were: (i) being enrolled in the Bachelor's Degree in Physical Education at the Mexicali Campus; (ii) regular class attendance. Exclusion criteria: (i) not giving consent for the use of data in the research; (ii) not filling out the data collection form completely and correctly.

Sample size

We have observed the stipulations of Carretero-Dios & Pérez (2005) of having at least ten participants per item for a Confirmatory Factor Analysis (CFA). An a priori effect size analysis was

performed using the *Free Statistics Calculator* v.4.0 software (Soper, 2024) which estimated a minimum of 333 subjects to detect effect sizes f^2=.19, with a statistical power level of 90 % and a significance level of α=.05 in a structural equation model (SEM) with two latent variables and 11 observed variables. A total of 355 students participated in the study. According to the institution's transparency portal, the total research population (*N*) of the Sports Faculty of the Mexicali Campus of the Autonomous University of Baja California is 553 students of the Bachelor's Degree in Physical Education. This implies a participation of 64 % of *N*, so the sample is representative with a confidence level of 99 % and a margin of error of 4.11 %.

Instruments

Interpersonal Teaching Style in Higher Education (ITSHE) (*Estilo Interpersonal Docente en Educación Superior*). The wording of the items was adapted to the Mexican university context from the Spanish scale by Granero-Gallegos, Hortigüela, et al. (2021), which is composed of two correlated factors to measure the students' perception of the teacher's *controlling style* (6 items; e.g., "My professor offered less support to students who did not perform well in class") and the teacher's *autonomy support* (5 items; e.g., "My professor presented different opportunities and options during class"). Responses were collected using a Likert scale from 1 (*Completely disagree*) to 5 (*Completely agree*).

Academic Self-Concept (ASC). The scale used was an adaptation to the Mexican context from the original Spanish version by Granero-Gallegos, Baena-Extremera, et al. (2021) for measuring ASC in university students. The scale is composed of two correlated factors to measure *academic confidence* (3 items; e.g., "I can follow the flow of classes with ease") and *academic effort* (3 items; e.g., "I pay attention to the professor during classes") of the students. Responses were collected using a Likert scale from 1 (*Completely disagree*) to 7 (*Completely agree*).

Procedure

The research proposal was presented to the general director of the Faculty of Sports and the three deputy directors of the three campuses (Tijuana, Mexicali and Ensenada) of the Autonomous University of Baja California (Mexico). Upon the approval to conduct the study, a digital questionnaire was administered in person in the institution's computer room during March 2022. During the administration of the questionnaire, participants were taught how to fill out the measurement scales, and informed of the importance of the study, that their responses were anonymous and would have no impact on their academic grades, and that they were free to withdraw from participation at any time if they so desired. All participants included in the study gave their consent for their responses to be included. The research protocol was approved by the Bioethics Committee of the University of Almeria (Ref:UALBIO2023/001).

Risk of Bias

It should be noted that convenience sampling was followed, so the sample was not randomized. There was blinding between participants and researchers in charge of data processing and analysis. Regarding selection bias, it should be noted that communication with the students was face-to-face, and participation was voluntary.

Statistical Analysis

The descriptive statistical data of each item were calculated using SPSS v.29 (IBM, Chicago, IL, USA) and the original factorial structure of each instrument was assessed (i.e.: ITSHE, ASC) conducting a CFA with AMOS v.29. In terms of the CFA, Mardia's coefficient was considered for multivariate normality, and analyses were conducted using the maximum likelihood (ML) method and the 5000-iterations bootstrapping (Kline, 2016). For the analysis, values of the standardized regression weights ≥.32 were minimally accepted (Hair et al., 2018). The CFA was conducted observing different goodness-of-fit indices: χ^2/df ratio (chi-squared/degrees of freedom), CFI (*Comparative Fit Index*), TLI (*Tucker–Lewis Index*), RMSEA (*Root Mean Square Error of Approximation*) with an interval of confidence (IC) of 90 %, and SRMR (*Standardized Root Mean Square Residual*). For the χ^2/df ratio,

values <2.0 were considered excellent (Tabachnick & Fidell, 2019), whereas <5.0 were deemed acceptable (Hu & Bentler, 1999); for CFI and TLI, values between .90 and .95 were acceptable, and values >.95 were excellent; for RMSEA, values <.06 were deemed excellent, and <.10 were marginally acceptable; and for SRMR, values <.60 were excellent and <.08 were acceptable. The internal consistency of each scale was assessed using different parameters: Cronbach's alpha (α), McDonald's omega (ω), and AVE (*Average Variance Extracted*) for convergent validity. Reliability values >.70 and AVE>.50 were deemed acceptable (Hair et al., 2018).

Results

Participants

Participants were 357 university students (247 male; 208 female; 2 others) aged between 18 and 45 (M_{age} =21.01, *SD*=3.06). There were no lost values in the included sample data.

Confirmatory Factor Analysis and Reliability

Table 1 shows the descriptive statistical data of the 11 items of the ITSHE (see Appendix-1) and the CFA results with the two correlated factors that yielded acceptable goodness-of-fit indices: χ^2/df=2.83, *p*<.001; CFI=.949; TLI=.932; RMSEA=.072 (90%CI=.057;.087); SRMR=.064. Reliability indices were as follows: *controlling style* (F1), ω=.88, α=.88, AVE=.61; *autonomy support* (F2), ω=.72, α=.73, AVE=.43. The correlation between factors was -.16. According to Hair et al. (2018), the AVE shows acceptable convergent validity (and composite reliability) levels when all standardized regression weights of a latent variable are significant and >.50, as in this case, even with an AVE <.50.

Table 1
Descriptive statistical data of the items and CFA of the ITSHE

					CFA	
Items	***M***	***SD***	**Q1**	**Q2**	**F1 (λ)**	**F2 (λ)**
Item-1	2.46	1.34	0.44	-1.05	**.66**	
Item-4	2.29	1.38	0.69	0.13	**.80**	
Item-5	2.09	1.32	0.92	-0.39	**.89**	
Item-7	2.02	1.30	1.05	-0.08	**.86**	
Item-8	2.22	1.33	0.70	-0.73	**.80**	
Item-10	1.83	1.27	1.35	0.55	**.63**	
Item-2	3.68	1.21	-0.69	-0.39		**.71**
Item-3	4.03	1.08	-0.99	0.42		**.71**
Item-6	4.10	1.02	-1.11	0.13		**.61**
Item-9	3.89	1.12	-0.85	0.13		**.56**
Item-11	4.04	1.11	-1.10	0.63		**.64**

Note. *M*=mean; *SD*=standard deviation; Q1=asymmetry; Q2=kurtosis; F1=controlling style; F2=autonomy support; λ=standardized factorial loads.

In addition, a CFA was performed with the six items and two correlated factors of the ASC (see Appendix-2) that yielded the following goodness-of-fit indices: χ^2/df=3.26, *p*=.002; CFI=.981; TLI=.959; RMSEA=.080 (90%CI=.045;.117); SRMR=.035. The descriptive statistical data and standardized factorial loads of the CFA can be found in Table 2. The internal consistency values were: *confidence* (F1), ω=.86, α=.78, AVE=.65; *effort* (F2), ω=.75, α=.75, AVE=.49. The factor correlation was .78.

Table 2

Descriptive statistical data of the items and CFA of the ASC

Items	*M*	*SD*	*Q1*	*Q2*	CFA F1 (λ)	CFA F2 (λ)
Item-1	5.54	1.32	-0.77	0.31	**.89**	
Item-2	5.62	1.41	-0.97	0.49	**.80**	
Item-3	6.35	1.10	-1.86	3.19	**.71**	
Item-4	5.76	1.24	-0.82	0.16		**.82**
Item-5	4.05	1.77	-0.05	-0.85		**.42**
Item-6	5.54	1.40	-0.74	-0.03		**.78**

Note. *M*=mean; *SD*=standard deviation; Q1=asymmetry; Q2=kurtosis; F1=confidence; F2=effort; λ=standardized factorial loads.

Study-2

Method

Study Design

This study followed the same design and inclusion/exclusion criteria described in study-1. study-2 involved Mexican university students enrolled in the Physical Education Bachelor's degree program at the Ensenada and Tijuana campuses of the Autonomous University of Baja California (Mexico).

Sample size

As in study-1, an a priori effect size analysis was conducted, which calculated a minimum of 805 subjects to detect effect sizes f^2=.18, with a statistical power of 95 % and a significance of α=.05 in a SEM with eight latent variables and 81 observed variables. A total of 808 students participated in the research; according to the institution's transparency portal, the total study population (*N*) is 1110 Physical Education undergraduate students at the Ensenada and Tijuana Campuses. This translates into a participation of 73 % of *N*, so the sample is representative with a confidence level of 99 % and a margin of error of 2.37 %.

Instruments

Interpersonal Teaching Style in Higher Education (ITSHE). The eleven-item version of study-1 was used. A CFA of the scale was conducted with the participants of study-2, and the goodness-of-fit indices obtained were: χ^2/df=3.78, p<.001; CFI=.963; TLI=.950; RMSEA=.059 (90%CI=.049,.069), SRMR=.045. The observed reliability values were: controlling style, ω=.85, α=.86, AVE=.56; autonomy support, ω=.80, α=.75, AVE=.43. All standardized regression weights in this case were >.50 and significant, so the AVE value, although <.50, was deemed acceptable (Hair et al. (2018).

Academic Self-Concept (ASC). The final six-item version of study-1 was used. A CFA of the scale was performed with the participants of study-2, and the goodness-of-fit indices obtained were excellent: χ^2/df=3.06, p<.001; CFI=.996; TLI=.987; RMSEA=.050 (90%CI=.015,.089), SRMR=.012. The attained reliability values were ω=.83, α=.77, AVE=.60.

Satisfaction of Basic Psychological Needs (SBPN). The scale used was adapted to the Mexican context by Zamarripa et al. (2017), and is composed of three correlated factors that measure autonomy frustration (6 items; e.g., "I feel that I am prevented from making decisions regarding my way of working"); competence frustration (5 items; e.g., "There are situations that make me feel ineffective"); and the need for relatedness (5 items; e.g., "I feel rejected by those around me"). Responses were collected using a Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). Another CFA of the scale was conducted with the participants of study-2, and the goodness-of-fit indices obtained

were excellent: χ^2/df=2.41, p<.001; CFI=.999; TLI=.997; RMSEA=.035 (90%CI=.000,.076), SRMR=.005. The reliability values obtained were ω=.78, α=.77, AVE=.57.

Frustration of Basic Psychological Needs (FBPN). The scale used was validated for Mexico by López-Walle et al. (2013) and contains three correlated factors to measure the students' need for autonomy (6 items; e.g., "I can decide what activities I want to do"); for competence (5 items; e.g., "I think I am pretty good"); and for relatedness (5 items; e.g., "Supported"). Responses were collected using a Likert scale ranging from 1 (Completely disagree) to 7 (Completely agree). A CFA of the scale was performed with the study-2 participants and the goodness-of-fit indices obtained were excellent: χ^2/df=3.32, p<.001; CFI=.996; TLI=.991; RMSEA=.045 (90%CI=.022,.069), SRMR=.013. Attained reliability levels were ω=.81, α=.81, AVE=.52.

Academic Motivation. We used the scale validated for Mexico by Martínez-Ávila et al. (2022), composed of three correlated factors to measure the students' AM (12 items; e.g., "Because learning new things is pleasant and satisfactory to me"), controlled motivation (16 items; e.g., "Because passing my courses makes me feel important"), and amotivation (4 items; e.g., "At the time, I had good reasons to enroll, but now I wonder if I should pursue this"). Responses were collected using a Likert scale ranging from 1 (Does not apply at all) to 7 (Fully applies). A CFA of the scale was performed with the study-2 participants and the goodness-of-fit indices obtained were excellent: χ^2/df=2.98, p<.001; CFI=.985; TLI=.977; RMSEA=.041 (90%CI=.030,.052), SRMR=.029. Reliability values attained were: AM, ω=.79, α=.78, AVE=.56; controlled motivation, ω=.77, α=.77, AVE=.53; amotivation: ω=.72, α=.72, AVE=.50.

Procedure

The research proposal was presented to the general director of the Faculty of Sports and the three deputy directors of the three campuses (Tijuana, Mexicali and Ensenada) of the Autonomous University of Baja California (Mexico). Upon the approval to conduct the study, a digital questionnaire was administered in person in the institution's computer room during March 2022. During the administration of the questionnaire, participants were taught how to fill out the measurement scales, and informed of the importance of the study, that their responses were anonymous and would have no impact on their academic grades, and that they were free to withdraw from participation at any time if they so desired. All participants included in the study gave their consent for their responses to be included. The research protocol was approved by the Bioethics Committee of the University of Almeria (Ref:UALBIO2023/001).

Risk of Bias

It should be noted that convenience sampling was followed, so the sample was not randomized. There was blinding between participants and researchers in charge of data processing and analysis. Regarding selection bias, it should be noted that communication with the students was face-to-face, and participation was voluntary.

Statistical Analysis

The descriptive and correlations analysis was calculated using SPSS v.29. The factor model of each instrument was evaluated conducting a CFA using the ML method and the 5000-iteration bootstrapping procedure (Kline, 2016) using AMOS 29. The same set of indices from study-1 was used for the CFA (χ^2/df, CFI, TLI, RMSEA, SRMR) and for the reliability of each scale (α, ω, and AVE). Finally, the hypothesized predictive relationships of the teacher interpersonal style on the academic self-concept with multiple mediation of SBPN, FBPN, AM, controlled motivation and amotivation were verified using a SEM model with latent variables. The students' campus and gender were used as covariates. The fit indices referred to above (χ^2/df, CFI, TLI, RMSEA, SRMR) were used to evaluate the SEM fit. Since the results suggested non-normality of the data (Mardia=196.70), the ML method was used with the bootstrapping procedure for 5000 resamples (Kline, 2016). Direct and indirect effects were assessed according to Shrout & Bolger (2002), in such a way that indirect effects (i.e., mediated) and their 95 % IC were estimated with the *bootstrapping* technique. The indirect effect

was deemed significant (p<.05) if its IC 95 % did not include the value zero. In addition, R^2 was used for effect sizes (ES) to improve the interpretation of the results, as it estimated the degree of influence quantifying the variance percentage of the dependent variable explained by the predictors (Domínguez-Lara, 2017). Cut-off points of the ES were: .02 (small), .13 (medium) and .26 (large) (Cohen, 1992). Furthermore, intervals of confidence (IC 95 %) were calculated to ensure that no R^2 value was <.02, the minimum value required for its interpretation.

Results

Participants

808 university students participated in study-2 (564 male; 241 female; 3 others), aged between 17 and 50 (M =21.39, SD=3.34). There were no lost values in the included sample data.

Preliminary Results

Table 3 shows the descriptive statistical data and correlations between the variables included in the study.

Table 3

Descriptive statistical data and correlation between variables

Variable	*Range*	*M*	*SD*	Q1	Q2	2	3	4	5	6	7	8
1.Autonomy support	1-5	3.98	0.79	-0.68	0.33	-.17**	.41**	-.22**	.29**	.14**	-.23**	.43**
2.Controlling style	1-5	2.18	1.01	0.71	-0.15		-.15**	.35**	-.05	.09*	.28**	-.14**
3.SBPN	1-7	5.22	0.95	-0.60	0.75			-.36**	.44**	.20**	-.21**	.61**
4.FBPN	1-7	2.90	1.37	0.55	-0.36				-.14**	.11**	.35**	-.33**
5.AM	1-7	5.76	0.99	-1.08	1.40					.58**	-.28**	.43**
6.Controlled motivation	1-7	5.08	1.20	-0.64	0.03						.09*	.15**
7.Amotivation	1-7	1.98	1.25	1.55	2.10							-.26**
8.Academic self-concept	1-7	5.39	1.01	-0.59	0.35							

Note. **The correlation is significant at level .01; *M*=mean; *SD*=standard deviation; Q1=asymmetry; Q2=kurtosis; SBPN=Satisfaction of Basic Psychological Needs; FBPN=Frustration of Basic Psychological Needs; AM=Autonomous Motivation.

Main Results

The SEM showed acceptable goodness-of-fit indices: $\chi 2/df$=2.75, p<.001; CFI=.942; TLI=.928; RMSEA=.047 (90%CI=.043;.050; p_{close}=.937), SRMR=.043. Explained variance reached 71 % for the academic self-concept, 32 % for AM, 17 % for controlled motivation, 22 % for amotivation, 31 % for SBPN and 19 % for FBPN. The model showed a direct, positive and significant relationship between the controlling style and the FBPN (p=.034) and amotivation (p=.007), as well as a direct, negative and significant relationship with SBPN (p=.007). The direct relationship of the controlling style with controlled motivation (p=.122), AM (p=.396) and academic self-concept (p=.522) was not significant. On the contrary, the autonomy support style showed predictive direct significant relationships with the rest of the relevant variables, with a positive relationship with SBPN (p=.026), AM (p=.026), controlled motivation (p=.032) and self-concept (p=.032), and a negative relationship with FBPN (p=.012) and amotivation (p=.011). On the other hand, the SBPN showed a high predictive relationship with academic self-concept (p=.014), and a positive relationship with AM (p=.019) and with controlled motivation (p=.004), while the relationship with amotivation (p=.957) was not significant. FBPN had positive and significant direct relationships with the three types of motivation: controlled motivation (p=.005), AM (p=.027) and amotivation (p=.011), although the direct relationship was not significant with self-concept (p=.783). Finally, in the direct predictive relationships of SEM, AM (p=.036) predicted self-concept positively, and controlled motivation (p=.037) negatively, while amotivation (p=.794) did not present a significant direct relationship.

In terms of the mediating variables, the mediating role of SBPN and AM can be highlighted. On the one hand, SBPN plays an important role as a mediating variable between autonomy support and self-concept, as the indirect relationship is β=.36, increasing the total effects to β=.50. Likewise, the mediation of AM increases the total effects between autonomy support and self-concept (β=.17) up to β=.20 with the multiple mediation of SBPN and AM.

Finally, the total indirect effect calculated in the SEM of the autonomy support style on academic self-concept is significant (β=.38; 95%IC=.28, .47; *p*=.019), while the total indirect effect of the controlling style on self-concept is not significant (β=-.07; 95%IC=-.16, -.01; *p*=.061).

Figure 2

Predictive relationships of the teaching interpersonal style on academic commitment through SBPN, FBPN, academic motivation, controlling the gender and campus variables

Note: **p<.01; *p<.05; R^2=explained variance; IC=interval of confidence; SBPN = satisfaction of basic psychological needs; FBPN = frustration of basic psychological needs.

Discussion

The objective of study-1 was to analyze the psychometric properties of the adaptation of the ASC and EIDES scales in Mexican university students, whereas the objective of study-2 was to analyze the predictive effect of the ITS on ASC with multiple mediation of the SBPN, FBPN and academic motivation in Mexican university students. It should be noted that this research makes a relevant contribution to the scientific literature with the validation of the ITSHE and ASC scales from study-1 to the Mexican university context. These instruments, which present similar and acceptable adjustments to the Spanish versions, both in terms of validity and reliability (Granero-Gallegos, Hortigüela-Alcalá, et al., 2021; Granero-Gallegos, Baena-Extremera et al., 2021), might help other researchers to analyze how to increase academic well-being and thus contribute to aspects such as decreasing the high dropout rate in Mexican university students (Álvarez-Pérez & López-Aguilar,

2021). On the other hand, the main results of study-2 underscored the importance of the ITSof autonomy support and the mediating effect of the SBPN in the improvement of the students' ASC.

The main result obtained from this research was underscoring the importance of the SBPN in the proposed predictive framework, since it considerably enhances the prediction of ASC through the mediation between the autonomy support style and AM, although its mediating effect between autonomy support and ASC should also be highlighted. This could be because when teachers support autonomy, they generate different learning situations in which they prioritize the students by having them make decisions (Manzano-Sánchez et al., 2023). Students feel thus compelled to improve their competencies by seeking solutions to the problems posed, enhancing their AM and relationships with their peers (Ryan & Deci, 2017). In so doing, their confidence and academic effort, both important aspects of ASC (Granero-Gallegos, Baena-Extremera, et al., 2021), will increase. In this line, several earlier studies had drawn a relationship between the autonomy support style and the SBPN (Codina et al., 2018; Granero-Gallegos, Hortigüela et al., 2021; Moreno-Murcia et al., 2019; Okada, 2023; Orsini et al., 2020), SBPN and AM (Desmarais & Grenier, 2023; Granero-Gallegos, López-García & Burgueño, 2023; Hope et al., 2019; Moreno-Murcia et al., 2015; Müller et al., 2021; Orsini et al., 2018; Vergara-Morales & Del Valle, 2021) and SBPN with the ASC (Granero-Gallegos, Baena-Extremera, et al., 2023; Granero-Gallegos, López-García, Baena-Extremera, et al., 2023). However, to our knowledge, no studies in the scientific literature have analyzed in one model all the variables used in this research and their impact on ASC considering the relevance of ASC as a key determinant of academic achievement and the attainment of success in university students (Granero-Gallegos, Baena-Extremera, et al., 2023). This is why the results obtained in this study represent an important contribution to the scientific literature, not only in the Mexican context, but worldwide.

In terms of the basic psychological needs, the results show that FBPN is a significant mediator between the controlling teaching style, and CM and amotivation. Similar results were obtained by other researchers (Codina et al., 2018; Granero-Gallegos, Hortigüela et al., 2021; Moreno-Murcia et al., 2019; Okada, 2023; Orsini et al., 2020). A potential reason is that teachers exercising a controlling style display a coercive and authoritarian behavior by controlling the student's interactions and decision making. This scenario causes the student to adopt a passive attitude in their learning process due to the control exercised by the teacher; their AM decreases and their needs for autonomy and competence become frustrated (Ryan & Deci, 2017). In this study, neither a controlling style, nor the FBPN, nor amotivation are predictors of ASC, although other authors, such as Granero-Gallegos, Baena-Extremera et al. (2023) did conclude that the FBPN negatively and directly predicts ASC. Because few studies have analyzed the relationship between basic psychological needs and ASC in university students, we believe that future research should delve more deeply into this line of research.

The results obtained in this study reveal a direct and positive predictive relationship between autonomy support and SBPN, AM, CM and ASC. In line with this, Monacis et al. (2023) highlight the relevance of the autonomy support style and the teacher-student relationship, which can positively impact the students' psychological factors and improve their learning motivation and academic performance. On the contrary, the controlling style positively predicts FBPN and amotivation. These results are similar to those obtained by Huéscar et al., (2020), who emphasized that this style could frustrate basic psychological needs and limit motivation. In fact, it is advisable to support learning in an autonomy support teaching style because, as different authors state, this interpersonal style favors more meaningful learning compared to the controlling style (Duchatelet & Donche, 2019; Hernández et al., 2022).

Finally, we will describe several strengths and limitations of this study that we consider should be mentioned. The research topic can be highlighted as a strength itself because the ASC, as shown in the source literature, is a variable of great interest in educational research and virtually no studies have been conducted on it and its relationship with variables of Self-Determination Theory. Another strength to highlight is the size of the sample used, seeing extensive participation of Mexican undergraduate Physical Education students from Baja California. In addition, there was blinding between the participants and the researchers who processed and analyzed the data. In terms of limitations, it should be noted that the sample was not randomized, that the use of self-report measures

may induce social desirability bias, and that the study design was cross-sectional, so causal inferences cannot be demonstrated. Because of these limitations, we believe that more research using longitudinal or experimental designs is needed to provide more evidence to help to explain the underlying mechanisms of the research variables. Future research efforts could raise more interest by conducting interviews to collect the qualitative data needed to delve further and gain a deeper understanding of the interaction of the variables used in this study.

Conclusions

In conclusion, it should be noted that improving ASC among students requires a teaching style that supports autonomy as a starting point. If the SBPN of the students is strengthened, this will in turn improve AM and the ASC itself. However, university students feeling FBPN due to a controlling teaching style is a major obstacle, as this enhances the prediction of CM and academic amotivation. Thus, university professors should design a series of learning strategies that minimize pressure on students, provide them with sufficient information and options, and encourage initiative and decision making. Finally, teachers must know each of their students well in order to be able to offer classes in which the students' needs for autonomy, competence and relatedness with their peers are satisfied.

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APPENDIX-1

Scale items: INTERPERSONAL TEACHING STYLE IN HIGHER EDUCATION (Estilo Interpersonal Docente en Educación Superior, EIDES) adapted to the Mexican context
(1) Mis profesores han sido menos amables con quienes no se esforzaron por ver las cosas a su manera
(2) Mis profesores han ofrecido diferentes oportunidades y opciones durante las clases
(3) Mis profesores piensan que es importante que participemos en clase porque realmente queramos hacerlo
(4) Mis profesores ofrecieron menos apoyo a los/as alumnos/as que no tuvieron buen rendimiento en clase
(5) Mis profesores prestaron menos atención a los/as alumnos/as que les desagradaron
(6) Mis profesores responden a las preguntas de los/as alumnos/ de forma clara
(7) Mis profesores aceptan menos a los/as alumnos/as que les decepcionan
(8) Mis profesores solo recompensaron a los/as alumnos/as si tenían buen rendimiento académico en clase
(9) Cuando los profesores nos piden hacer algo en clase, explican por qué era bueno realizarlo
(10) Mis profesores nos amenazan con castigos o sanciones durante las clases
(11) Mis profesores piensan que es importante que participamos en las clases porque nos resultan importantes

APPENDIX-2

Scale items: ACADEMIC SELF-CONCEPT (ASC) (Autoconcepto Académico) adapted to the Mexican context
(1) Puedo seguir el desarrollo de las clases con facilidad
(2) Puedo ayudar a mis compañeros de clase en su trabajo escolar
(3) Si trabajo duro, creo que puedo sacar mejores notas
(4) Presto atención al profesorado durante las clases
(6) Estudio mucho para mis exámenes
(6) Normalmente estoy interesado en el trabajo de clase