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Teaching skills in physical education teacher training: theoretical and factor models

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Training in skills requires implementing reliable tools allowing them to prove their development during teacher training. This research is aimed at assessing the psychometric properties of a measuring tool implemented when training teaching skills for physical education teachers and at proving whether its internal structure fits in the theoretical models reviewed in the literature. The research included 1104 undergraduate students (59.78% male and 40.22% female) from Spanish higher education institutions. A factor and exploratory analysis from the Teaching Skills in Physical Education Teacher Training survey was carried out for a such purpose. The results showed a good fit to the three-correlated model and some discrepancies regarding the skills of the theoretical models suggested by the literature. Implications for the teaching practice and the student's skill development are hereby discussed.

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The knowledge society claims teacher qualifications in all the different educational levels. After the Sorbonne Declaration (1998), higher education takes a skills approach. The teacher training institutions establish that prospective teachers should learn to get to know, live in, and be in an ever-evolving society and school (Delors, 1996). This requires bringing the university closer to society within the context of the new European Higher Education Area (EHEA) (OECD, 2016; Palmer et al., 2009).

In the international scene (Giroux, 2018; Laval and Dardot, 2013; Muros and Fernández-Balboa, 2005) it has been questioned whether the teacher training institutions might have been aligned with neoliberal political interests. Often, the search for a greater connection between the university and the business demand seems to lead us to create professional profiles according to financial demands. Bernstein (2001) advised on the situation arising from the economy and the cultural practices, as well as the sort of educational practices being replicated in the various educational scenarios. According to Apple (2000), both the teacher training institutions and the schools themselves ended up adjusting to the needs and interests of the neoliberal society.

Nevertheless, regarding the skills training in initial teacher training, Echeverría (2002) thinks there should be three levels of professionalisation: learning to develop teaching tasks, acquiring and improving personal skills and knowing how to implement them in an integrated fashion within a context. For such purpose, personal and professional skills must be activated, strategically combining skills and abilities. Corominas et al. (2006) and Tejada and Navío (2005) also support the need for learning how to dynamically harmonise intellectual and practical skills combined with other personal and interpersonal ones during the theoretical–practical training, in order to allow prospective teachers to overcome uncertainty when social changes arise (OECD, 2016).

From a critical training perspective, the teachers' skills development must be linked to social transformation (Laval, 2004; Ritzer, 2007), in order to train reliable teachers willing to commit themselves to the training of a citizenry (Sachs, 2016). In this regard, within the educational scenarios, there is a need for professionals with high capacities to take part in the teaching–learning processes and solve issues in a creative and ethical fashion (Evetts, 2013; Frey et al., 2019; Gluchmanová, 2017; Ribeiro-Silva and Amorim, 2020). Hence, it is necessary to train skills in novel teachers by seamlessly addressing their personal and professional capacities. Therefore Capitanescu-Benetti and D´Adonna (2020) and Perrenoud (2004) find mastering teaching development skills are crucial for teacher training, as well as other interpersonal skills to learn how to involve students in the learning activities. Erhorn et al. (2020) and Silva et al. (2021) also encourage the development of training opportunities resulting in learning how to support students with specific learning needs by means of inclusive, interactive, and collaborative pedagogical sequences aimed at addressing diversity and different learning paces within the classroom.

Campos-Izquierdo and Martín-Acero (2016), and Tilbury and Wortman (2004) consider two types of skills for training novel teachers: generic skills and specific skills. Acquiring and developing them will require a disciplinary and transdisciplinary collaboration, which will overcome the traditional issue of balkanisation or fragmentation of the existing knowledge inherent to the educational programmes for those novel teachers (Hargreaves and Fullan, 2014). The project Tuning Educational Structures in Europe (González and Wagenaar, 2003) arises from a methodology based on four pillars: (a) generic skills; (b) specific skills; (c) the role of the ECTS system within the curricula; and (d) the learning, teaching, assessing and performance roles to achieve quality. This skills training model means a benchmark for Europe regarding the design and academic organisation of university degrees. For Spain, the design of higher education degrees lies on the Spanish National Agency for Quality Assessment (ANECA), which guides and monitors specific and generic teaching skills (De Miguel et al., 2005; González Maura and González Tirados, 2008). Specifically, in Initial Teacher Training in Physical Education (ITTPE) such teaching skills are organised as instrumental (including cognitive skills), interpersonal (relating to the capacity to express one's feelings, critical skills, and the capacity for self-criticism) and systemic (such as creativity or leadership) levels (ANECA, 2005a, 2005b).

In ITTPE, the development of instrumental skills enables to optimise of the pedagogical capacity of prospective teachers by activating communicative, technological, and cognitive skills (Kirk et al., 2006; Romero et al., 2017). Changes observed in physical education teaching have evolved from positivist traditional training to constructivist and social–critical ones (Anderson and Krathwohl, 2001; Arends, 2012; Kelly, 2004; Kirk et al., 2006). Thus, new skills are included: cognitive skills in order to understand ideas and thoughts supporting the motor field; to take decisions and solve issues connected to the practice of physical and motor activities, as well as technological ones enabling the management of new tools and operating systems, both for the teaching practice and for collecting data and monitoring sports performance; and lastly, linguistic skills as the oral and written communication method for accessing knowledge arising from the different international scenarios.

Personal and interpersonal skills stand for affective-social abilities enabling success in social relationships resulting from collaborative work, the development of personal and group accountability, ethical commitment and social skills (Hopkins and Ravindranath, 2007; Wright et al., 2021). Such abilities require consensus, consultation and discussion capacities, problems solving and the search for solutions (Aririguzoh, 2022; Jafar, 2016), which are vital for organising and leading educational institutions (Bourgonje and Tromp, 2011; Sánchez-Tarazaga, 2016). In the specific field of physical education, this is related both to the emotional body language capacity and the improvement of social skills connected to sports activity where there is teamwork enabled by the social and ethical commitment promoted by such processes of interaction and social cooperation.

Systemic and integrative skills require awareness and knowledge to understand how the parts interrelate and integrate within a whole (Ceo-DiFrancesco et al., 2019). Combining understanding and knowledge enables the (teaching and learning) person to analyse how the parts of a whole interrelate and group with each other. In the case of body-expressive activities, students are encouraged to create, experiment, choose gestures and dynamic movements by the music in order to find ways to face challenges either individually or in the group, with creative and innovative actions where the body self-awareness is present (Buck and Snook, 2018; De Bono, 2005; Harker et al., 2018). This triggers personal autonomy, self-efficiency to perform tasks and the capacity to solve problems (Hepplestone et al., 2016; Keller-Mathers, 2011). All this requires previously acquiring and mastering instrumental and personal skills. In this sense, the European Commission (2013) has called for the development of a teacher training model incorporating such skills aimed at learning how to think, know, feel and act as a teacher.

Reviewing the latest studies on the evaluation of competences in physical education teacher training, we found several focused mainly on the review of their presence in training programmes (Baena and Granero, 2012; Boned et al., 2004; Díaz del Cueto, 2009; Gallardo, 2006; Gallego-Ortega and Rodríguez-Fuentes,

2018; Lleixá et al., 2008, 2010; Romero, 2009). Others, such as the work of Baena et al. (2015), carried out the Spanish validation of the Evaluation of Teaching competences Scale—ETCS scale developed to measure the competences of Secondary Physical Education teachers. The work of Martínez-Mínguez (2016), used the instrument called "Self-perception Scale of Professional competences" to know the influence of the development of a learning project carried out with teachers analysing five teaching competences: organisation, evaluation, teamwork, programming, environment and dissemination. In the university context, Salcines-Talledo et al. (2018) developed and validated a scale of self-perception of transversal competences for students, which included a specific scale for initial teacher training in Physical Education (FIPEF).

Also, Moreno-Murcia et al. (2015) developed a questionnaire to assess the competences of university teachers (Teaching Performance Assessment Questionnaire), which they applied to a group of university students. Their results showed a factorial structure with three dimensions: planning, development and outcome, with adequate reliability and validity. In addition, Castejón-Oliva et al. (2015) validated a questionnaire to assess students' perceptions in relation to participatory methodology and formative assessment received. Moreover, Aparicio and Fraile (2015) analysed the development of interpersonal competences based on a corporal expression programme carried out with future Physical Education teachers. They used the "Assessment scale of interpersonal competences of Physical Education teachers", which consisted of 33 items corresponding to the following interpersonal competences: teamwork, communication, interpersonal skills, appreciation of diversity and multiculturalism, critical capacity and ethical commitment.

However, Palacios-Picos et al. (2019) in recent studies in ITTPE on the training of generic and specific skills for teaching physical education, point out that not all of them are equally present or valued in curricula programmes or assessment systems. Hortigüela-Alcalá et al. (2018) acknowledge five dimensions: creative and autonomous work skills, interpersonal and intrapersonal skills, capacity for reflection, critical thinking and communication skills, metacognitive skills and specific skills. As for Meier (2020), Moreno-Murcia et al. (2015), training teaching skills means developing capacities for planning learning, its development and implementation, the teacher performance and results in assessment. In this regard, the teaching practice requires mastering skills for developing teaching–learning strategies enabling drive the students' autonomy, increase physical activity practice and the active development of students as key points to have a good atmosphere in the classroom and more efficient teaching–learning processes (Aelterman et al., 2014; Cheon and Reeve, 2015; Moreno-Murcia and Sánchez-Latorre, 2016; Pérez-González et al., 2019; Perlman, 2011; Yew and Wang, 2016).

Despite the reviewed theoretical models guiding the teachers' skills training, there are no studies proving the validity of tools for measuring skills within the context of teachers' higher education. The polysemous concept of skill and the models suggested by the Tuning Project or the ANECA has not yet been empirically verified. Therefore, the purpose of this study was to assess metric properties of a measuring tool used in teaching skills training for Physical Education teachers and on proving its fit to the theoretical models suggested by Tuning and ANECA. To achieve this general objective, the following research questions were proposed:

- RQ1: What is the internal structure of the measuring instrument?
- RQ2: Does this internal structure fit the theoretical models proposed in the literature?

- RQ3: Does the test adequately represent the construct: evidence of convergent and discriminant validity?

Methods

Participants. This study involved 1104 undergraduates (660 male participants 59.78%, 444 female participants 40.22%) from a 20 university centre in 20 Spanish cities. Out of them, 751 (68%) were undergraduates studying the fourth academic year of a degree in primary education teacher with Special Mention in Physical Education (SMPE) and 353 (32%) were undergraduates studying the fourth academic year of a Degree in Physical Activity and Sports Sciences (DPASC). The participant's selection was carried out by a non-probabilistic sample, taking universities belonging to a Red Nacional de Evaluación Formativa en Educación Superior (Spanish National Network of Formative Assessment in Higher Education) as the benchmark. The data collection was performed by duly trained teachers, with all the participants' explicit consent. The ethical rigour was guaranteed as established by the Ethics Committee of the researchers' university. Also, an informed consent form was signed by all participants, who, in turn, were not only informed, verbally and in writing, about the purposes and the procedure of the study but also were ensured anonymity and that the data would exclusively be used for the purposes of the investigation.

Tool. The Questionnaire of Perception of Teaching Skills in Physical Education (Palacios-Picos et al., 2019) is made up of two blocks. The first of them is made up of four subscales relating to teaching skills and the second block is made up of three subscales relating to transversal skills. So far, only the psychometric properties of the first block, the four subscales (Palacios-Picos et al., 2019), referring to teaching skills have been analysed. In this study, the psychometric properties of the second block, three subscales related to transversal skills, are analysed. The initial set of items of the second block (transversal skills) was reviewed by eight expert judges specialised in ITTPE, both for primary physical education and the degree in DPASC, with a minimum of 15 years of experience in ITTPE and renowned prestige as teachers and researchers. After reviewing and analysing the experts' appraisals, items were grouped, removed and changed, resulting in a total of 21 items out of the 24 initial ones.

This questionnaire has proved sufficient evidence regarding reliability and validity (Palacios-Picos et al., 2019) when talking about teaching skills, although the metric properties of the transversal skills segment have not been analysed. Those 21 items relate to the perception students have of the help received by means of the subjects taken for each degree in order to develop every transversal skill included in them. The first subscale is made up of nine items relating to personal and interpersonal skills (e.g. "Ability to analyse and summarise", "Ability to organise and plan", "Teamwork", "Abilities in interpersonal relationships"). The second subscale is made up of seven items on skills for managing teaching–learning processes (e.g. "Organising and encouraging learning settings", "Devising and implementing attention to diversity strategies"). The third subscale refers to instrumental skills and has five items (e.g. "Knowledge of a foreign language", "Computer knowledge related to study"). The participants articulated their level of agreement with regard to each of the statements on a five-point Likert scale (0 = not at all and 4 = a lot).

Data analysis. The analysis process was developed following two stages. Stage 1 divided the initial sample into two random subsamples of $n = 552$ participants each and performed an exploratory factor analysis (EFA) with respect to the polychoric

correlations matrix among the items (Hair et al., 2010) assessed taking into account the replies of the first half of the sample ($n = 552$). After verifying the data suitability for the factor analysis with the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity (KMO = 0.94; Bartlett's test of sphericity, $\chi^2(276) = 1296.07$; $p < 0.001$) an optimised parallel analysis was carried out (Timmerman and Lorenzo-Seva, 2011).

At stage 2, three models were assessed by the confirmatory factor analysis (CFA) with respect to the polychoric correlations matrix obtained through the second random subsample ($n = 552$): the single-factor model, the two-correlated factor model and the three-correlated factor model. Reliability of measurements (internal coherence, reliability of individual indicators, construct reliability and measurement error) was assessed in the last model. All the models were assessed through diagonally weighted least squares with respect to the polychoric correlations matrix using the R 3.6.3 software (R Core Team, 2021) and the Lavaan package (Rosseel, 2012).

Results

The aim was to verify whether the grouping of systemic, instrumental and personal skills carried out by the Tuning study matched the exploratory and confirmatory analysis of this work.

Stage 1: Exploratory factor analysis. The optimised parallel analysis performed on 1000 random replications obtained an optimal solution of a factor when considering the 95th percentile of the random variance ratio and of three factors when considering its mean value. The three-factor selected solution explains the 52% of common variance. Table 1 shows the factor analysis results. The first factor, with an eigenvalue of 8.87, explains 21% of the common variance and has been named *Personal and Interpersonal Skills* (F1). It is made up of 9 items with their contents being related to individual skills concerning being able to express feelings, having criticism and self-criticism capabilities, having social skills related to interpersonal skills, developing the ability to work in teams or expressing social or ethical commitment. These skills usually promote social interaction and cooperation processes. The second factor, with an eigenvalue of 1.37, explains 18% of the common variance and has been named as *Teaching–Learning Process Management and Planning* (F2). It groups 7 items related to various organisational and managing skills for teaching-learning processes. The third factor, with an eigenvalue of 1.03, explains 13% of the common variance and refers to the *Instrumental Skills* (F3). It is made up of items related to technological skills concerning the use of new technologies and information management, as well as linguistic skills such as oral and written communication or the knowledge of a foreign language.

Stage 2: Confirmatory factor analysis. At the second stage, the goodness-of-fit of three one-, two- and three-factor models was compared. The result was very favourable to the three-correlated factor model. As shown in Table 2, the improvement of fit in model 3 with respect to the rest of the models, was conclusive.

Overall, ordinal alpha reliability results (Gadermann et al., 2012) of $\alpha = 0.94$, and McDonald's omega (McDonald, 2013; Revelle and Zinbarg, 2009) of $\omega = 0.95$ were obtained. Both values were considered excellent. As for the first subscale, internal consistency indexes ($\alpha_1 = 0.89$; $\omega_1 = 0.89$) were good. Regarding the second subscale, reliability indexes ($\alpha_2 = 0.87$; $\omega_2 = 0.89$) were good. Likewise, regarding the third subscale, reliability values ($\alpha_3 = 0.83$; $\omega_3 = 0.84$) were adequate.

The composite reliability (CR) analysis of every latent variable provides a construct reliability indicator. The CR was higher than

Table 1 Exploratory factor analysis. saturations, communalities and explained variance.

		F1	F2	F3	h2
Factor 1: Personal and interpersonal skills[a]					
1.25	Analysis and synthesis capabilities	0.46	0.22	0.08	0.39
1.26	Organisational and planning abilities	0.52	0.20	0.00	0.46
1.30	Teamwork	0.62	0.01	0.10	0.33
1.31	Interpersonal relationship skills	0.56	0.15	0.04	0.48
1.32	Critical thinking	0.88	0.12	0.04	0.69
1.33	Ethical commitment	0.66	0.07	0.17	0.53
1.34	Autonomous learning	0.82	0.14	0.02	0.55
1.35	Adjusting to new situations	0.67	0.10	0.04	0.59
1.36	Creativity	0.48	0.22	0.00	0.43
Factor 2: Teaching–learning process management and planning[b]					
1.23	Knowing educational institutions organisational features	0.03	0.43	0.23	0.39
1.24	Developing suggestions for changing the educational reality	0.10	0.52	0.13	0.48
2.1	Organising and encouraging learning settings	0.27	0.69	0.17	0.61
2.2	Managing learning progress	0.19	0.78	0.16	0.65
2.3	Devising and implementing attention to diversity strategies	0.10	0.78	0.01	0.51
2.4	Involving students in their learning and the institution's life	0.01	0.76	0.04	0.64
2.7	Informing and involving families	0.22	0.49	0.46	0.56
Factor 3: Instrumental skills[c]					
1.28	Knowledge of a foreign language	0.06	0.11	0.58	0.38
1.29	Computer knowledge related to study	0.14	0.20	0.82	0.59
2.6	Taking part in institution's management	0.14	0.42	0.51	0.59
2.8	Using Information and communications technology	0.11	0.13	0.78	0.57
2.9	Addressing the profession's duties and ethical dilemmas	0.18	0.16	0.48	0.53

[a]Eigenvalue: 8.87; Explained common variance: 21%; Ordinal Cronbach's $\alpha = 0.89$; McDonald's $\omega = 0.89$.
[b]Eigenvalue 1.37; Explained common variance: 18%; Ordinal Cronbach's $\alpha = 0.87$; Mcdonald's $\omega = 0.89$.
[c]Eigenvalue: 1.03; Explained common variance: 13%; Ordinal Cronbach's $\alpha = 0.83$; McDonald's $\omega = 0.86$.

0.70 (CR$_1$ = 0.86; CR$_2$ = 0.85; CR$_3$ = 0.80) for all instances. This means the three subscales' indicators, when taken together, are a reliable measurement for the construct. As for the average variance extracted (AVE), values of $AVE_1 = 0.51$ for the first latent variable, $AVE_2 = 0.52$ for the second latent variable, and $AVE_3 = 0.51$ for the third latent variable were obtained. Since the average variance extracted was higher than 0.50 for all instances, it was concluded that a substantial amount of the indicator's variance was explained by the construct when compared to the measurement error. Overall, all these indicators meant reliability signs in the operationalisation of the three latent variables making up the scale.

The single-indicator reliability was also simultaneously analysed. Each indicator's reliability could be verified by R^2 values, which show a variance ratio for each indicator explaining the latent variable, where high R^2 values meant the indicator was reliable. The most reliable indicator of Factor 1 (Personal and Interpersonal Skills) was item 1.35 (*Adjusting to new situations*; $R^2 = 0.55$) and the least reliable was item 1.30 (*Teamwork*; $R^2 = 0.19$). As for factor 2 (Teaching–Learning Process Management and Planning), the most reliable was item 2.4 (*Involving students in their learning and the institution's life*; $R^2 = 0.53$) and the least reliable item was 1.23 (*Knowing educational institutions' organisational features*; $R^2 = 0.32$). Finally, regarding factor 3

Table 2 Comparison of fit indexes for the three models considered.

Model	χ^2 (df)	$\Delta\chi^2$ (Δdf)	$p(\Delta\chi^2)$	RMSEA	ΔRMSEA	CFI	ΔCFI	TLI	ΔTLI
1	1106.63 (189)	–	–	0.066	–	0.967	–	0.963	–
2	732 (188)	374.43(1)	<0.001	0.051	0.015	0.980	0.013	0.978	0.015
3	645.59 (186)	86.81(2)	<0.001	0.047	0.004	0.983	0.003	0.981	0.003

RMSEA root mean square error of approximation, *CFI* comparative fit index, *TLI* Tucker–Lewis Index, *df* degrees of freedom; Δ (*CFI, TLI, RMSEA*) changes in fit with respect to the previous least restrictive model.

Table 3 Three-correlated factor solution assessments.

Latent factor	Indicator	B	SE	Z	p-value	Beta
F1	1.25 Analysis and synthesis capabilities	1	0	–	–	0.68
F1	1.26 Organisational and planning abilities	0.9	0.03	34.89	0	0.65
F1	1.30 Teamwork	0.6	0.02	28.47	0	0.45
F1	1.31 Interpersonal relationship skills	0.97	0.03	34.82	0	0.66
F1	1.32 Critical thinking	1.02	0.03	35.87	0	0.71
F1	1.33 Ethical commitment	1.06	0.03	35.43	0	0.68
F1	1.34 Autonomous learning	0.87	0.03	33.23	0	0.61
F1	1.35 Adjusting to new situations	1.09	0.03	36.4	0	0.73
F1	1.36 Creativity	1.06	0.03	34.64	0	0.64
F2	1.23 Knowing educational institutions organisational features	1	0	–	–	0.61
F2	1.24 Developing suggestions for changing the educational reality	1.14	0.03	34.21	0	0.67
F2	2.1 Organising and encouraging learning settings	1.01	0.03	34.58	0	0.7
F2	2.2 Managing learning progress	1.02	0.03	34.66	0	0.72
F2	2.3 Devising and implementing attention to diversity strategies	1.01	0.03	33	0	0.62
F2	2.4 Involving students in their learning and the institution's life	1.19	0.03	35.2	0	0.74
F2	2.7 Informing and involving families	1.27	0.04	33.66	0	0.64
F3	1.28 Knowledge of a foreign language	1	0	–	–	0.54
F3	1.29 Computer knowledge related to study	1.15	0.04	31.75	0	0.65
F3	2.6 Taking part in institution's management	1.29	0.04	32.67	0	0.73
F3	2.8 Using Information and communications technology	1.18	0.04	31.68	0	0.66
F3	2.9 Addressing the profession's duties and ethical dilemmas	1.24	0.04	32.88	0	0.75

Table 4 Comparison of fit indexes for the four three-factor models.

Model	χ^2 (df)	$\Delta\chi^2$ (Δdf)	$p(\Delta\chi^2)$	RMSEA	ΔRMSEA	CFI	ΔCFI	TLI	ΔTLI
3 Factors	645.59 (186)	–	–	0.047	–	0.983	–	0.981	–
1 (F1–F2)	3917.69 (187)	3272.3 (1)	<0.001	0.134	0.087	0.865	0.118	0.848	0.133
2 (F1–F3)	3712.69 (187)	3066.8 (1)	<0.001	0.131	0.084	0.872	0.111	0.856	0.125
3 (F2–F3)	3149.76 (187)	2504.4 (1)	<0.001	0.120	0.073	0.893	0.09	0.879	0.102

RMSEA root mean square error of approximation, *CFI* Comparative Fit Index, *TLI* Tucker–Lewis Index, *df* degrees of freedom, Δ (*CFI, TLI, RMSEA*) changes in fit with respect to the previous least restrictive model.

(Instrumental Skills), the most reliable was item 2.9 (*Addressing the profession's duties and ethical dilemmas;* $R^2 = 0.6$) and the least reliable was item 1.28 (*Knowledge of a foreign language;* $R^2 = 0.3$).

With regard to convergent validity evidence (e. g. indicators for each latent variable share a high ratio of common variance), as shown in Table 3, (a) the factorial loads for all the indicators were significant; (b) all of them, except one, were higher than 0.5; and (c) the saturations' average variance of the items for each factor were all higher than 0.5, which can also be considered as a convergent validity indicator.

The discriminant validity evidence showed that all of the constructs analysed is unique and different from each other. In order to verify whether there is discriminant validity evidence, three approaches (Hair et al., 2010) were used. Firstly, the correlation between each pair of factors was set to 1, and the fit of the resulting models was compared to the initial three-correlated factor model's fit. The results showed that this model was significantly higher than the models where the correlation

between *F1* and *F2* ($\Delta\chi^2$ (1) = 3272.3, $p < 0.001$), between *F1* and *F3* ($\Delta\chi^2$ (1) = 3066.8, $p < 0.001$), and between *F2* and *F3* ($\Delta\chi^2$ (1) = 2504.4, $p < 0.001$) was set to 1, as shown in Table 4.

Secondly, the confidence interval test (Anderson and Gerbing, 1988) showed that the confidence interval of correlations between factors did not include 1 ($\rho F1–F2 = 0.778$ [0.762–0.794], SE = 0.008; $\rho F1–F3 = 0.703$ [0.687–0.719], SE = 0.008; $\rho F1–F3 = 0.835$ [0.817–0.853], SE = 0.009). Thirdly, it was confirmed that the HTMT ratio (Henseler et al., 2015) of correlations between indicators of different factors (heterotrait-heteomethod correlations—HT) and between the correlations of the same factor (monotrait-heteomethod correlations—MT) was lower than 0.9 (F1–F2, HT/MT = 0.771; F1–F3, HT/MT = 0.693; F2–F3, HT/MT = 0.835).

Discussion

Sufficient evidence has been provided to support that the three subscales that make up the measurement instrument have adequate internal consistency, sufficient reliability for the individual

indicators and appropriate reliability for the construct. In terms of validity, there has been sufficient evidence of convergent and discriminant validity. However, it has not been possible to deepen the analysis of the possible existence of a strong common factor, as suggested by the correlation values between the three latent variables and the results of the optimised parallel analysis, so it is necessary to go further in this direction in the future. Nevertheless, the results obtained show a structure in which a certain connection between the competences can be observed, evidencing a training model in which three orientations that develop teaching competencies converge and are also aligned with ANECA (2005a, 2005b). Thus, the exploratory factor analysis revealed a three-factor structure corresponding to three types of competences. The first factor is related to personal and interpersonal skills and was composed of nine items integrated around two dimensions: the first, personal attributes such as the capacity for autonomous learning, critical thinking, ethical commitment and creative, adaptive, analytical, synthesis, planning and organisational skills. And the second, interpersonal or social skills, necessary to work in a team, relate and coexist with others (Wright et al., 2021). The presence in the formative model of the development of critical capacity and ethical commitment (Frey et al., 2019; Ribeiro-Silva and Amorim, 2020) shows the concern for forming self-awareness skills in students, which is an essential basis for developing in them other capacities and teaching skills to adapt, be flexible and creative in the face of the continuous changes and needs of people in the school context (Delors, 1996; OECD, 2016). For their part, the development of personal and interpersonal skills, present in Tuning (González and Wagenaar, 2003), is crucial to promote specific educational skills such as dynamising learning environments and involving students in a meaningful way (Perrenoud, 2004).

In relation to the second factor, is related to teaching skills. It seems to follow two formative orientations. The first one facilitates knowledge of the functioning and organisation of the educational reality. And the second teaches how to plan and develop the teaching and learning process in the classroom. This dual perspective is aligned with the guidelines that the European Commission (2013) recommended for teacher training, seeking their training not only in terms of mastering pedagogical practices and classroom management but also knowing the educational institution, organisation and functioning (Bourgonje and Tromp, 2011), learning, from the first moments, to think, feel and do as teachers. This dual perspective is essential as teachers must not only be professionally involved inside their classroom but also outside, for example, by taking responsibility for the school's educational project (Sánchez-Tarazaga, 2016) or dynamising actions to connect the school with families and the environment (Capitanescu-Benetti and D'Adonna, 2020).

The third factor is related to instrumental competences. This group includes the competences of technological mastery and knowledge of languages. The first, which is present in the training model under consideration, allows for the assumption of various professional roles, such as administrative and management roles (Prat and Camerino, 2012; Prat et al., 2013; Romero et al., 2017), and teaching, in the management of the teaching and learning process, such as collecting and systematising data for the monitoring of sports performance activities or recording the creative results of the bodily expressive challenges developed in class (Buck and Snook, 2018; De Bono, 2005; Harker et al., 2018). For its part, knowledge of languages is understood as vital in a globalised and interconnected world, allowing teachers to participate in shared educational innovation projects between countries (Perrenoud, 2004), expanding knowledge of teaching practice beyond the limits of the school itself, better understanding the complexity of the

educational reality in order to transform it (González and Wagenaar, 2003). In this way, a comprehensive model of competence training is demonstrated, which is aligned and coherent with the guidelines established by the major national and international bodies and reports, and in which various types of competences are linked in favour of comprehensive teacher training. The connection present in the model of personal and interpersonal competences (in terms of affective and social skills) and instrumental (methodological) competences facilitates the more successful development of purely teaching competences. On the one hand, oriented toward pedagogical practice, it is more necessary than ever to promote inclusive education. On the other hand, they are aligned with educational management and leadership functions, based on consensus, ethical responsibility, self-critical and critical spirit, teamwork, creativity and openness, as the basis for good, committed and responsible professional practice. Exploring new connections between competences could improve the integrated approach to the training of future teachers.

Data availability
The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy reasons.

References

Aelterman N, Vansteenkiste M, Van den Berghe L et al. (2014) Fostering a need-supportive teaching style: intervention effects on physical education teachers' beliefs and teaching behaviors. J Sport Exerc 36(6):595–609. https://doi.org/10.1123/jsep.2013-0229

Anderson J, Gerbing D (1988) Structural equation modeling in practice: a review and recommended two-step approach. Psychol Bull 103(2):411–423. https://doi.org/10.1037/0033-2909.103.3.411

Anderson LW, Krathwohl D (2001) A taxonomy for learning, teaching, and assessing: a revision of Bloom's taxonomy of educational objectives. Longman

ANECA (2005a) Libro blanco. Título de grado en magisterio. Agencia Nacional de la Evaluación de la Calidad y la Acreditación

ANECA (2005b) Libro blanco. Título de grado en ciencias de la actividad física y el deporte. Agencia Nacional de Evaluación de la Calidad y la Acreditación

Aparicio JL, Fraile A (2015) La evaluación de competencias interpersonales en la formación del profesorado de educación física a través de un programa de expresión corporal. Int J 21st Century Educ 2(2):21–34

Apple W (2000) Teoría crítica y educación. Miño y Dávila

Arends R (2012) Learning to teach. McGraw-Hill

Aririguzoh S (2022) Communication competencies, culture and SDGs: effective processes to cross-cultural communication. Humanit Soc Sci Commun 9(96) https://doi.org/10.1057/s41599-022-01109-4

Baena A, Granero A (2012) Competencias profesionales en Educación Física y necesidades educativas. Espiral Cuad Profr 5(10):105–109. https://doi.org/10.25115/ecp.v5i10.945

Baena A, Granero A, Martínez M (2015) Validación española de la Escala de Evaluación de la Competencia Docente en Educación Física de secundaria. Cuad Psicol Depor 15(3):113–122. https://doi.org/10.4321/S1578-84232015000300011

Bernstein B (2001) La estructura del discurso pedagógico. Morata

Boned CJ, Rodríguez-Romo G, Mayorga JI, Merino A (2004) Competencias profesionales del Licenciado en Ciencias de la Actividad Física y del Deporte. Eur J Hum Mov 15:1–6

Bourgonje P, Tromp R (2011) Quality educators: an international study of teacher competences and standards. Oxfam Novib

Buck R, Snook B (2018) Negotiating meanings and examining practice of 'arts across the curriculum'. Res Dance Educ 18(3):321–334. https://doi.org/10.1080/14647893.2017.1370450

Campos-Izquierdo A, Martín-Acero R (2016) Perception of professional competences of graduates in Science of Physical Activity and Sport. J Sport Psychol 25(2):339–346

Capitanescu-Benetti A, D´Adonna C (2020) Les parents, enseignant dans la clase à l´heure du Covid-19. N´Autre École Hebdo 1:19–24

Castejón-Oliva FJ, Santos-Pastor ML, Palacios-Picos A (2015) Cuestionario sobre metodología y evaluación en formación inicial en educación física. Rev Int Med Cienc Act Fís Deport 15(58):245–267. https://doi.org/10.15366/rimcafd2015.58.004

Ceo-DiFrancesco D, Kochlefl MK, Walker J (2019) Fostering inclusive teaching: a systemic approach to develop faculty competencies. J High Educ Theory Pract 19(1):31–43. https://doi.org/10.33423/jhetp.v19i1

Cheon SH, Reeve J (2015) A classroom-based intervention to help teachers decrease students' amotivation. Contemp Educ Psychol 40:99–111. https://doi.org/10.1016/j.cedpsych.2014.06.004

Corominas E, Tesouro M, Capell D et al. (2006) Percepciones del profesorado ante la incorporación de las competencias genéricas en la formación universitaria. Rev Educ 341:301–336

De Bono E (2005) El pensamiento creativo. Paidós

Delors J (1996) Learning: the treasure within. Report to UNESCO of the international commission on education for the twenty-first century. https://unesdoc.unesco.org/ark:/48223/pf0000109590

De Miguel M, Alfaro IJ, Apodaca P et al. (2005) Adaptación de los planes de estudio al proceso de convergencia europea. Universidad de Oviedo

Díaz del Cueto M (2009) Percepción de competencia del profesorado de Educación Física e inclusión. Rev Int Med Cien Act Fís Deport 9(35):322–348

Echeverría B (2002) Gestión de la competencia de acción profesional. Rev Investig Educ 1(20):7–43. https://doi.org/10.6018/rie

Erhorn J, Moeller L, Langer W (2020) Academic physical education training for inclusive physical education? A critical review of the state of research. German J Exerc Sport Res 4(50):487–500. https://doi.org/10.1007/s12662-020-00668-5

European Commission (2013) Supporting teacher competence development for better learning outcomes. http://ec.europa.eu/education/policy/school/doc/teachercomp_en.pdf. Accessed 20 Dec 2020

Evetts J (2013) Professionalism: value and ideology. Curr Sociol 61(5–6):778–796

Frey N, Fisher D, Smith D (2019) All learning is social and emotional: helping students develop essential skills for the classroom and beyond. ACSD

Gadermann AM, Guhn M, Zumbo BD (2012) Estimating ordinal reliability for Likert-type and ordinal item response data: a conceptual, empirical, and practical guide. Pract Assess Res Eval 17(3):1–13. https://doi.org/10.7275/n560-j767

Gallardo MA (2006) Evaluación de las competencias profesionales para la inserción laboral de los maestros de Educación Física. Rev Electrón Investig Psicoeduc 9(3):469–492

Gallego-Ortega JL, Rodríguez-Fuentes A (2018) Percepciones del profesorado sobre competencias comunicativas de futuros maestros de educación. Rev Int Med Cienc Act Fís Deport 18(71):479–492. https://doi.org/10.15366/rimcafd2018.71.005

Giroux HA (2018) Pedagogy and the politics of hope: theory, culture and schooling. Routledge

Gluchmanová M (2017) Theoretical and practical aspects of a professional ethics of teaching. Hum Aff 27(1):75–81. https://doi.org/10.1515/humaff-2017-0007

González Maura V, González Tirados RM (2008) Competencias genéricas y formación profesional: un análisis desde la docencia universitaria. Rev Iberoam Educ 47:185–209. https://doi.org/10.35362/rie470710

González J, Wagenaar R (2003) Tuning educational structures in Europe. Deusto University

Hair JF, Black WC, Babin BJ et al. (2010) Multivariate data analysis, 7th edn. Prentice-Hall, Englewood Cliffs, NJ

Hargreaves A, Fullan M (2014) Capital profesional: Transformar la enseñanza en cada escuela. Morata

Harker B, Snook B, Buck R (2018) Creating the dance and dancing creatively: exploring the liminal spaces of choreography for emergence. J Can Assoc Curric Stud 16(1):162–174

Henseler J, Ringle CM, Sarstedt M (2015) A new criterion for assessing discriminant validity in variance-based structural equation modeling. J Acad Mark Sci 43(1):115–135. https://doi.org/10.1007/s11747-014-0403-8

Hepplestone S, Glover I, Irwin B et al. (2016) Setting out the role of feedback in the assessment process through both the student and tutor perspective. Practitioner Res High Educ 10(1):81–90

Hopkins C, Ravindranath MJ (2007) Teacher education—a crucial contribution to DESD. Recommendations. In: Sarabhai KV, Pandya M, Namagiri R (eds) International conference on DESD, CEE, Ahmedabad, India, Centre for Environment Education

Hortigüela-Alcalá D, Palacios-Picos A, López-Pastor V (2018) The impact of formative and shared or co-assessment on the acquisition of transversal competences in higher education. Assess Eval High Educ 44(6):933–945. https://doi.org/10.1080/02602938.2018.1530341

Jafar A (2016) Student engagement, accountability, and empowerment: a case study of collaborative course design. Teach Sociol 44(3):221–232. https://doi.org/10.1177/0092055X16644489

Keller-Mathers S (2011) Building passion and potential for creative learning in higher education. Collect Essays Learn Teach 4:1–6

Kelly AV (2004) The curriculum. Theory and practice. Sage

Kirk D, Mcdonald D, O´Sullivan M (2006) The handbook of physical education. Sage

Laval C (2004) La escuela no es una empresa. El ataque neoliberal a la enseñanza pública. Paidós

Laval C, Dardot P (2013) La nueva razón del mundo. Ensayo sobre la sociedad neoliberal. Gedisa

Lleixà T, Robert M, Batalla A (2008) Evaluación de competencias en la formación del profesorado de Educación Física: El caso del Blaagaard Seminarium de Copenhague. Fuentes 8:116–124

Lleixà T, Torralba MA, Abrhao SR (2010) Evaluación de competencias en Educación Física: Investigación-acción para el diseño de procedimientos de evaluación en la Etapa Primaria. Movimiento 16(4):33–51

Martínez-Mínguez ML (2016) Proyectos de aprendizaje tutorados y autoevaluación de competencias profesionales en la formación inicial del profesorado. Retos 29:242–250. https://doi.org/10.47197/retos.v0i29.42719

McDonald RP (2013) Test theory: a unified treatment. Psychology Press, New York

Meier M (2020) Development and validation of a testing instrument to assess pedagogical content knowledge of German preservice physical education teachers. J Phys Educ Sport 20:3010–3016

Moreno-Murcia JA, Sánchez-Latorre F (2016) The effects of autonomy support in physical education classes. Rev Int Cien Deporte 43(12):79–89. https://doi.org/10.5232/ricyde2016.04305

Moreno-Murcia JA, Silveira Y, Belando N (2015) Questionnaire evaluating teaching competencies in the university environment. Evaluation of teaching competencies in the university. J New Approch Educ Res 4(1):54–61. https://doi.org/10.7821/naer.2015.1.106

Muros B, Fernández Balboa JM (2005) Physical education teacher educator´s personal perspectives regarding their practice of critical pedagogy. J Teach Phys Educ 24(3):243–264. https://doi.org/10.1123/jtpe.24.3.243

OECD (2016) Education at a Glance 2016: OECD Indicators. OECD Publishing

Palacios-Picos A, López-Pastor V, Fraile Aranda A (2019) Cuestionario de percepción de competencias docentes de educación física. Rev Int Med Cienc Act Fís Depor 19(75):445–461. https://doi.org/10.15366/rimcafd2019.75.005

Palmer A, Montaño JJ, Palou M (2009) Las competencias genéricas en la educación superior. Estudio Comparativo Entre la Opinión Empleadores Académicos. Psicothema 21(3):433–438

Pérez-González AM, Valero-Valenzuela A, Moreno-Murcia JA et al. (2019) Systematic review of autonomy support in physical education. Apunts Educ Fís Deporte 138:51–61. https://doi.org/10.5672/apunts.2014-0983.es.(2019/4).138.04

Perlman D (2011) The influence of an autonomy-supportive intervention on preservice teacher instruction: a self-determined perspective. Aust J Teacher Educ 36(11):73–79

Perrenoud P (2004) Diez nuevas competencias para enseñar: invitación al viaje. Graó

Prat Q, Camerino O (2012) Las tecnologías del aprendizaje y el conocimiento (TAC) en la educación física. La WebQuest como recurso didáctico. Apunts Educ Fís Deporte 109:44–53. https://doi.org/10.5672/apunts.2014-0983.es.(2012/3).109.04

Prat Q, Camerino O, Coiduras J (2013) Introducción de las TIC en educación física. Estudio descriptivo sobre la situación actual. Apunts Educ Fís Deporte 113:37–44. https://doi.org/10.5672/apunts.2014-0983.es.(2013/3).113.03

R Core Team (2021) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria

Revelle W, Zinbarg RE (2009) Coefficients alpha, beta, omega and the glb: comments on Sijtsma. Psychometrika 74(1):145–154. https://doi.org/10.1007/s11336-008-9102-z

Ribeiro-Silva E, Amorim C (2020) Physical education cooperating teachers' perspectives on professional ethics. J Sport Pedagog Res 6(1):46–50. https://doi.org/10.47863/FWVN1757

Ritzer G (2007) Los tentáculos de la McDonalización. Popular

Romero C (2009) Definición de módulos y competencias del maestro con mención en Educación Física. Rev Int Med Cienc Act Fís Deporte 9(34):179–200

Romero R, Castejón F, López-Pastor V et al. (2017) Evaluación formativa, competencias comunicativas y TIC en la formación del profesorado. Comunicar 52:73–82. https://doi.org/10.3916/C52-2017-07

Rosseel Y (2012) lavaan: An R package for structural equation modeling. J Stat Softw 48(2):1–36. https://doi.org/10.18637/jss.v048.i02

Salcines-Talledo I, González-Fernández N, Ramírez-García A, Martínez-Mínguez L (2018) Validación de la escala de autopercepción de competencias transversales y profesionales de estudiantes de educación superior. Profr Rev Curric Form Profr 22(3):31–51. https://doi.org/10.30827/profesorado.v22i3.7989

Sachs J (2016) Teacher professionalism: why are we still talking about it. Teach Teach 22(4):413–425. https://doi.org/10.1080/13540602.2015.1082732

Sánchez-Tarazaga L (2016) Los marcos de competencias docentes: Contribución a su estudio desde la política educativa europea. J Supranatl Polic Educ 5:44–67. https://doi.org/10.15366/jospoe2016.5

Silva R, Farias C, Mesquita I (2021) Challenges faced by preservice and novice teachers in implementing student-centred models: a systematic review. Eur Phys Educ Rev 27(4):98–816. https://doi.org/10.1177/1356336X21995216

Tejada J, Navío A (2005) El desarrollo y la gestión de competencias profesionales: Una mirada desde la formación. Rev Iberoam Educ 37(2):1–16. https://doi.org/10.35362/rie3722719

Tilbury D, Wortman D (2004) Engaging people in sustainability. Commission on Education and Communication. IUCN

Timmerman ME, Lorenzo-Seva U (2011) Dimensionality assessment of ordered polytomous items with parallel analysis. Psychol Methods 16(2):209–220. https://doi.org/10.1037/a0023353

Sorbonne Declaration (1998) La Educación Superior en el siglo XXI. Conferencia Mundial sobre Educación Superior. La Educación Superior en el siglo XXI: Visión y acción. UNESCO, https://www.iesalc.unesco.org/ess/index.php/ess3/article/view/171

Wright PM, Grey S, Richards KA (2021) Understanding the interpretation and implementation of social and emotional learning in physical education. Curric J 32:67–86. https://doi.org/10.1002/curj.85

Yew M, Wang K (2016) The effectiveness of an autonomy-supportive teaching structure in physical education. Rev Int Cien Deporte 12(43):5–28. https://doi.org/10.5232/ricyde2016.04301

Author contributions

JL-A conceived, designed and conducted the study, drafted the manuscript, coordinated and performed the data interpretation and discussion. AF-A contributed to the study design, assisted in writing the manuscript and discussion. JR-M designed the study, coordinated and conducted the analysis and interpretation of the data, assisted in writing the discussion. All authors approved the final manuscript as submitted.

Competing interests

The authors declare no competing interests.

Ethical approval

The ethical rigour established by the Ethics Committee of the University of Valladolid and the Spanish National Network of Formative Assessment in Higher Education was guaranteed. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The European Commission's recommendation of 17/07/12 (2012/417/EU) on scientific information and its preservation was also followed.

Informed consent

Informed consent was included in the questionnaire sent to the participants (Questionnaire of Perception of Teaching Competences in Physical Education). It informed in writing about the aims and procedure of the study and guaranteed anonymity and the use of the data only for the purposes of the research. All participants signed an informed consent form for general participation in the research.

Additional information

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