



Research article

Teachers' professional identity: validation of an assessment instrument for preservice teachers

Elisa Pérez Gracia^a, Rocío Serrano Rodríguez^{a,*}, Alfonso Pontes Pedrajas^b, Antonio J. Carpio^c^a Department of Education, Faculty of Education, University of Córdoba, Spain^b Department of Applied Physics, Faculty of Sciences, University of Córdoba, Spain^c Department of Zoology, Faculty of Sciences, University of Córdoba, Spain

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ABSTRACT

This study aims to develop and validate an instrument to analyse future Secondary Education teachers' perceptions regarding the development of Teachers' Professional Identity (TPI). The data were collected from a sample of 733 participants who were students enrolled in the Master's Degree for Secondary Education teachers. The psychometric properties of the instrument were obtained by analysing content, and comprehension validity, construct validity and reliability. A first subsample was used for an Exploratory Factor Analysis, and a second one to verify the identified factor structure via Confirmatory Factor Analysis. The instrument is made up of 31 items in four scales namely the understanding of TPI, the development of TPI at various educational levels, the development of TPI in comparison with that of other professionals and the influencing factors. The results show that it has high levels of validity and reliability. Therefore, it provides TPI research field with an instrument to assess it during the initial teacher training period in consecutive training models where it seems to occur more identity crisis.

1. Introduction

Scholars increasingly acknowledge the construction and development of Teachers' Professional Identity (TPI) as a central focus on initial teacher training periods and the teaching profession (Beijaard et al., 2004; Cameron and Grant, 2017; Izadinia, 2015; Zhang et al., 2016).

In this sense, TPI is not a static attribute that remains the same throughout teachers' training processes (preservice teachers) and the development of their careers (inservice teachers), but rather a dynamic, changing, active and on-going process of the interpretation of experiences (Pérez Gracia et al., 2022; Beijaard et al., 2004; Donnini Rodrigues et al., 2018), that generates changes in knowledge and skills related to each person's conception of teaching and actions as a teacher (Garner and Kaplan, 2019). Learning to teach is a complex process in which an interaction between personal values and professional demands of teaching takes place (Leeferink et al., 2019). It could bring about diverse discernments that may end up as identity crisis. Thus, further understanding of how this interplay develops along preservice teachers training and the factors that may influence it is needed in order to strengthening the teaching profession.

Teacher learning not only refers to learning subject matter content, pedagogical strategies or teaching and learning theories, but it is also an identity making process (Schaefer and Clandinin, 2019). Thus, it is strongly essential to work with future teachers' perceptions of teachers' work and practices. TPI should begin at the same time as the training process, since it is considered to be the central process of becoming a teacher. Throughout this process, teachers negotiate and debate their self-conceptions and prior knowledge about the teaching-learning procedures, and reflect on their role as teachers (Clarke et al., 2017; Lim, 2011).

Therefore, teacher learning can and should be conceptualised as teacher identity learning (Capps et al., 2012). Knowing future teachers' beliefs in detail is consequently decisive for both their professional development and the students' academic performance (Pillen et al., 2013) and understanding their continuing development of their identity of becoming and being education professionals.

Moreover, results from prior research indicate the wide range of personal and contextual elements that should be analysed (e. g. Kim, 2013; Papavassiliou-Alexiou and Zourna, 2016; Yuan et al., 2019).

For that purpose, it is interesting to design and validate an instrument that enables researcher to get information about these issues and attain

* Corresponding author.

E-mail address: rocio.serrano@uco.es (R.S. Rodríguez).

greater knowledge of how TPI is understood. In this way, it could be also useful to have such instrument so as to be able to carry out a diagnostic assessment in different moments of the initial teacher training process and consider these aspects in teacher education curricula with the final goal of strengthening future teachers' identity and prevent early career teachers' burnout. Therefore, in order to select and formulate the items of the instrument, the variables studied in previous research studies, whose influence and determination have been proved, were considered.

1.1. Understanding of TPI

Firstly, it is necessary to know how preservice teachers understand the TPI concept before going further with other aspects such as its differences depending on the educational stage and its influencing factors.

In this sense, preservice teachers tend to understand TPI as a process (either continuous or discontinuous) with highs and lows and full of transformative phases (Leeferink et al., 2019) and associated to diverse variables that may help them to develop their commitment and identity towards the teaching practise and work (Izadinia, 2015).

On the one hand, some student teachers may find easier to integrate the new experiences and learning with the existing knowledge into their personal life, so they are immersed within a steady process characterised by the continuous combination of concepts and practices from different contexts, they do not have an internal debate about themselves as teachers (Olsen, 2008; Leeferink et al., 2019). They are keen on learning teaching strategies to teach their discipline, to communicate with their colleagues and are self-critical in their practise (Salazar and McCluskey, 2017). On the other hand, there are also preservice teachers who go through diverse crises and tensions (Meijer et al., 2011). In those cases, these frictions are linked to lack of motivation and commitment (Rodrigues and Mogarro, 2019), they do not have intrinsic motivation towards the education world so their self-esteem along the process is low (Leeferink et al., 2019). However, these periods may be followed by an inspiring moment when they are able to feel the motivation back and it coincides with moments in which they have the chance of sharing their thoughts with their colleagues (Meijer et al., 2011).

1.2. TPI in teachers of diverse educational levels and in other professions

After gathering information about the definition of TPI and the variables associated with it, literature review (e.g. Schwartz and Dori, 2020) points out that the construction of TPI may differ according to the educational stage in which they are going to be develop their professional careers and, in comparison between the education world and other sectors due to its particularities and social mission (Zhong, 2020; Keary et al., 2020). Thus, these aspects were also considered in the instrument construction.

Firstly, there are two key points to be considered in this sense: (a) it should be considered that both the curriculum requirement and teaching functions and competences are different depending on the educational level (Green, 2015); (ii) the teacher training models (consecutive vs. simultaneous) (Gómez et al., 2017).

Early Childhood Education and Primary Education preservice teachers are usually enrolled in these degrees as their first option, so they made their decision following their intrinsic motivation (Hong, 2010; Keary et al., 2020; Zhong, 2020). They follow a simultaneous training model, so science and pedagogy are trained at the same level and given de same treatment. On the other hand, secondary and higher education student teachers usually come from a professional background (e. g. music, nursing, chemistry, economic), they feel "strongly identified with their (former) professions" (Van Lankveld et al., 2017, p. 328). For instance, Spain and other European countries (Eurydice, 2018) has opted for a consecutive training model in which scientific training predominates and practical training, along with training in secondary-level pedagogy, take second place (Bolívar, 2007; Gómez et al., 2017). Therefore, see themselves as professionals rather than teachers (expert becomes novice) and

they undervalue the need to learn teaching strategies, resources and issues regarding coexistence, values, etc.

The TPI construction process finds crises in both scenarios but the reasons differ. In early stages, these dilemmas are consequence of the personal and academic development, their mindset as we all their "view of an education degree as something meaningless" (Schaefer and Clandinin, 2019, p. 55). In higher education levels, the principal causes than take student teachers to face critical moments have to do with economic issues, trends, instability and "the perception of teaching as a job that is fitting for those who cannot get into other faculties of professions (Schaefer and Clandinin, 2019, p. 55). The identity learning process is so complex at that stages that the rate of early career attrition is significant (Clandinin et al., 2015).

1.3. TPI influencing factors

Finally, in light of the above mentioned, literature shows that building TPI involves a process that is influenced by a wide range of personal and contextual elements (Rodrigues and Mogarro, 2019). Therefore, a scale on this regard is needed in order to know in dept to which variables preservice teachers devote more importance (Aykaç et al., 2017).

Thus, motivation, self-concept and self-image and the desire to design a professional project are key issues (Huu and Ngoc, 2017; Izadinia, 2015). Futhermore, there are three factors that seem to have stronger influence namely psychopedagogical training (Darling-Hammond, 2017), the placement period during initial teacher training (Yuan et al., 2019) and the interaction with colleagues (Avraamidou, 2014). The first one refers to the pedagogical tools that students are provided with in order to develop their skills and awareness on the importance of not only control the knowledge content, but also diverse psychological and education strategies to approach the students (Izadinia, 2015). Then, students attain great importance to the workplace learning process (teaching practicum), and social interactions with their mentors and other in-service teachers in different school settings (Henry, 2016; Leeferink et al., 2019).

All in all, after reviewing the existing literature on this field, there is a need to design this instrument for varied reasons:

- There is not an instrument including these elements (understanding of TPI, TPI in teachers of diverse educational levels and in other professions and TPI influencing factors) to assess TPI during the initial teacher training period but the existing ones refer to inservice teachers, so they cover other aspects (Hanna et al., 2020).
- Most of the research regarding TPI has been focused on inservice teachers despite the fact that there is a claim highlighting the urgent need of working on TPI since initial teacher training processes (Capps et al., 2012; Zhu and Gang, 2018).
- There is a mainstream that mainly focuses the research on the development of TPI considering simultaneous training models, so it would be convenient to analyse TPI construction in consecutive training models where it seems to occur more identity crisis (Anspal et al., 2019; Avraamidou, 2019).

Thus, the current study aims to describe the process employed to design and validate an instrument, which aims to analyse the perceptions of future secondary education teachers regarding the development of teachers' professional identity (TPI). The specific objectives are, therefore:

- To analyse the validity of the content as regards the 'Instrument for the development of Teachers' Professional Identity'.
- To analyse the validity of the comprehension as regards the 'Instrument for the development of Teachers' Professional Identity'.
- To study the construct validity of the 'Instrument for the development of Teachers' Professional Identity'.

2. Methods

2.1. Participants

A sample of 733 Secondary Teacher Training Masters' Degree students at the University of Cordoba, corresponding to the academic years between 2014 and 2018, took part in this study (62.68% women and 37.2% men). The reason why we chose Master's Degree students is justified by diverse reasons: i) Considering previous literature (Schaefer and Clandinin, 2019), it was identified that TPI should be built since the initial teacher training process in order to guarantee quality education as well as prevent early career teachers' burnout; ii) The context where the research has been conducted applied a consecutive teacher education model, so it focuses pedagogy training that follows disciplinary content degree studies (Zuzovsky and Donitsa-Schmidt, 2017). Therefore, it is in the Master's degree when they first receive pedagogy training to become teachers.

Considering the home university, 50% of the students enrol in this master's degree carried out their degree studies at the University of Cordoba (UCO), 30% of them at other universities within the same region (Andalusia), and 20% at other universities of the country (Spain). Besides, 54% of the participants were aged between 20 and 25 years of age, whereas 19.1% were between 26 and 30 years of age. The remaining participants were over 30 years of age. Regarding their teaching experience, the participants have between 0 (no experience) and 3 years of experience (range; mean \pm SD = 0–3; 1.7 ± 1) (see Table 1).

According to Morales (2012), the minimum number of participants recommended to establish the factorial validity of an instrument should be 10 subjects per item of the questionnaire or a minimum overall sample of 300 respondents (Burton and Mazerolle, 2011). Table 2 shows the distribution of the participants.

The sampling technique applied was the convenience sampling (Emerson, 2015) for the reason that participants were selected based on availability and willingness to take part. Participants were previously informed about the purpose of the present study and research ethical principles were applied so as to protect their anonymity, dignity, rights and welfare throughout the whole research project. Furthermore, before that, the research team asked for permission to both the University of Córdoba Committee on Publication Ethics and then, to the professors of the Master's Degree where the instrument was going to be administrated.

2.2. Instrument

In order to achieve the proposed objectives, an *ad hoc* instrument entitled 'Instrument for the development of Teachers' Professional Identity' was designed as part of more wide-ranging research.

The results of a previous qualitative research work on the development of TPI among preservice Secondary Education teachers (Serrano Rodríguez, 2013) were taken into account for this purpose. The original open questions were validated by experts and through a pilot study and consisted of five open questions: i) What do you think the term TPI means or what would be the main characteristics of this identity?; ii) Is the professional identity of primary education teachers, secondary education teachers and university teachers the same? Why?; iii) Do you think that future secondary education teachers develop during their degree studies a TPI equivalent to that developed by doctors, architects, lawyers, engineers, journalists or any other profession that requires university training? Why?; iv) At what training stage or career moment do you think

Table 2. Participants according to the field of knowledge.

Field of knowledge	Frequency	Percentage
Social Sciences (SS)	181	24.7%
Humanities (HUM)	213	29.1%
Art (ART)	60	8.2%
Experimental Sciences (ES)	155	21.2%
Technology and Computing-Mathematics (TCM)	124	16.8%
Total	733	

preservice secondary education teachers begins to develop their TPI? Why?; v) Indicate which aspects you think that can contribute the most to developing TPI during the initial training process for secondary education teachers.

Once the textual and conceptual analyses of the content (processed with Atlas.ti) had been performed, we were able to identify the categories, subcategories and codes that helped to define the 'I-TPI' quantitative scale (Serrano Rodríguez and Pontes Pedrajas, 2016).

The I-TPI contains two differentiated blocks, the first of which is related to socio-demographic data includes variables whose influence has been tested in previous research studies: sex (Pé rez Gracia et al., 2019), age, year when they finish their tertiary studies (Pé rez Gracia et al., 2019), degree (Keary et al., 2020); current employment situation (Van Lankveld et al., 2017) and teaching experience (Green, 2015; Yuan et al., 2019). The second part, meanwhile, consists of 33 items, whose aim is to analyse the preservice teachers' beliefs regarding the construction and development of TPI. It is measured using a 5-point Likert-type response scale ranging from 1 (totally disagree) to 5 (totally agree). The 33 items are contained in four scales and they cover the main aspects gathered in literature: the understanding of TPI (Schaefer and Clandinin, 2019), the development of TPI at diverse educational levels (Zhong, 2020), the development of a professional identity in comparison with that of other professions (Schwartz and Dori, 2020) and factors that contribute to its development (Leeferink et al., 2019).

2.3. Research design and procedure

The development of the instrument follows four well differentiated steps that provide it with preciseness and reliability (Figure 1).

- 1. Selection and formulation of the items.** Firstly, a review of the literature was carried out in order to identify the different variables that may influence the process of TPI construction and the aspects that can be distinguished in developing professional identity. Thus, they were organised in different blocks that coincides with the structure of the introduction of this paper and the scales within the instrument.
- 2. Content validation** by the panel of scientific experts. Secondly, a panel of experts judged the instrument's clarity, appropriateness and relevance using a Likert-scale. Then, this validation of the items and scales in terms of content lead to some adaptations that were done.
- 3. Comprehension validation.** Thirdly, after modifying the instrument considering the experts' suggestions, it was given to 16 participants to analyse its comprehension.
- 4. Construct validation.** Finally, this large-scale study focuses on establishing the quality of the instrument with regard to the measuring of the four aspects: TPI understanding, TPI in teachers of

Table 1. Participants' data.

Sample	Sex		Age		Home university (degree studies)			Teaching experience		
	M	W	<25	>25	UCO	Region	Spain	0	<3	>3
733	62.68%	37.2%	54%	46%	50%	30%	20%	66%	28%	6%

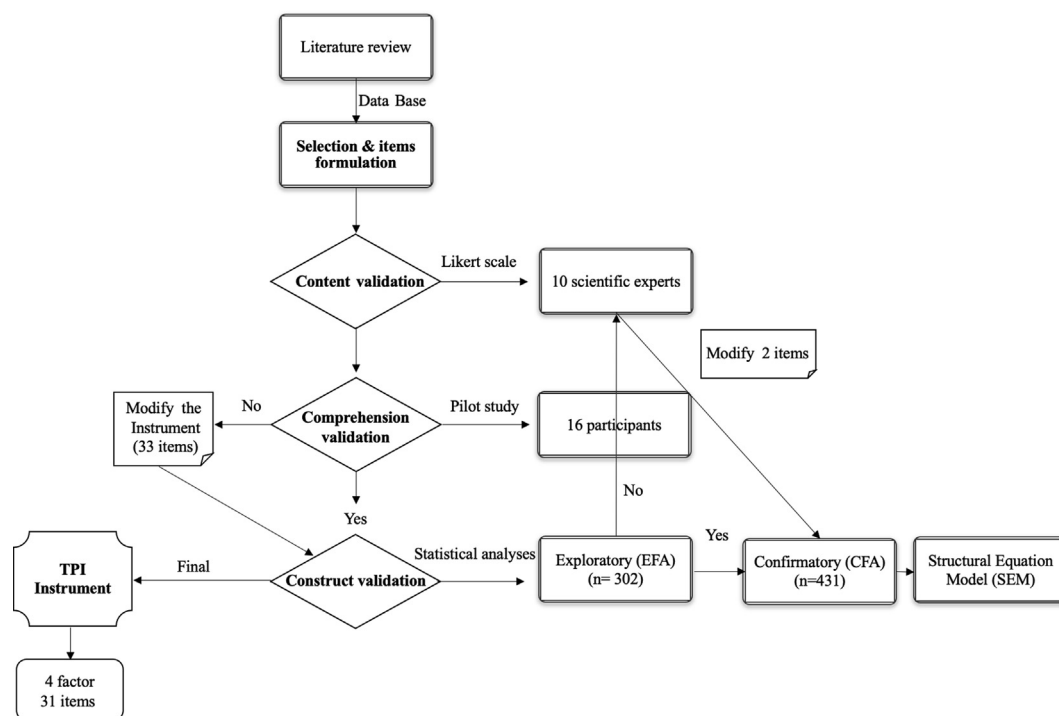


Figure 1. Flow diagram for instrument development.

diverse educational levels and in other professions, and TPI influencing factors. This construct validity is used to determine how well the instrument measures what it is supposed to measure, in other words, whether it successfully test our objectives.

- As the **final step**, the instrument is made up by 31 items gathered in four different scales.

As for the procedure, the instrument was administrated differently in stage 3 and stage 4 (see Figure 1). On the one hand, in stage 3, the participants' questions, doubts and suggestions were recorded in a face-to-face session. These data were collected at the beginning of the master's degree, in October. On the other hand, as for the fourth stage, I-TPI was administrated in face-to-face sessions at the beginning of the generic module, in the subject of Contexts and Educational Processes (face-to-face sessions), within the block on teaching professionalism, in which contents related to the professional profile and access to the teaching function are taught.

Moreover, participants were volunteers, after been informed by the research group about the implications and benefits of the study, they showed great interest in taking part on this stage of the process justifying their motivation towards improving initial teacher training on this regard. They showed their interest in contributing by sharing their beliefs with the research team because they were aware of the importance of TPI for their future career. It is also important to highlight the motivation of the professors who were in charge of administrating the instrument, their encouragement was high because they used this instrument as the starting point of a reflection activity.

2.4. Data analyses

Then, these steps as well as the analyses applied are explained in detail:

2.4.1. Content validity

In order to validate the content of the instrument, an expert panel reviewed it in terms of its clarity, appropriateness and relevance (Burton and Mazerolle, 2011). To do so, the criteria and suggestions made by

Almanasreh and Moles (2018) were followed. Therefore, the panel was made up of ten experts considering their expertise in relation to TPI, professional experience (at least ten years in the field of education), their knowledge of and experience as regards the Delphi Method and their ability to intercommunicate (Oluwatayo, 2012). Not only did the experts consider that the items were appropriate to achieve the objectives of this research, but they were also of the opinion that none of the items were redundant (Lloret et al., 2014).

In order to carry out this validation, a scale rating 1 to 4 (1 anything, 2 little, 3 quite, 4 a lot) was used to gather experts' opinions. Then, depending on the results, an expertise index is generated. Those items of the instrument with a low score (<58% of the total) are modified (in terms of clarity) or eliminated (in case of accuracy and relevance). To calculate the CVR (content validity ratio) and CVI (content validity index), the Lawshe's method was used. On the one hand, the CVR was performed by linear transformation according to the number of experts that evaluated the instrument as *essential* using the formula: $CVR = (ne - N/2)/(N/2)$ where ne is the number of experts who gave this *essential* rating and N is the total number of experts. On the other hand, the CVI calculation is the proportion of experts who gave a *relevant* rating of 3 and 4 out of the total number of experts (Almanasreh and Moles, 2018).

2.4.2. Comprehension validity

Comprehension validity was then analysed by means of a pilot study, in which 16 students (Alaminos and Castejón, 2006) enrolled on the master's degree for Secondary Education teachers took part. This was useful to test the degree of comprehension from a qualitative point of view.

2.4.3. Construct validity

The construct was validated by applying two-step statistical analyses. To check the quality of the developed instrument, an Exploratory (EFA) and Confirmatory Factor Analyses (CFA) were conducted with two sub-samples (Tondeur et al., 2017). The data were randomly splitted into approximately 40% and 60% (40% for EFA and 60% for CFA). A sample-to-variable ratio of 10:1 (Costello and Osborne, 2005; Singh et al., 2016) or alternately more than 300 cases are generally considered

adequate for factor analysis (Tabachnick and Fidell 2013). In this case, the larger subsample can be used for the more crucial process of item evaluation and scale construction and the smaller for cross-validation (DeVellis, 2017). Therefore, we used 40% in EFA and 60% in CFA (Kyriazos, 2018). Furthermore, the ratio between both subsample sizes ($n_1 = 302$ and $n_2 = 431$) and the number of items (31) met the minimum requirement of 10 participants per item (Floyd and Widaman, 1995; Burton and Mazerolle, 2011). The survey was constructed to measure a multidimensional construct with four dimensions. First, EFA (in SPSS 21) was used to explore the possible underlying factor structure of a set of observed variables without imposing a preconceived structure on the outcome. By performing EFA, the underlying factor structure was identified. It was permuted on subsampled 1 and with all the items ($n_1 = 302$) in order to identify the number of latent factors underlying Teachers Professional Identity. In this first analysis, maximum likelihood was used as an extraction method, and the factors extracted were rotated using direct oblimin rotation. After carrying out the direct oblimin rotation, the decision was made to report all those items with a factor loading of ≥ 0.3 , and we further identified as 'uniquely significant' those items for which the factor loading was ≥ 0.2 higher than the next highest loading (Jennrich and Bentler, 2011). Second, after performing the EFA, we extracted a more suitable factor structure from the new dataset. In the second stage, a Maximum Likelihood CFA (AMOS 21) was applied to subsample 2 ($n = 431$) to investigate whether the identified exploratory factor structure fit the data. CFA allowed to test the hypothesis that a relationship between observed variables and their underlying latent constructs existed. The researchers used knowledge of the theory and empirical research to postulate the relationship pattern a priori and then it is tested the hypothesis statistically. In this sense, maximum likelihood and principal axis factoring are generally recommended extraction methods. The factors extracted were rotated by means of direct oblimin rotation. Due to the fact that the CFA showed high correlations between the four factors, it raised the hypothesis of the existence of a latent second-order factor that could explain the common variance among them. For this reason, a Structural Equation Modelling (SEM) was carried out considering the second-order factor that is inferred from the model. Therefore, this global factor was not scaled from other indicators, but as a latent factor to the four factors of the CFA. Thus, the SEM was carried out using the regression coefficients of the four dimensions (of the previous CFA) as variables. In this model, a principal component analysis was used as an extraction method, and the factors extracted were rotated by means of promax rotation. For this purpose, several models fit indices and their

criteria were used to examine the goodness-of-fit of the model as regards the given dataset (Bollen, 1989; Fábregas et al., 2018): goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), the Parsimony Goodness of Fit Index (PGFI), Chi-square (χ^2), Chi-square/degrees of freedom ($\chi^2/df < 3.0$), root mean square error of approximation (RMSEA < 0.08) and root mean square residual (RMS < 0.08).

Finally, the reliability of the items in each factor was examined using Cronbach's α . This validation provides confidence that the scale measures what it is intended to.

3. Results

3.1. Content validity

Considering the scale completed by the ten experts, Table 3 shows the results of the CVR and CVI. These results show that all the items of the instrument were acceptable. Only five of the items underwent modifications because their CVR values in clarity were under 0.5823. These suggestions of correction were mainly focused on clarifying some concepts that could lead to misunderstanding (for example: teaching techniques or strategies) as well as on writing all the items from a positive viewpoint, so that all of them follow the same direction. The definitive scale was made up of 8 sociodemographic items and 33 items related to TPI.

3.2. Comprehension validity

Once the expert panel for the validation of the content of the questionnaire had made its decisions, the pilot study was carried out with the intention of improving the validity of comprehension. No difficulties were detected in the piloting and all the data were consequently included as part of the final sample.

3.3. Construct validity

It was confirmed that the sample size was appropriate to study the technical quality of the instrument (Morales et al., 2003) and thereby analyse the construct validity.

3.3.1. Exploratory Factor Analysis ($n = 302$)

The Kaiser-Meyer-Olkin measure (KMO) showed a high level of sampling adequacy (0.891) and the Bartlett test was significant (Chi-

Table 3. Content validity index of the instrument.

BLOCK	N° of ITEMS	N° of EXPERTS	Features assessed	Sum CVR	M	ACCEPT	PARTIAL CVI	TOTAL CVI
Level of adequacy sociodemographic data items	8	10	Essential	6.4	8	YES	0.800	0.800
TPI Understanding	15	10	Clarity	8.6	12	YES	0.716	0.714
			Appropriateness	9.6	15	YES	0.640	
			Relevance	11.8	15	YES	0.786	
TPI Ed. Levels	7	10	Clarity	4.4	5	YES	0.88	0.826
			Appropriateness	5.8	7	YES	0.828	
			Relevance	5.4	7	YES	0.771	
PI Professionals	5	10	Clarity	4.4	5	YES	0.88	0.906
			Appropriateness	4.8	5	YES	0.96	
			Relevance	4.4	5	YES	0.88	
TPI Factors	6	10	Clarity	5.8	6	YES	0.966	0.977
			Appropriateness	5.8	6	YES	0.966	
			Relevance	6	6	YES	1	

M = Number of items with CVR values > 0.5823 .

Acceptable = 95% of the items have CVR values > 0.5823 .

Partial CVI = $\Sigma CVR / M$ obtained for the set of items on each aspect assessed (clarity, appropriateness and relevance).

Total CVI = Average of the all partial CVI' M = Number of items with CVR values > 0.5823 .

Source: own elaboration.

Square = 4947.731; $p < 0.001$), signifying that a factor analysis would be suitable. Four factors were extracted according to the Eigenvalues obtained and screen test (Figure 2), explaining 40% of the variance. In addition, a parallel analysis (PA) was performed to confirm the existence of these four factors. The PA was performed with SPSS (O'Connor 2000), reaffirming the existence of 4 factors that present eigenvalues greater than those that would be obtained by chance (Horn, 1965).

In total the 4 factors explain 41.6% of variance. The first factor explains the greatest amount of the variance (23.6%), second factor explains 7.08%, third factor explains 5.79% and the last explains 5.2%. Finally, the rotated component matrix determines the factorial loads for the selection of items for each factor (Table 4).

In these results, 4 factors were extracted from the 33 variables. Their commonality values are generally high for all variables, indicating that the 4 factors adequately represent the variables. For example, 32 variables had values > 0.4 (except item 17).

The four factors are, hereafter, denominated as:

Factor 1, which contains 15 items regarding how participants understand TPI (TPI Understanding).

Factor 2, which contains 7 items related to the development of TPI at diverse educational levels (TPI Ed. Levels).

Factor 3, which contains 5 items related to the development of TPI and other professionals' identity (PI professionals).

Factor 4, which contains 6 items that gather information concerning the factors that may contribute to the development of TPI (TPI Factors).

Items 21 and 22 were removed ('There is a common purpose, which is the Education and training of people' and 'The psychological and cognitive characteristics of students change according to their age') because their absolute values were under 0.3 (Peterson, 2000). However, this decision was also checked with the panel of experts responsible for the content validation of the instrument so that the removal of both items was agreed.

Finally, we performed the correlation matrix of the factors (Table 5), to establish the relationship that exists between the 4 factors (see Tables 6 and 7).

3.3.2. Confirmatory Factor Analysis ($n = 431$)

In order to study the internal structure, we carried out a Confirmatory Factor Analysis because it provides the appropriate statistical framework in which to evaluate both the validity and reliability of each item, rather than analysing them globally (Batista et al., 2004). The 31 items (which have been consecutively renumbered from item 21 onwards so as to avoid missing numbers) obtained from the EFA were, therefore, grouped into four dimensions, which correspond with the factors. Table 8 shows the main descriptive data from each item on the scale. This signifies that the a priori model fits the sample data. In sum, a total of 78 parameters were estimated: 31 factors loadings, 31 error variances, 4 error variances, 6 factors and 6 factors correlations.

The indexes show that the adjustment of the proposed model is highly appropriate. Calculate the goodness of fit (GFI) by measuring how much of the sample variance and covariance is explained by the model. 0.80 is usually considered as the minimum threshold for a good GFI fit (Hooper et al., 2008). In the model, the GFI value was 0.889, which suggests a good fit. Adjusted goodness-of-fit statistic (AGFI), it is the same indicator as GFI, but adjusted according to the degrees of freedom (Westland, 2015). A value close to 1 would indicate a perfect fit, while the minimum limit that is usually admitted is 0.8 (Bentler and Bonnett, 1980). The AGFI value for the model was 0.872, therefore within of this threshold. The parsimony indices PGFI, PNFI and PCFI took values of 0.773, 0.728 and 0.799 respectively. The threshold set for them is lower, generally standing at 0.5 (Mulaik et al., 1989), instead of the 0.9 cuts that are usually set in the other groups of indices. In this case, the three indices analysed exceeded the minimum limit. In order to be considered acceptable, Chi square would have to take a value below 0.05, in this study was < 0.01 . However, it is a very sensitive measure to sample size (Bentler and Bonnett, 1980). Therefore, for studies with large samples such as the one in this research, it is more appropriate to use it weighted

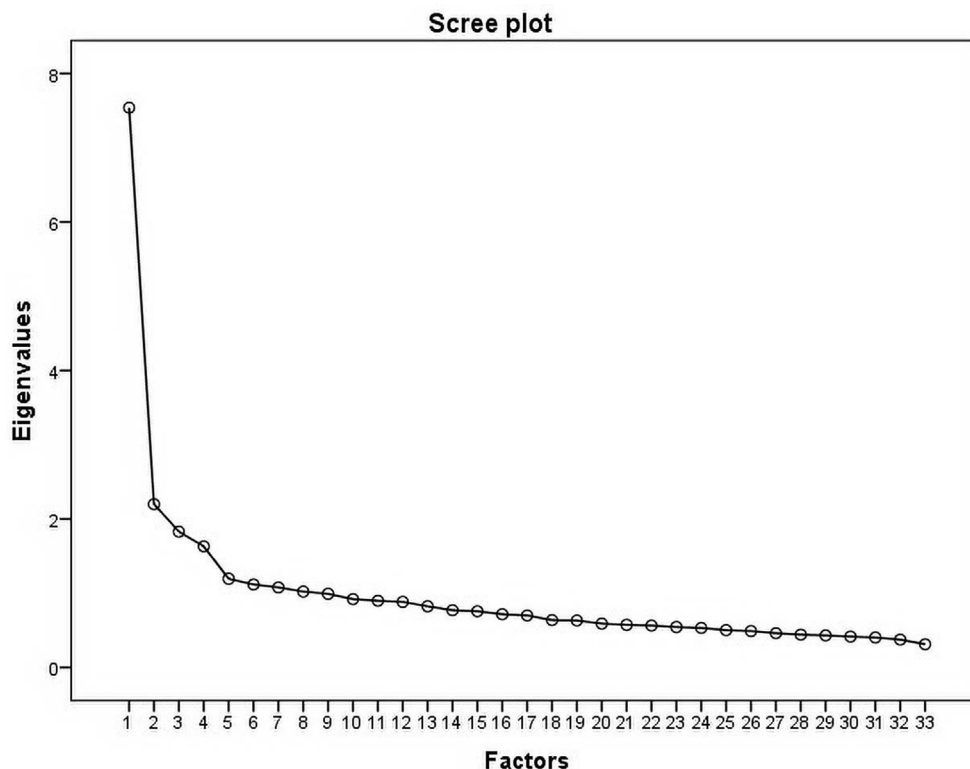


Figure 2. Scree plot of EFA analysis.

Table 4. Rotated component matrix.

Items	TPI Underst.	TPI Ed. Levels	PI Profess.	TPI Factors	Common.
6. Using and mastering teaching communication techniques	.654				.538
11. Ability to manage class work and solve possible conflicts	.645				.581
9. Properly combining theory and practise about teaching	.614				.504
3. Having solid training regarding Education and teaching	.605				.604
7. Showing an interest in knowing and understanding students	.580				.618
5. Knowing how to adapt yourself to educational changes according to the circumstances	.573				.462
13. Being an expert in one's discipline	.542				.434
8. Integrating ICT into teaching	.512				.578
14. Motivation to awaken the students' interest in learning	.488				.607
2. Feeling a high level of commitment to the teaching profession	.486				.579
15. Adopting a reflective and self-critical attitude with regard to teaching practise	.477				.488
1. Having an adequate capacity to teach	.456				.557
12. Having high self-esteem as a teacher	.440				.600
10. Worrying about human relationships in the educational context	.424				.655
4. Building a positive self-image as an aspiring teacher	.418				.489
16. The previous academic training to become a teacher is different at each stage		.590			.722
17. There is a different Curriculum for each educational level		.548			.354
19. The problems of coexistence are more frequent in Secondary Education		.479			.519
20. There are different teaching functions in each stage		.458			.533
18. The methodological strategies and resources vary according to the circumstances		.406			.536
21. There is a common purpose, which is the Education and the training of people		.226*			.456
22. The psychological and cognitive characteristics of students change according to their age		.220*			.445
25. Teaching implies a relationship with students that contributes to their personal and academic development			.684		.606
24. Teaching includes an educational practise that makes it different from other professions			.577		.573
27. Teaching fulfils a very specific social mission which differs from that of other professions			.548		.546
23. Psycho-pedagogical training is required for the teaching profession			.513		.531
26. Teaching places a different importance on the interpersonal relationships in the workplace			.341		.445
32. Learning through experiences with other teaching professionals				.570	.557
30. The recognition and social evaluation of the teaching profession				.548	.551
31. The acquisition of new methodologies and the use of educational resources				.542	.514
33. The promotion of teacher motivation and the development of a professional project				.532	.529
29. A broader psycho-pedagogical training during the Master's Degree				.478	.474
28. Longer placement period				.360	.430

* Values under 0.3 – Items removed.

Table 5. Factor correlations matrix.

Factor	1	2	3	4
1	1.000	.313	-.394	-.383
2		1.000	-.235	-.325
3			1.000	.258
4				1.000

by degrees of freedom (Wheaton et al., 1977). Given the scope of the research, the degrees of freedom amounted to 768. Thus, the study has taken the value of χ^2/df , which to be considered acceptable must take a value between 2.0 and 5.0 (Hooper et al., 2008). The value of $\chi^2/d.f.$ (1034,722/431) in the model it is 2.401, which fits perfectly within the acceptable parameters. Finally, the RMSEA (Root Mean Square Error of Approximation) shows that the model has a good fit, with an index of 0.05 (Lo = 0.046 - Hi = 0.054), and the RMR is 0.044. RMSEA indicates the degree to which the model fits the sample covariance matrix. There is no consensus about the threshold to consider the acceptable fit: some authors consider that it should be below 0.08 (McDonald and Ho, 2002), while others place it at 0.07 (Steiger, 2007). The RMSEA value in the model was 0.05, which is within what is acceptable in any of the cases. It is, therefore, possible to conclude that the proposed model provides a

Table 6. Values of inter-item covariances and inter-item correlation.

	Mean	Minimum	Maximum	Range	Variance
Inter-element covariances	.160	.021	.484	.462	.005
Inter-element correlations	.202	.021	.540	.519	.010

sensible approximation to the data and can contribute towards supporting the multidimensionality hypothesis of the construct.

Finally, subscale 1 (TPI understanding) has 15 items; subscale 2 (TPI Ed. Levels) includes 5 items; subscale 3 (TPI and other professions) counts with 5 items and subscale 4 (TPI factors) has 6 items. It should be considered that the Likert-scale ranges between 1 (totally disagree) and 5 (totally agree) points and that all items were written in positive according to the experts' suggestion. Therefore, when the mean value of the first scale is higher than 3, it means that participants know and understand what TPI, whereas mean values lower than 3 shows that participants have a diffuse concept of TPI. As for the second scale, mean values higher than 3 show agreement among the participants regarding the fact that TPI is built differently depending on the educational stage. Mean values lower than 3 in the third scale reports participants coincide with the reasons why TPI is different than professional identities of other professionals. Finally, in the fourth scale, higher values (>3) point out that participants know the factors that could influence the construction of TPI.

Table 7. Intraclass correlation coefficients.

Scales	α	95% confidence interval	
		Lower limit	Upper limit
Global	0.879	0.864	0.893
Subscale 1	0.867	0.850	0.883
Subscale 2	0.776	0.732	0.817
Subscale 3	0.730	0.682	0.755
Subscale 4	0.694	0.653	0.731

Table 8. I-TPI basic descriptive statistical analyses.

Scales	Items	M	SD	Assym	Kurt
TPI Underst.	1	4.13	0.884	-0.589	0.472
	2	4.32	0.771	-0.914	0.843
	3	3.97	0.840	-0.438	-0.128
	4	3.88	1.033	-0.479	0.035
	5	4.34	0.794	-0.893	0.587
	6	4.35	0.756	-1.042	1.773
	7	4.58	0.684	-1.623	3.127
	8	3.94	0.983	-0.631	0.232
	9	4.27	0.802	-0.945	1.300
	10	4.33	0.803	-0.911	0.624
	11	4.46	0.735	-1.311	2.360
	12	4.07	0.857	-0.467	-0.192
	13	4.20	0.806	-0.557	-0.111
	14	4.69	0.600	-1.924	4.462
	15	4.43	0.726	-0.957	0.762
Scale	1–15	4.264	0.805	-0.912	1.076
TPI Ed. Levels	16	3.71	1.160	-0.324	-0.164
	17	3.88	1.076	-0.365	0.247
	18	4.08	0.931	-0.671	0.537
	19	3.79	1.170	-0.521	0.270
	20	3.76	1.203	-0.310	-0.115
Scale	16–20	3.844	1.108	-0.438	0.155
PI Profess.	21	4.08	0.964	-0.958	0.772
	22	4.06	0.978	-0.840	0.708
	23	4.42	0.779	-1.253	1.762
	24	4.00	1.022	-0.277	-0.072
	25	4.21	0.931	-1.009	0.942
Scale	21–25	4.154	0.935	-0.867	0.822
TPI Factors	26	4.07	1.062	-0.815	0.345
	27	3.80	1.121	-0.587	-0.209
	28	3.87	1.131	-0.563	-0.063
	29	4.02	1.019	-0.627	0.437
	30	4.39	0.842	-1.091	1.385
	31	4.23	0.905	-0.909	1.085
Scale	26–31	4.063	1.013	-0.765	0.497

Figure 3 represents the results of the CFA (left side) and SEM (right side). It shows that the four factors are well differentiated and related to each other in a coherent manner. This can, therefore, be considered as a proof of the internal consistency of the research instrument.

Finally, the Pearson correlation coefficient was analysed in order to test the concurrent validity among the different factors on the scale. Table 9 shows that they have a significant correlation with each other.

Table 9 presents the coefficient values as regards the correlation among the factors on the scale. They are statistically significant ($p < 0.001$). This raises the hypothesis that all of them have a common latent factor (Oliva and Blanco-López, 2021), which may be a global factor (GF) related to the 'global vision of future teachers regarding the construction of TPI'. To evaluate this hypothesis, a SEM was, therefore,

carried out using the regression coefficients of the 4 dimensions (from the previous model) as variables. In this model, a principal component analysis was used as an extraction method, and the factors extracted were rotated using promax rotation. This second reduction of dimensions allowed us to see the effect in the value of each dimension on the global factor (Figure 2). In addition, Composite Reliability (CR) and average variance extraction of each sub-constructs in the CFA were calculated (Table 10). Although AVE were below .50, it could be considered, since CR is above .70 (Fornell and Larcker, 1981), which might give support to retain the factors. Although, in the case of the TPI Ed. Levels the reliability value is close (although below 0.7). However alpha, did not suggest that deleting any items improve subscale reliability.

The Cronbach's Alpha test proved to have a highly reliable coefficient at a global level (0.879). The four dimensions or factors also have high values as regards reliability since they are close to or higher than 0.800. All in all, it can be considered that the scale is adequate (Hair et al., 2010).

4. Discussion and conclusions

This work describes the procedure carried out to design and validate an instrument for the evaluation of future Secondary Education teachers' perceptions of the construction and development of TPI.

First, and with regard to the first objective of this paper, the content and understanding validity have been analysed by a panel of experts and by running a pilot study. Both analyses were highly useful as regards improving the readability, internal consistency and appropriateness of the scale. These results evince that the selection of the items was appropriate in term of content, and they show consistency with previous research studies on TPI (Hanna et al., 2020; Zhong, 2020). Moreover, they meet length and comprehensive parameters as indicated by De Von et al. (2007).

In the case of the second objective, the results presented here demonstrate that the scale has a satisfactory metric quality, since they have been evaluated by means of confirmatory procedures and show that the proposed model is adequately adjusted. The results specifically allow us to conclude that the structure of four factors is replicated: TPI understanding, TPI Ed. Levels, PI Professionals and TPI Factors. They also show adequate reliability in terms of internal consistency, both for factors and the whole scale, which facilitates the applicability of the scale in diverse contexts. Each factor is supported by previous studies which highlighted the need to consider those aspects within the TPI construction process. As for the first one, since there has been a maturation process as regards the concept of TPI, it is necessary to start by analysing how it is understood by future teachers, since this could influence the other factors (Beijaard et al., 2004; Garner and Kaplan, 2019). For the second and third scales, it is also relevant attain a detailed knowledge of whether they find differences according to the educational level and different professionals because there are issues such as vocation or motivation that directly influence the construction of TPI (Green, 2015; Kim, 2013; Schaefer and Clandinin, 2019). Finally, the last factor is decisive since it could explain on which elements (personal and contextual) they place more importance during their training process and, consequently, which ones they associate with the construction and development of TPI (Lorenzo et al., 2015; Leeferink et al., 2019; Yuan et al., 2019).

Moreover, the existence of a GF allows us to conclude that the instrument is solid, since it explains all the factors. These psychometric results of factor structure and reliability complement the aspects of content validity. With regard to the third objective, all of the above enables us to conclude that the scale is, according to the empirical evidences analysed to date, of a reliable psychometric quality. Moreover, the design of this scale has made it possible to identify a set of priority aspects for the initial teacher training of future Secondary Education teachers. These four factors additionally coincide with the main aspects found in literature (Leeferink et al., 2019; Rodrigues and Mogarro, 2019; Van

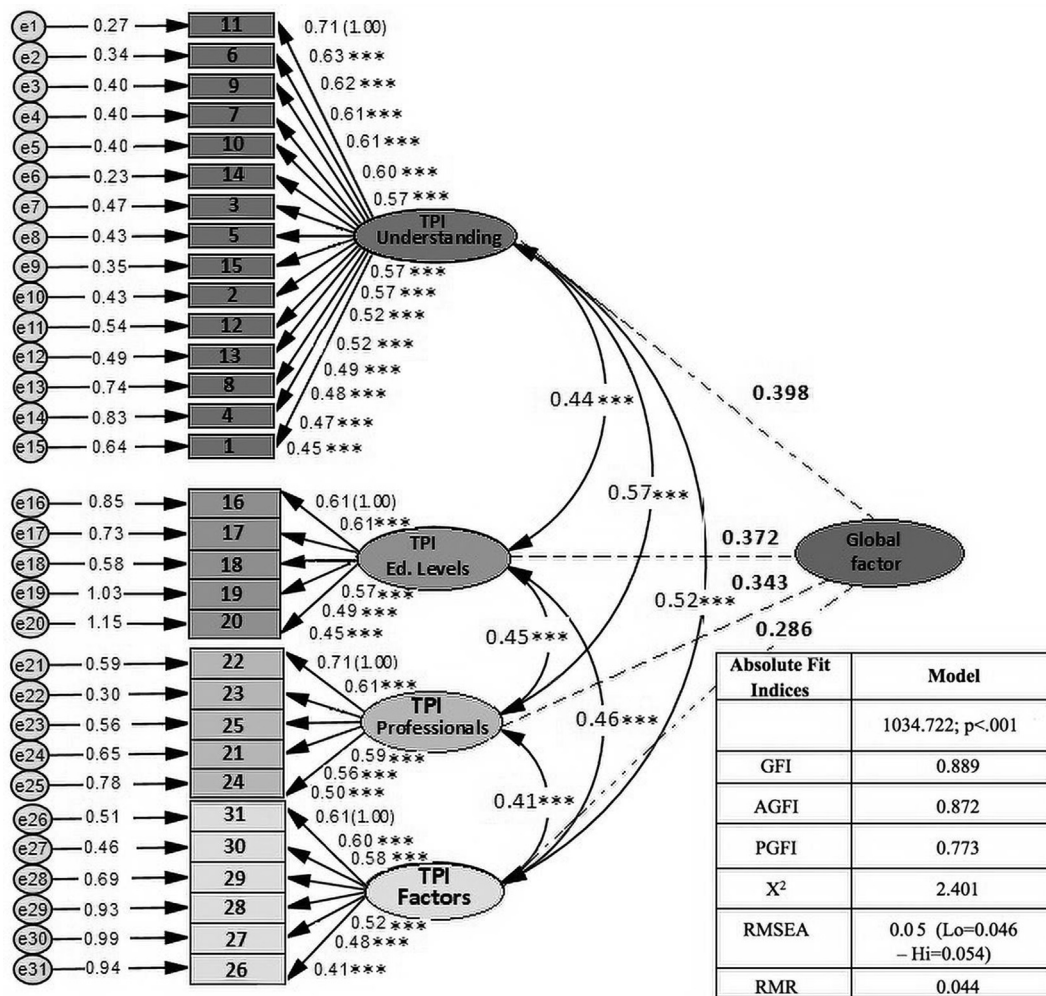


Figure 3. Factorial saturations corresponding to the items and goodness-of-fit indexes of the model.

Table 9. Correlations among the factors.

	F2	F3	F4
F1	.338*	.442*	.395*
F2		.329*	.330*
F3			.319*

Table 10. Composite reliability (CR) and average variance extraction of each sub-constructs in the CFA.

Sub-constructs	Average variance extracted	Composite reliability (CR)
TPI Understandings	0.321	0.875
TPI Ed. Levels	0.302	0.681
TPI Professionals	0.358	0.733
TPI Factors	0.290	0.706

Lankveld et al., 2017; Yuan et al., 2019) as regards the fact that they are considered relevant in order to improve teacher education programmes and education quality.

To conclude, we should emphasise that the instrument is solid in terms of its content and construct validity and reliability, since it is able to discover and analyse the perceptions of future Secondary Education teachers as regards the development of the TPI. This instrument, therefore, allows us to analyse possible imbalances or deficiencies in the initial

teacher training process that directly influence the teaching-learning process (preservice training) with regard to students.

These results suggest proposals, whose objective is to continue analysing teacher training programmes so as to make relevant improvements and remove those contents that become redundant. Moreover, this information is essential in order to guarantee the quality of the educational system in general and that of Secondary Education teacher training in particular. The participants' opinions and beliefs may contribute to the continuous betterment and progression of the teaching profession and even to the reformulation of new objectives in future curricular designs. In addition, this scale not only enables the possibility of continuing research into TPI and progressing in education quality and initial teacher training (Zhang et al., 2016), but also allows advances to be made in the research methods used for the investigation of the TPI to date, since there is a lack regarding quantitative research in this field (Aykaç et al., 2017).

All in all, the main implications of this study and the validation of the instrument can be classified in three groups: i) implications for initial teacher education; ii) implications for future teachers; iii) implications for reconsidering research on TPI.

Firstly, this instrument could be used as a resource in the class to promote debate about their teaching beliefs. Thus, it brings the chance of reinforcing both the constructivist and the reflective approaches to teacher education for the reason that it makes student teachers more aware and, consequently, engaged in their progression of meaning and knowledge construction and gives relevance to one's teaching experiences perspectives. Furthermore, it drives teacher educators to reflect about where to focus. Not only they should be aware of the importance of

subject matter knowledge and teaching skills, but also be concerned with identities of preservice teachers by mentoring them throughout the initial training period. Teacher education should go further than improving pedagogical training. Thus, improving the quality of initial teacher training programs is among this study's implications. A proof of that is that the participants establish an important relationship between TPI development and diverse training aspects that had been analysed in previous studies (Serrano Rodríguez and Pontes Pedrajas, 2015) and which are closely related to items included in I-TPI (e.g. Using and mastering teaching communication techniques (It.6), integrating ICT into teaching (It.8) and adopting a reflective and self-critical attitude with regard to teaching practise (It.15). In the aforementioned work, an experience on the use of the CmapTools software in the development of teaching communication techniques and in favouring reflection on initial training itself is described through the elaboration of concept maps (individual and collaborative) on texts related to the problem of teaching activity in secondary education (Serrano Rodríguez and Pontes Pedrajas, 2015). Subsequently, other ICT resources have been incorporated, such as interactive simulations (Phet) and immediate response systems (Turning Point), along with the use of virtual teaching platforms (Moodle and Blackboard Collaborate), whose influence on the initial development of the IPD will be analysed in future research projects.

Secondly, considering the previous ideas, enhancing teacher education by paying attention to train future teachers to be resilient, resourceful and committed may lead to prevent early career teachers flee the profession.

Finally, the use of TPI could induce to consider other aspects that have not been deeply studied yet such as TPI in teachers of diverse educational levels (contrasting parallel and consecutive teacher education models) and in other professions. Consequently, teacher educators, preservice teachers and education policy makers could benefit from the present study.

Possible limitations of the study could be related to the fact that it is a self-report scale and problems such as the social desirability and sincerity of the sample when answering it could, therefore, have affected the analysis. It would consequently be suitable to contrast the information collected by carrying out interviews with students (preservice teachers). Besides, the context of the study could be a limitation too since most of the participants have carried out their degree studies in the same university, so it could be useful to apply the instrument to other contexts where teacher education model is not consecutive but parallel.

Declarations

Author contribution statement

Elisa Pérez Gracia, Rocío Serrano Rodríguez, Alfonso Pontes Pedrajas: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Antonio J. Carpio: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data included in article/supplementary material/referenced in article.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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