

ORIGINAL RESEARCH

Open Access



Design and validation of a self-perception instrument on the use of scientific knowledge in teaching practice

Montse Guinovart-Pedescoll^{1*}  and Ramon Palau²

*Correspondence:
eguinova@xtec.cat

¹ Departament d'Educació de
La Generalitat de Catalunya,
Generalitat de Catalunya,
Tarragona, Spain

² Universitat Rovira i Virgili /
Espanya, Tarragona, Spain

Abstract

In the educational context, the transmission of scientific evidence to the classroom is essential to improve the quality of education and to develop effective research-based practices. However, in the interplay between teachers, researchers, political and educational institutions, there are a number of barriers that hinder this transmission. According to several studies, these difficulties arise from the lack of teacher training, work overload, the difficulty of accessing scientific articles, the existence of unethical behaviour and the instability of the Spanish educational system.

Approaching the teaching reality with the will to strengthen this link will allow making proposals that will have a significant impact on their teaching practices. Thus, the objective of this work is to design and validate a questionnaire that measures self-perception on the use of scientific knowledge in teaching practice. This tool, intended for future teachers and active teachers, will allow the collection of perceptions on barriers and facilitators for the implementation of scientific evidence in the classroom. Based on a quantitative research approach, the content of the questionnaire was validated by means of an expert judgment. Then, a pilot test was carried out with the participation of 278 future teachers of the Master's Degree in Teacher Training of 4 Catalan universities. Finally, an analysis of reliability and construct validity was carried out by means of an Exploratory Factor Analysis (EFA).

The result has been the validation of a tool that will allow a more detailed understanding of the phenomenon of barriers between educational scientific evidence and teachers. This will facilitate the detection of strengthening pathways between educational research and classroom practices, promoting a more effective implementation of scientific evidence that will result in a continuous, more effective and more efficient improvement of education.

Keywords: Educational scientific evidence, Validation of questionnaires, Initial teacher training, Teaching quality, Educational research

1 Introduction

Teachers face many barriers that interfere with their effectiveness (Fernández-García et al., 2023). According to various authors (Doménech Betoret & Gómez Artiga, 2010; Vicente de Vera & Gabari Gambarte, 2019; Fernández-García et al., 2023), the obstacles

teachers face range from a lack of rewards and resources, inadequate scheduling, excessive bureaucracy and workload, low levels of autonomy, high levels of social stress, student diversity and demotivation, to the need to adapt to a changing curriculum and educational legislation (LODE, 1985; LOGSE, 1990; LOCE, 2002; LOE, 2006; LOM-LOE, 2020) that alters the socio-political, financial, and technological conditions of the country.

Strengthening the link between fundamental and applied research and the teaching profession could provide the necessary resources, pedagogical techniques, and psychological skills to preserve and enhance teacher effectiveness (Fernández-García et al., 2023). This assertion is also supported by Cooper et al. (2009), Vanderlinde and Van Braak (2010), See et al. (2016), and Sato and Loewen (2019), who advocate for fostering dialogue between research and pedagogy.

Both individual professionals and institutions responsible for the educational field perceive the benefits of applying educational evidence to teaching practice (Cooper et al., 2009; MacLellan, 2016; Rathnakar, 2018; Sato & Loewen, 2019; Gorard, 2020; Ghafar, 2024).

Unfortunately, a gap has long persisted between the evidence gathered in academic educational research and teachers (Kaestle, 1993; Kennedy, 1997; Cooper et al., 2009; MacLellan, 2016; Gorard, 2020; Hobbiss et al., 2020; Ghafar, 2024). These gaps are generated by various factors. On the one hand, the causes of poor application of scientific evidence in the classroom are conditioned by the low integration of research competence in graduated teachers (Ayuste et al., 2021). The importance of this competence has long been emphasized by various authors (Ghafar, 2024; Kaestle, 1993; Kennedy, 1997; Zabalza, 2012). In the later stages of the teaching profession, professionals also encounter difficulties in interpreting and applying research evidence (Sato & Loewen, 2019). In fact, few education professionals are trained to assess the quality of research evidence and distinguish reliable evidence from unfounded claims (See, 2020). Maclellan (2016) also points out another problem: time. The teaching team is unwilling to invest time in engaging in educational research, and those in higher educational positions are unwilling to invest in the resources to help them do so. See et al. (2016) and Hobbiss et al. (2020) also highlight teacher workload as a factor that prevents teachers from effectively applying research in the classroom.

At the same time, there is a growing interest among all countries in promoting significant educational findings. This eagerness, initially positive, may have compromised the quality and ethics of the research (Gorard, 2020). Furthermore, at the political level, there are also tendencies to make decisions under pressure or interest (Cooper et al., 2009; Kaestle, 1993). Such behaviors, seen as unethical, bring consequences (Gorard, 2020): they lead society to incorrectly confuse impact with quality, thus fostering the adoption of ineffective practices. This compromises various ethical principles set forth in the “Singapore Statement on Research Integrity” (2010) or the AERA Code of Ethics (2011).

Additionally, Kennedy (1997) already highlights that the nature of the social phenomenon studied makes it difficult to carry out research with experimental designs and conclusive and lasting results. Therefore, the author concludes that teachers must develop the skills to apply the new strategies suggested as rigorously as possible and also the

capabilities to adapt them to their context and overcome minor inconsistencies in the theory that could be resolved and explained over time. It is also common for teachers to disregard research because the realities of their classroom differ from those of the research (relevance problem). An example of this is the pilot study conducted by See et al. (2016), where researchers found that there were no guidelines on how to transfer research knowledge to the classroom context. For his part, MacLellan (2016) collects the impressions of Gorard, who, along with See (2020), believes that the greatest difficulty for teachers in implementing educational research is the way scientific articles are written (accessibility problem).

These reasons may lead teachers to resort to different means and formats than original studies (from professional training to information obtained in the workplace or from mass or specialized media, including publications in professional associations), as stated by Cooper et al. (2009).

For scientific evidence to influence teaching practices, a series of psychological phenomena that condition the reception, integration, and application of information by teaching professionals must be considered. As Kennedy (1997) points out, teachers may experience psychological resistance to change due to pre-existing beliefs and values. The fact that the scientific information received by teachers (e.g., in continuing education courses) does not impact their practices is also reflected by Hobbiss et al. (2020). In this case, the authors mention an "ossification" of teaching practice. They identify a pattern in how teaching effectiveness develops. This pattern affects student outcomes, and they observe that in the first 5 to 7 years of teaching, effectiveness improves rapidly. Subsequently, the improvement of this skill becomes slower. This latter phenomenon is due to a common psychological reality among teachers: the transition, at the neuronal level, from deliberate reflective practices to habits (Hobbiss et al., 2020). Therefore, the accessibility of research applies not only to physical means but also to conceptual ones: research must consider not only what information it offers, but also how it presents it.

The instability of the educational system is also a potential obstacle. Many countries must face legislative changes and periodic reforms, which may involve political pressures that condition the quality of teaching for political reasons but not for scientific evidence (Kennedy, 1997). Additionally, innovations are regularly disseminated through exaggerated claims rather than reasonable arguments. Gorard (2020) testifies to the persistence of this phenomenon. He warns that the implications of disseminating poor-quality research are significant, just as the lack of use of quality evidence is.

Before proposing any solution, as Kaestle (1993) asserts, it is essential to thoroughly understand the "frontline" of the system. That is, a clear picture of the teaching reality is needed. Therefore, it is imperative to delve into the phenomenon of how and to what extent the dissemination of scientific evidence reaches classrooms. After an intensive and systematic search and not finding a validated instrument to understand better teachers' perceptions on the focus of this research, it was prioritized to develop such a tool. Thus, the overall objective of this study is to design and validate a self-perception questionnaire on the use of scientific knowledge in teaching practice. This tool aims to determine the main barriers and facilitators that teachers and future teachers perceive as obstacles or aids to accessing educational scientific literature and its implementation in the classroom, with particular attention to the role of technology as a facilitator.

2 Method

During the research, the ethical principles outlined in the Code of Ethics (2011), developed by the American Educational Research Association (AERA), have been applied, and the study has been guided by the values expressed in the Code of Conduct for Research Integrity (All European Academies, 2018). For data collection and handling, a responsibility declaration has been signed under the Ethical Committee for Research on People, Society, and Environment at Universitat Rovira i Virgili (URV) and the Information Security standards established by the *Real Decreto 3/2010, de la Ley Orgánica 3/2018, de 5 de diciembre, de protección de datos personales y garantía de los derechos digitales*, and the *Reglamento (UE) núm. 2016/679, del Parlamento Europeo y del Consejo, de 27 de abril de 2016, relativo a la protección de las personas físicas en cuanto al tratamiento de datos personales*, have been applied.

2.1 Tool design

The design of the questionnaire is cross-sectional (Creswell & Creswell, 2018; Fink, 2013), and to ensure valid and reliable results, it is based on the guidelines of Dillman et al. (2014). The premises proposed in their model "The Tailored Design Method" (TDM) allow for a flexible and adaptable questionnaire model for our target population. This perspective has been combined with that of Fink (2013), with which it converges on many points.

The characteristics taken into account when drafting the questionnaire questions are clarity, impartiality, and conciseness. Additionally, each question refers to a single element, and sections have been developed following the models of Sato and Loewen (2019) and adapted to our construct.

As Sato and Loewen (2019) point out, it is important that the questionnaire delineates what is meant by research, as definitions within the population may vary. Thus, a definition of the term "educational research" and "scientific evidence" has been incorporated to ensure a common framework between the research team and the participants.

To monitor and control the progress of the questionnaire, it has been opted to carry it out through Microsoft Forms.

2.2 Variables

The variables contemplated within the questionnaire are measured using a Likert scale in a quantitative manner:

- Perception of Barriers: The perception of participants is measured with a numerical scale of ordinal nature. For example, in response to the question "What do you think are the barriers that hinder the access and transfer of scientific evidence to teaching practice?", the scale ranges from "1 = Not relevant at all" to "5 = Very relevant."
- Perception of Facilitators: Similarly to the perception of barriers, this variable is ordinal. For example, in response to the question "What do you think could be done to promote the consultation and reading of educational research by teachers?", the scale ranges from "1 = Not relevant at all" to "5 = Very relevant."

- Perception of the Potential of New Technologies as Facilitators: As with the previous variables, this one is also ordinal. In response to the question "How do you think technology can help the teaching team integrate scientific evidence into the classroom?", the scale ranges from "1 = Not relevant at all" to "5 = Very relevant."

2.3 Sample

Our unit of analysis (Creswell & Guetterman, 2013) consisted of trainee professionals from 4 universities in Catalonia who are enrolled in a Master's program to become Secondary Education teachers. The sampling process was non-probabilistic and by convenience, as defined by Corral et al. (2015).

2.4 Content validation

To measure the content validity, an expert judgment process was conducted. As noted by Escobar-Pérez and Cuervo-Martínez (2008), evaluations were collected from a minimum of 10 experts (in this case $n = 11$). The experts evaluated the questionnaire items based on three criteria in a survey that includes a Likert scale for grading comprehension or clarity, relevance, and importance, following the model proposed by Escobar-Pérez and Cuervo-Martínez (2008). Additionally, a comments section was added at the end of the evaluation for the expert group to include any additional remarks.

The process followed for selecting professionals in the application phase of the expert judgment was based on the article by Cabero and Barroso (2013). Thus, the initial criteria used for selecting experts through judgment sampling were as follows:

- Having work experience in the educational field and in educational technologies.
- Having training in the field of scientific research.
- Having work experience in the educational field for more than 3 years.
- Belonging to different educational bodies.
- Belonging to different educational institutions.

The experts were ultimately composed of 9 professionals from the university sector and 2 teachers (from primary and secondary education) also linked to a university. For the implementation of the expert judgment, individual aggregation of the experts was chosen (Cabero & Barroso, 2013), as the goal was not to achieve homogeneity in the evaluation results, but rather to gather contributions from each expert individually without the need for them to interact with each other. To ensure the validity of the opinions collected from the experts, a self-evaluation questionnaire was developed to assess their level of competence in the study topic, and the K Coefficient or Expert Competence Coefficient was calculated (Cabero & Barroso, 2013).

Each contribution from the group of experts was evaluated, and necessary decisions were made to modify the questionnaire, resulting in the version used in the pilot test.

2.5 Pilot test

Once the questionnaire was modified, a pilot test was conducted to measure the reliability and construct validity. The questionnaire (see Appendix) was sent to students from

various universities in Catalonia (Universitat de Lleida, Universitat Ramon Llull, Universitat Rovira i Virgili, and Universitat de Vic) who were enrolled in different disciplines of the teacher training master's program. A total of 278 responses were collected from a population of 450 students. The questionnaire was distributed via email and by attending classes in person at universities, providing students with a QR code to access the questionnaire from their mobile devices.

2.6 Data analysis and results

To analyse the data obtained from the different phases (expert judgment and pilot test), the software JASP 0.18.3.0 and Excel were used.

2.6.1 Calculation of the K Coefficient

For the calculation of the K Coefficient, the guidelines of Cabero and Barroso (2013) were followed. Thus, $K = \frac{1}{2}(Kc + Ka)$, where Kc is the "Knowledge Coefficient" or the information the expert has about the topic, and Ka is the "Argumentation Coefficient". Kc is obtained from the evaluation conducted by the expert on a scale from 0 to 10, multiplied by 0.1. Ka is the result of assigning scores to the different sources of argumentation provided by the expert. The results indicate a predominantly high Expert Competence Coefficient ($K > 0.8$ and $K \leq 1$), with two cases being medium ($K \geq 0.7$ and $K \leq 0.8$).

2.6.2 Results of the questionnaire item evaluation

When integrating the evaluations of the experts, and as indicated by Escobar-Pérez and Cuervo-Martínez (2008), if 80% of the experts agreed on the validity of an item they evaluated in the questionnaire, it could be incorporated into the instrument. For this purpose, the Excel office software was used.

The results for each question allowed them all to be included in the questionnaire, as all items received an average score higher than 3.5 out of 4.

2.6.3 Reliability and construct validity

Based on the data collected in the pilot test and to measure the reliability and construct validity of the questionnaire, the Cronbach's Alpha coefficient and an Exploratory Factor Analysis (EFA) were calculated, respectively, using the JASP software.

2.6.4 Evaluation of the statistical technique for construct validation

Following Mindrila's (2017) recommendations, the properties of the observed variables and the sample have been examined to assess the use of a factor analysis. According to the author, our sample ($n = 278$) can be considered sufficiently large, and the nature of the questionnaire's measurement scale (ordinal scale) is appropriate for a factor analysis. Consistent with the author's advice, before conducting a factor analysis, it was verified that the distribution of the variables is normal by calculating the univariate skewness and kurtosis indices for each questionnaire item (see Table 1).

Given that skewness and kurtosis coefficients above 2 and 7, respectively, are considered indicative of non-normality (Mindrila, 2017), the possibility of proceeding with a factor analysis has been positively assessed. A multivariate kurtosis coefficient by Mardia above 3 is considered indicative of non-normality (Finney & DiStefano, 2006, cited in

Table 1 Kurtosis and skewness of the ordinal questionnaire data

Reference Items (I)	Skewness	Kurtosis
I1. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Formal education	-0.799	-0.377
I2. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Training courses	0.279	-1.099
I3. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Conferences and congresses	1.037	0.106
I4. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Scientific articles	-0.126	-0.916
I5. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Books	-0.166	-0.881
I6. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Educational blogs	-0.125	-1.040
I7. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Social networks	-0.235	-0.980
I8. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Educational podcasts	0.307	-0.990
I9. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Educational documentaries	0.334	-0.958
I10. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Forums and/or discussion groups	1.001	0.153
I11. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Information exchange with peers	-0.638	-0.644
I12. How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Artificial Intelligence	0.056	-1.147
I13. In general, do you believe that reading scientific articles on educational research has a positive impact on teaching practice?	-0.360	-0.467
I14. What do you think are the barriers that hinder access to and transfer of scientific evidence into teaching practice?—Lack of time during the daily routine as a teacher	-0.998	0.039
I15. What do you think are the barriers that hinder access to and transfer of scientific evidence into teaching practice?—Difficulty in accessing scientific journals/publications	0.090	-0.820
I16. What do you think are the barriers that hinder access to and transfer of scientific evidence into teaching practice?—Difficulty in understanding articles, as most are in English	0.414	-0.741
I17. What do you think are the barriers that hinder access to and transfer of scientific evidence into teaching practice?—Difficulty in understanding articles due to their complexity	0.280	-0.818
I18. What do you think are the barriers that hinder access to and transfer of scientific evidence into teaching practice?—Lack of relevant conclusions for teaching practice	-0.027	-0.540
I19. What do you think could be done to encourage teachers to consult and read educational research?—Dissemination of scientific literature by educational institutions	-0.670	-0.468
I20. What do you think could be done to encourage teachers to consult and read educational research?—Direct access to the research team to ask questions	-0.390	-0.692
I21. What do you think could be done to encourage teachers to consult and read educational research?—Having specific time for that purpose	-1.102	0.491
I22. What do you think could be done to encourage teachers to consult and read educational research?—Simplification of research articles (summaries in a more accessible language for all audiences)	-0.757	-0.318
I23. What do you think could be done to encourage teachers to consult and read educational research?—Having articles in my language	-0.371	-0.922
I24. What do you think could be done to encourage teachers to consult and read educational research?—Dissemination of more relevant studies that are more applicable to teaching	-1.005	0.233
I25. What do you think could be done to facilitate the application of scientific knowledge in your teaching practice?—Dissemination of scientific knowledge by educational institutions	-0.684	-0.410

Table 1 (continued)

Reference Items (I)	Skewness	Kurtosis
I26. What do you think could be done to facilitate the application of scientific knowledge in your teaching practice?—Direct contact between the research team and the teaching team	-0.427	-0.582
I27. What do you think could be done to facilitate the application of scientific knowledge in your teaching practice?—Having specific time to inform oneself and adapt implementation in the classroom	-1.162	0.557
I28. What do you think could be done to facilitate the application of scientific knowledge in your teaching practice?—Simplification of research articles	-0.592	-0.616
I29. What do you think could be done to facilitate the application of scientific knowledge in your teaching practice?—Having articles in my language	-0.285	-1.066
I30. What do you think could be done to facilitate the application of scientific knowledge in your teaching practice?—Dissemination of more relevant and practical studies for teaching	-0.955	0.273
I31. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—As a means to disseminate scientific knowledge	-0.776	-0.437
I32. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Facilitating direct contact between the research team and the teaching team	-0.586	-0.511
I33. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Assisting in simplifying teaching tasks and freeing up specific time	-0.848	-0.190
I34. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Using it to create simplified versions of research articles	-0.656	-0.285
I35. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Facilitating translations of articles into my language	-0.600	-0.627
I36. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Facilitating automatic translations	-0.462	-0.867
I37. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Facilitating the creation of virtual assistants that use artificial intelligence	-0.338	-0.946
I38. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Offering means of direct contact between the teaching team and the researcher	-0.411	-0.602
I39. How do you think technology can help the teaching team integrate scientific evidence in the classroom?—Facilitating the creation of learning communities between teachers and researchers	-0.792	-0.171

Mindrila, 2017), as found in this study (Mardia's coefficient = 18.963). According to Mindrila (2017), even when working with non-normal data, modern factor analysis methods provide accurate results by choosing an appropriate estimation procedure. Therefore, despite deviations from normality indicated by the results of univariate skewness and kurtosis, the Weighted Least Squares (WLS) method was chosen, known for robustness against non-normality in EFA.

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy yielded $KMO = 0.847$, and Bartlett's test of sphericity ($\chi^2 = 5251.332$, $df = 741$, $p < 0.001$) was significant. These results indicate that factorization can proceed, as a KMO above 0.80 is considered good (Mindrila, 2017). Additionally, the high values of Bartlett's test support factor analysis as a suitable option for construct validation.

An oblique rotation (Promax) was used to allow correlations between factors during analysis. The correlation matrix among factors (see Table 2) numerically confirms significant correlations between factors, validating the use of oblique Promax rotation. As stated by Mindrila (2017), correlations are considered high if they exceed

Table 2 Correlation matrix among the factors extracted in the EFA indicating the relationship between each pair of factors

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Factor 1	1.000	0.455	0.359	0.132	0.445	0.138	-0.107
Factor 2	0.455	1.000	0.507	0.167	0.432	0.099	0.145
Factor 3	0.359	0.507	1.000	0.270	0.336	0.038	0.050
Factor 4	0.132	0.167	0.270	1.000	0.246	0.321	0.001
Factor 5	0.445	0.432	0.336	0.246	1.000	0.187	0.088
Factor 6	0.138	0.099	0.038	0.321	0.187	1.000	-0.153
Factor 7	-0.107	0.145	0.050	0.001	0.088	-0.153	1.000

0.50 (4.76% of total data in this study), moderate if between 0.30 and 0.50 (28.57%), and low if equal to or less than 0.30 (66.67%).

Regarding the factor loadings resulting from the EFA, Mindrila (2017) specifies that having three to five observed measures as an acceptable number for representing factors, with an absolute value of 0.32 being the minimum threshold for a loading to be considered a significant indicator of a common factor. As seen in the factor loading matrix (see Table 3), the EFA shows 7 factors adequately represented by a minimum of 3 items with significant loadings.

To determine the number of common factors underlying the data, following Mindrila (2017), we sought a factor solution that uses the fewest number of factors to explain the maximum amount of variance. Applying the Kaiser criterion or latent root criterion as described by Mindrila (2017), we consider factors with eigenvalues greater than 1 as potential factors (see Table 4).

To determine an optimal number of factors, a scree test and a parallel analysis were conducted to compare the actual eigenvalues with those derived from random data. In Fig. 1, the first 3 factors stand out above the simulated eigenvalues (showing an elbow between the 4th and 5th factor). These factors capture a substantial proportion of the variance in the data. Additionally, all 7 factors are observed to be above the eigenvalues derived from the parallel analysis.

Since all factors have eigenvalues above 1 and all factors are above the line of simulated data, it has been deemed appropriate to retain a total of 7 factors. Regarding the reliability of each factor, as explained in Mindrila’s (2017) book, a result above 0.7 in Cronbach’s Alpha in the social sciences’ domain, as in this study (see Table 5), indicates adequate internal consistency, except for factor 7, which shows moderately low internal consistency.

All factors have shown high or adequate internal consistency above 0.7, indicating that the Cronbach’s Alpha test suggests the items appear to measure the same sub-construct, except for Factor 7, which yields a score of 0.492.

On one hand, Factor 7 has an eigenvalue above 1, indicating its relevance in explaining the variance of the data. For this reason, and considering that the low internal consistency result could be due to the inclusion of few items (3), it is deemed appropriate to include Factor 7.

Table 3 Factors and item loadings identified in the EFA

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Uniqueness
I36	0.893							0.324
I35	0.808							0.262
I37	0.790							0.388
I34	0.441							0.398
I12	0.408							0.718
I29	0.403				0.387	0.480		0.295
I28	0.338				0.395			0.375
I21		0.746						0.439
I25		0.670						0.413
I27		0.641						0.503
I19		0.607					0.335	0.449
I31		0.487						0.428
I14		0.457						0.797
I33		0.386						0.452
I18		-0.347						0.831
I38			0.848					0.234
I32			0.741					0.299
I26			0.622					0.460
I39			0.535					0.426
I20			0.504					0.475
I9				0.732				0.449
I8				0.729				0.496
I6				0.615				0.598
I10				0.572				0.632
I3				0.544				0.649
I2				0.463				0.720
I7				0.437				0.661
I5				0.368			0.371	0.713
I11				0.330				0.796
I30					0.765			0.426
I24					0.689			0.459
I22					0.504			0.333
I23					0.377	0.578		0.290
I16						0.783		0.385
I17						0.633		0.468
I15						0.431		0.744
I4							0.464	0.728
I13							0.359	0.714
I1								0.855

On the other hand, theoretically, it could be considered to add the items from Factor 7 (Scientific literature as a resource) into Factor 4 (Educational Resources). Having already added Item 1 (reducing Cronbach's Alpha to 0.742), including the 3 items from Factor 7 would increase Cronbach's Alpha to 0.764, which would also be acceptable in terms of internal consistency. However, due to the research emphasis on the use of scientific evidence gathered from literature, it is positively valued to keep it as a separate factor.

Therefore, the resulting factors are:

Table 4 Eigenvalues of the factors obtained in the EFA

Factors	Eigenvalues
Factor 1	9.172
Factor 2	3.338
Factor 3	3.035
Factor 4	2.005
Factor 5	1.656
Factor 6	1.582
Factor 7	1.521

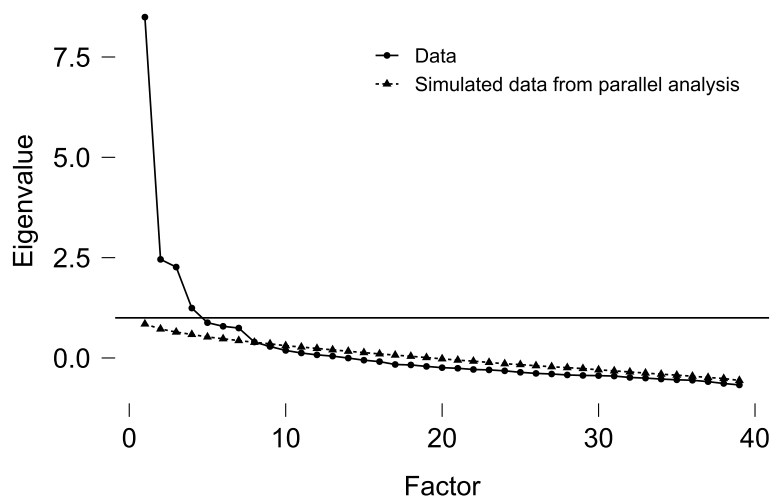


Fig. 1 Scree plot and parallel analysis showing eigenvalues of the actual data and simulated data

Table 5 Calculation of Cronbach's Alpha for each factor obtained in the EFA

Factor (Point Estimate)	Cronbach's Alpha
Factor 1	0.804
Factor 2	0.759
Factor 3	0.861
Factor 4	0.776
Factor 5	0.788
Factor 6	0.775
Factor 7	0.492

- Factor 1. Technology as a facilitator. The items related to this factor are: I36 (0.893), I35 (0.808), I37 (0.790), I31 (0.304), and I12 (0.533). These items address how technology can assist in integrating scientific evidence into the classroom.
- Factor 2. Institutional support. The items loading on this factor are: I21 (0.841), I25 (0.684), I27 (0.786), I19 (0.670), I31 (0.304), I14 (0.732), I33 (0.386), and I18 (-0.347). This factor identifies needs dependent on educational institutions or organizations, focusing on facilitating time to integrate and implement scientific evidence, as well as on the dissemination and accessibility (in terms of language

- and complexity) of such evidence. The item negatively loading on this factor (I18) indicates a lack of relevant conclusions for teaching practice, highlighting a barrier faced by teachers. This emphasizes that facilitating access to scientific research can be countered if the evidence provided is not perceived as relevant by teachers.
- Factor 3. Contact between teachers and research teams. The items related to this factor are: I38 (0.411), I32 (0.586), I26 (0.741), I39 (0.792), and I20 (0.741). These items explore the direct relationship between researchers and teachers for the improved implementation of educational scientific evidence.
 - Factor 4. Educational resources. The items loading on this factor are: I9 (0.392), I8 (0.332), I6 (0.437), I10 (0.463), I3 (0.279), I2 (0.279), I7 (-0.235), and I11 (0.437). They revolve around the frequency of use of different educational resources to enhance the training impacting or to impact the teaching practice of the participants.
 - Factor 5. Relevance, accessibility, and practicality. The items comprising this factor are: I28 (0.592), I30 (0.730), I24 (0.785), and I22 (0.504). These items discuss how to facilitate the practical integration of scientific evidence in the classroom.
 - Factor 6. Barriers to access scientific articles. Items related to this factor are: I29 (0.772), I23 (0.689), I16 (0.682), I17 (0.633), and I15 (0.648). This factor encompasses physical and cognitive barriers to accessing scientific literature.
 - Factor 7. Scientific literature as a resource. The items grouped in this factor are: I5 (0.544), I4 (0.563), and I13 (0.744). It measures the relevance of books or scientific articles for the training and improvement of educational practices.

It should be noted that Item 1: "How often do you use each of these resources to expand your education with the intention of improving the quality of your (future) teaching tasks?—Formal education (postgraduate, master's or doctoral degree)" does not load onto any factor. Given its perceived relevance and theoretical fit with Factor 4 (Educational Resources), the impact of adding this item to that factor's reliability has been assessed. Initially, Factor 4 had a Cronbach's Alpha of 0.776. Including Item 1 decreased it to 0.742. This slight decrease suggests that Item 1 is reasonably aligned with the other items in Factor 4. Since the result still exceeds 0.7, and following Mindrila (2017), it could be considered acceptable to include this item from a reliability standpoint as well.

Finally, improvement suggestions are gathered for the questionnaire revision, including:

- In question 8, regarding the frequency of using different resources, it is proposed to replace "Books" with "Popular or Academic Books", as this item aligns with others linked to Factor 7, "Scientific Literature as a Resource".
- Item I18, which shows a negative loading, will be retained in Factor 2 as an indicator of barrier.
- Item I1 will be added to Factor 4, given its theoretical relevance and to maintain adequate internal consistency.
- The proposed changes from the expert judgment phase (which were already part of the pilot test) will be maintained in terms of their wording.

3 Discussion and conclusions

Fernández-García et al. (2023) highlight that educators face numerous barriers that interfere with their effectiveness. Many authors advocate for strengthening the dialogue between research and pedagogy to enhance teaching effectiveness (Cooper et al., 2009; Vanderlinde & Van Braak, 2010; See et al., 2016; Sato & Loewen, 2019; Fernández-García et al., 2023). However, as reported, this link presents significant mismatches—some longstanding (Kaestle, 1993; Kennedy, 1997; Cooper et al., 2009; MacLellan, 2016; Gorard, 2020; Hobbiss et al., 2020; Ghafar, 2024).

Regarding the stated objective, it can be concluded that a self-perception questionnaire on the use of scientific knowledge in teaching practice has been designed and validated, including content validity, construct validity, and reliability assessments. After validating the K coefficient (indicating high expert competence) of the 11 participants in this phase, their expert judgments allowed for modifications to the questionnaire and validation of its content. This questionnaire was used in a pilot test involving 4 universities and 278 prospective secondary education teachers.

The pilot test responses enabled the measurement of the questionnaire's reliability and construct validity. Both EFA and internal consistency metrics demonstrated adequate construct validity of the questionnaire. Initially, the various univariate normality tests were within acceptable ranges for conducting EFA. Since the multivariate normality analysis indicated non-normality, a method robust to non-normality was chosen. Both the KMO measure and Bartlett's Test of Sphericity indicated the data's suitability for EFA. Upon conducting EFA, 7 common factors or latent constructs (Mindrila, 2017) were identified, all with suitable eigenvalues to be considered potential factors.

Finally, through content validation, construct validation, and reliability analysis, improvement actions have been identified for the questionnaire's redesign.

Regarding study limitations, it is noted that convenience sampling was employed, potentially limiting representativeness. However, after calculating the specified margin of error, which was below 4%, the recommended sample size for this research was determined using a 99% confidence level and a common margin of error (5%). The result for a total population of 450 is a sample size of 259. Therefore, the results from the pilot test, with $n=278$, are considered to provide significant insights into this population. A future proposal would be to continue this research by analysing the responses to draw conclusions about perceptions of barriers and facilitators among prospective teachers. This quantitative study would also benefit from complementing it with qualitative research in the future. A mixed-methods design could enhance the validity and reliability of the findings (Creswell, 2009).

Furthermore, since the sample consisted exclusively of master's students from Catalan universities, the data may not be applicable to the broader teaching population, despite some students also working as teachers (37.05% of the sample)—a unique situation in the Catalan autonomous community. Therefore, now that the questionnaire has been validated for both current and prospective teachers at the content level, it would be ideal to administer the questionnaire to more active teachers, ensuring greater representation across various experience levels to strengthen the validity and utility of this tool.

Lastly, the implications of this study underscore the identification of pathways to strengthen the link between research and educational practices. As Kaestle (1993)

pointed out, understanding the field where all educational decisions impact is crucial for proposing effective solutions. Similarly, as Cooper et al. (2009) concluded, delving into how knowledge permeates thinking and organizational practices is key to mobilizing knowledge between researchers and teachers. Therefore, the creation and validation of the presented questionnaire becomes a useful and significant tool for assessing these perceptions among both prospective and active teachers regarding the mentioned facilitators and barriers. It provides insight into their reality and proposes effective solutions to enhance the quality of education in a robust and continuous manner.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1007/s44322-024-00026-5>.

Supplementary Material 1.

Acknowledgements

The authors express their gratitude to the participating education professionals, universities, university teachers and university students for their support in the research study.

Authors' contributions

Montse Guinovart-Pedescoll: Conceptualization, methodology, formal analysis, writing – original draft. Ramon Palau: Review and editing of the manuscript, supervision.

Funding

The authors did not receive support from any organization for the submitted work.

Data availability

The data used in this study are available upon request from the corresponding author.

Declarations

Ethics approval and consent to participate

A Responsibility Declaration was signed and approved by the Ethical Committee for Research on People, Society, and Environment at Universitat Rovira i Virgili (URV).

Informed consent was obtained from all individual participants included in the study.

Consent for publication

Participants have given their consent for the publication of the data.

Competing interests

The authors declare they have no financial interests.

Received: 11 July 2024 Accepted: 11 December 2024

Published online: 10 February 2025

References

- AERA Code of Ethics. (2011). American Educational Research Association Approved by the AERA Council February 2011. *Educational Researcher*, 40(3), 145–156. <https://doi.org/10.3102/0013189X11410403>
- All European Academies. (2018). *Código Europeo de Conducta para la Integridad en la Investigación*. Declaración del Grupo de Trabajo Permanente sobre Ciencia y Ética de ALLEA. https://www.allea.org/wp-content/uploads/2018/01/SP_ALLEA_Codigo_Europeo_de_Conducta_para_la_Integridad_en_la_Investigacion.pdf
- Ayuste, A., Gros, B., Sabariego Puig, M., & Palou, B. (2021). La competència de recerca en els graus d'Educació Infantil i Educació Primària. *Revista Digital de Investigación en Docencia Universitaria*. <https://www.researchgate.net/publication/355484876>
- Cabero Almenara, J., & Barroso Osuna, J. (2013). La utilización del juicio de experto para la evaluación de TIC: el Coeficiente de competencia experta. *Bordón. Revista de Pedagogía*, 65(2), 25–38. <https://doi.org/10.13042/brp.2013.65202>
- Cooper, A., Levin, B., & Campbell, C. (2009). The Growing (But Still Limited) Importance of Evidence in Education Policy and Practice. *Journal of Educational Change*, 10(2), 159–171. <https://doi.org/10.1007/s10833-009-9107-0>
- Corral, Y., Corral, I., & Franco Corral, A. (2015). Procedimientos de muestreo. *Revista Ciencias de la Educación*, (46), 151–167. <https://dialnet.unirioja.es/servlet/articulo?codigo=7472483>
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Sage Publications. https://www.ucg.ac.me/skladiste/blog_609332/objava_105202/fajlovi/Creswell.pdf
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications, Inc.

- Creswell, J. W. & Guetterman, T. C. (2013). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (6th ed.). Pearson.
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method. Wiley. <https://doi.org/10.1002/9781118625392>
- Doménech, F., & Gómez, A. (2010). Barriers perceived by teachers at work, coping strategies, self-efficacy and burnout. *The Spanish Journal of Psychology*, 13(2), 637–654. <https://doi.org/10.1017/S1138741600002316>
- Escobar-Pérez, J., & Cuervo-Martínez, Á. (2008). Validez de contenido y juicio de expertos: una aproximación a su utilización. *Avances en Medición*, 6, 27–36. <https://www.researchgate.net/publication/302438451>
- Fernández-García, C. M., Inda-Caro, M., & Viñuela-Hernández, M. P. (2023). Teaching effectiveness in Spain: Towards an evidence-based approach for informing policymakers. In R. Maulana, M. Helms-Lorenz, & R. M. Klassen (Eds.), *Effective teaching around the world* (pp. 283–298). Springer. https://doi.org/10.1007/978-3-031-31678-4_13
- Fink, A. (2013). *How to Conduct Surveys: A Step-by-Step Guide*. SAGE Publications, Inc.
- Finney, S. J., & DiStefano, C. (2006). Nonnormal and categorical data in structural equation models. In G. R. Hancock & R. O. Mueller (Eds.), *A second course in structural equation modeling* (pp. 269–314). Information Age.
- Ghafar, Z. N. (2024). The Impact of Education Research in a Multidisciplinary Perspective: An Overview. *Middle East Research Journal of Humanities and Social Sciences*, 4(2), 26–32. <https://doi.org/10.36348/merjhss.2024.v04i02.001>
- Gorard, S. (Ed.). (2020). *Getting Evidence into Education: Evaluating the Routes to Policy and Practice* (1st ed.). Routledge. <https://doi.org/10.4324/9780429290343>
- Hobbiss, M., Sims, S., & Allen, R. (2020). Habit formation limits growth in teacher effectiveness: A review of converging evidence from neuroscience and social science. *Review of Education*, 9(1), 3–23. <https://doi.org/10.1002/rev.3.2226>
- Kaestle, C. F. (1993). The Awful Reputation of Education Research. *Educational Researcher*, 22(1), 23–31. <https://www.jstor.org/stable/1177303>
- Kennedy, M. M. (1997). The Connection Between Research and Practice. *Educational Researcher*, 26(7), 4–12. <https://doi.org/10.3102/0013189X026007004>
- Ley Orgánica 3/2018. (2018, 5 de diciembre). *De Protección de Datos Personales y garantía de los derechos digitales*. Boletín Oficial del Estado, (294). <https://www.boe.es/eli/es/lo/2018/12/05/3/con>
- Ley Orgánica 8/1985, de 3 de julio, de Derechos y Libertades de los Centros Educativos. Boletín Oficial del Estado, núm. 159, de 4 de julio de 1985. <https://www.boe.es/eli/es/lo/1985/07/03/8>
- Ley Orgánica 1/1990, de 3 de octubre, de Ordenación General del Sistema Educativo. Boletín Oficial del Estado, núm. 238, de 4 de octubre de 1990. <https://www.boe.es/eli/es/lo/1990/10/03/1>
- Ley Orgánica 10/2002, de 23 de diciembre, de Calidad de la Educación. Boletín Oficial del Estado, núm. 307, de 24 de diciembre de 2002. <https://www.boe.es/eli/es/lo/2002/12/23/10>
- Ley Orgánica 2/2006, de 3 de mayo, de Educación. Boletín Oficial del Estado, núm. 106, de 4 de mayo de 2006. <https://www.boe.es/eli/es/lo/2006/05/03/2>
- Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación. Boletín Oficial del Estado, núm. 340, de 30 de diciembre de 2020. <https://www.boe.es/eli/es/lo/2020/12/29/3>
- MacLellan, P. (2016, August 9). Why don't teachers use education research in teaching? *RSC Education*. <https://edu.rsc.org/analysis/why-dont-teachers-use-education-research-in-teaching/2010170.article>
- Mindrila, D. (Ed.). (2017). *Exploratory factor analysis applications in school improvement research*. Nova Science Publishers.
- Rathnakar, G. (2018). Research in education its necessity of and importance-A study. *ICTACT Journal on Management Studies*, 4(1), 675–678. <https://doi.org/10.21917/ijms.2018.0091>
- Real Decreto 3/2010. (2010, 8 de enero). *Por el que se regula el Esquema Nacional de Seguridad en el ámbito de la Administración Electrónica*. Boletín Oficial del Estado, (25), 8089–8138. <https://www.boe.es/eli/es/rd/2010/01/08/3>
- Sato, M., & Loewen, S. (2019). Do teachers care about research? *The research-pedagogy dialogue*. *ELT Journal*, 73(1), 1–10. <https://doi.org/10.1093/elt/ccy048>
- See, B., Gorard, S., & Siddiqui, N. (2016). Teachers' use of research evidence in practice: A pilot study of feedback to enhance learning. *Educational Research*, 58(1), 56–72. <https://doi.org/10.1080/00131881.2015.1117798>
- See, B. (2020). Why is it difficult to get evidence into use?. In S. Gorard (Ed.), *Getting evidence into education: evaluating the routes into policy and practice* (84–99). Routledge. <https://doi.org/10.4324/9780429290343>
- Unión Europea. (2016, 4 de mayo). Reglamento (UE) 2016/679 del Parlamento Europeo y del Consejo, de 27 de abril de 2016, relativo a la protección de las personas físicas en lo que respecta al tratamiento de datos personales y a la libre circulación de estos datos y por el que se deroga la Directiva 95/46/EC (Reglamento General de Protección de Datos). *Diario Oficial de la Unión Europea*, L119, 1–88. <https://www.boe.es/doue/2016/119/L00001-00088.pdf>
- Vanderlinde, R., & Van Braak, J. (2010). The gap between educational research and practice: Views of teachers, school leaders, intermediaries and researchers. *British Educational Research Journal*, 36(2), 299–316. <https://doi.org/10.1080/00131881.2015.111779810.1080/01411920902919257>
- Vicente de Vera, M.I. & Gabarí Gambarte, M.I. (2019). Burnout y Factores de Resiliencia en Docentes de Educación Secundaria. *International Journal of Sociology of Education*, 8(2), 127–152. <https://doi.org/10.17583/riase.2019.3987>
- World Conference on Research Integrity. (2010). *Declaració de Singapur sobre la integritat de la recerca*. <https://www.wcrif.org/downloads/former-conferences/2nd-wcri-in-singapore-2010/translations-statements/23-singapore-statement-catalan/file>
- Zabalza, M.A. (2012). Las competencias en la formación del profesorado: de la teoría a las propuestas prácticas. *Tendencias Pedagógicas*, 20, 5–32. <https://dialnet.unirioja.es/servlet/articulo?codigo=4105027>

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.