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RESEARCH ARTICLES

Design and validation of the classroom climate for an inclusive education questionnaire (CCIEQ)

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ABSTRACT

This study aims to validate the *Classroom Climate for an Inclusive Education Questionnaire (CCIEQ)* to assess the quality of the conditions for inclusive teaching performance through three different procedures. Firstly, the study aims to evaluate the questionnaire's content validity, culminating in the selection of nine theoretically dimensions validated quantitatively by means of an adequate Minimum Discrepancy of the Chi-square Value Divided by Degree of Freedom Index (CMIN/DF). Secondly, it seeks to assess the construct validity of the questionnaire with a Robust Exploratory Factor Analysis Technique and Hull Method to evaluate internal consistency for a final configuration of a single factor to obtain a single final score. Thirdly, the study aims to evaluate the questionnaire's convergent validity, showing the existing correlations with other instruments previously validated for the same purpose (CEFI-R, UDL-checklist Test) using a common participant sample. To achieve these objectives, a sample of 153 in service teachers was used, recruited for the study sample from four different countries (Spain, Turkey, Latvia and Poland) through cluster sampling. The results show excellent psychometric properties and convergent validity of the CCIEQ, so its use as a scientific tool for samples of European in-service teachers is validated.

Keywords: inclusive education; classroom climate; in service teachers; European sample; factor analysis

1. Introduction

As many other countries, Spain is committed to developing an inclusive education system. In this respect, this country agreed to the contents of the 48th Session of the International Conference of Education promoted by UNESCO/IBE (United Nations Educational, Scientific and Cultural Organization / International Bureau of Education)[1], with the eloquent title: "Inclusive education: the path to the future". More recently, Spain has once again ratified its commitment to attaining a more inclusive education, assuming the so-called *UNESCO* Declaration of Incheon and its Action Framework for the Realisation of Sustainable Development Goal 4 (SDG4), by the year 2030[2] which has a relevant title for the present study: "Guaranteeing an inclusive and equitable education and promoting continuous learning opportunities for all".

Inclusive education is based on redistribution of access and participation in quality learning opportunities; recognition and valuing of the differences of all learners, reflected in content, pedagogy, and assessments. It

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should be emphasised that there is no single model of inclusive school. However, there are no common characteristics of inclusive schools nor inclusive classrooms. Many authors have focused on identifying the conditions or characteristics of inclusive classrooms[3–6]. The authors emphasize that embracing an inclusive perspective entail addressing the unique diversities among all students to ensure that they can learn in an environment that embraces and values them. This commitment involves several key aspects:

1) Shaping Teacher Attitudes and Perceptions: To begin with, it necessitates a transformation in teacher attitudes and beliefs regarding diverse learning needs, while also dispelling any prejudices that may be associated with these differences.
2) Establishing Organizational Structures: Secondly, it requires the establishment of specific organizational structures, including coordination efforts and spaces for collaborative reflection among teachers. Additionally, it involves the active engagement of students, families, and other community members in this inclusive process.
3) Curriculum and Teaching Methods: Furthermore, it's crucial to make thoughtful decisions regarding what to teach and how to teach it. This encompasses the adoption of inclusive methodologies such as Universal Design for Learning (UDL) and multi-level instructional strategies.
4) Equitable Evaluation: Lastly, it entails developing fair and equitable evaluation methods that account for the diverse needs and abilities of all students.

By addressing these components, educational institutions can genuinely commit to fostering an inclusive environment where every student feels not only welcome but also valued, thus facilitating their learning journeys.

Numerous studies have revealed that teachers harbor concerns regarding their ability to effectively implement inclusion, often due to a perceived lack of adequate training and qualifications[7–9]. In this sense, numerous studies report that teachers show certain concerns with respect to their performance in the implementation of inclusion, since they do not perceive that they are sufficiently trained and qualified[10–12]. Although teacher training influences their attitudes, values and beliefs toward inclusion, there are other factors that impact teacher performance to a greater or lesser extent, such as the years of teaching experience, the educational needs of the students, and the conditions in which teaching takes place[13].

According to the literature there are a number of relevant conditions[14,15] in the inclusive school context: Support role, understood as co-teaching within the ordinary classroom; Family-School Relationship; that is, the involvement of families, communication and participation in the educational centre; Teaching concept of diversity, evaluating a broad concept of education for all; Collaborative teaching work, collaborative practices among teachers to coordinate and attend to diversity; Evaluation for all, assessments according to the principles of the UDL that are adapted to the needs of each student; Multilevel, methodology that favors the participation and learning of all; Inclusive Methodologies; Collaborative learning among students, this is collaborative work; and Student participation, that is, give voice and know the needs of students.

These conditions do not constitute stable and invariable states, as their development is accompanied by actions conducted by the educational community that are aimed at enhancing and/or maintaining such states.

All this generates a conscious and voluntary process that is sustainable throughout time. In this regard, we agree with Booth and Ainscow[16]:

> The goal is not to obtain a certificate stating that the school has reached a destination regarding inclusion. Schools are constantly changing; the students and the staff leave; new forms of exclusion appear; new resources are mobilized. Inclusion is an endless process, "a never-ending story". The only sense in which it would be desirable to proclaim a school as "inclusive" would be the firm commitment to the sustainability of a school improvement process guided by inclusive values (p. 31).

Despite the abundance of self-evaluation assessments grounded in the dimensions and indicators of the Index for Inclusion[17], prevailing tools either inadequately gauge these dimensions or lack sound psychometric properties[18]. Moreover, many of these instruments fail to encompass the full spectrum of essential prerequisites outlined in the literature for creating genuinely inclusive classrooms. Typically, existing measurement tools tend to narrow their focus on isolated variables, such as the perception of competence (e.g., Teacher Training for Inclusion Evaluation Questionnaire: CEFI-R[19]), diversity training, and available resources within educational centers (e.g., Self-Assessment of Centers for Diversity Attention from Inclusion: ACADI[18]). This limited scope often disregards the multifaceted factors and diverse stakeholders crucial for establishing inclusivity within educational institutions. A comprehensive review conducted by Chang and Cochran-Smith[20] underscores the recurrent shortcomings in effectively addressing the most pressing challenges in contemporary teacher education and advancing profound equity and social justice objectives.

Ewing's review[21] shows that there are very few validated questionnaires in this area. Among the scarce instruments validated in Europe related to the evaluation of inclusive practices, it is worth highlighting the following three tests: CEFI-R[19], ACADI[18] and the Questionnaire for the evaluation of the diversity attention as an educational dimension in the school institutions (AVACO-EVADIE)[22]. CEFI-R assesses the self-perceptions of teachers regarding their training and competences to address diversity in the classroom in the broadest sense[19,23]. ACADI[18] allows analysing different aspects of the educational life of schools separately (Context, Resources, Educational Process and Results). Lastly, the AVACO-EVADIE questionnaire[22] gathers the following dimensions: centre, normality concept, diversity concept, intervention, diagnosis, curriculum, and performance level.

In recent decades, the Universal Design for Learning (UDL) approach has become closely intertwined with the advancement of inclusive education. This is largely owing to its substantial theoretical contributions, which are designed for direct application within the classroom setting. The UDL approach was originally introduced by the Center for Applied Special Technology (CAST) and is grounded in three core principles:

1) Providing Multiple Representation Media: This principle emphasizes the importance of offering diverse means of presenting information to cater to the varied learning styles and preferences of all students.
2) Providing Multiple Action and Expression Media: UDL encourages the use of various avenues through which students can express their understanding and skills, acknowledging that individuals may have distinct ways of demonstrating their knowledge.
3) Providing Multiple Forms of Engagement: UDL underscores the need to engage students through different strategies and activities, recognizing that learners have varying interests and motivators.

In 2011, CAST[24] introduced a set of guidelines and assessment criteria to facilitate the evaluation of the implementation of these UDL principles. Building upon this foundation, the work of Sánchez et al.[25] involved adapting and validating these propositions from CAST to create a measurement instrument for assessing the successful incorporation of UDL principles in educational settings.

Within this conceptual framework, we have shaped our concerns and directed our efforts. As a result, we have developed a novel instrument that goes beyond existing ones by encompassing various dimensions outlined in the literature as essential for the establishment of an inclusive classroom.

What sets our questionnaire apart is its consolidation of variables that have either been addressed in prior surveys or are highlighted in the literature as vital for the realization of true classroom inclusivity. This questionnaire is specifically tailored for the teaching staff within schools, acknowledging that while various agents within the educational community contribute to inclusivity[26], teachers occupy a pivotal role.

Teachers possess intimate knowledge of their own needs, the requirements of their educational institution, the resources at their disposal, the organizational structure of their school, as well as its strengths and weaknesses[27,28]. As a cohesive team, they collectively offer a comprehensive and insightful perspective on the extent to which all students are genuinely included in their educational environment.

Therefore, the aim of this study was to validate the *Classroom Climate for an Inclusive Education questionnaire (CCIEQ)* for scientific use, by means of three different procedures. Firstly, (1) the content validity of the questionnaire was assessed, specifying the initial design of the instrument according to the recommended scientific guidelines and validated quantitatively by means of an adequate Minimum Discrepancy of the Chi-square Value Divided by Degree of Freedom Index (CMIN/DF). Secondly, (2) the construct validity of the questionnaire was determined, analysing the psychometric properties of the designed instrument through Robust Exploratory Factor Analysis Technique and the Hull Method for selecting a model with an optimal balance between model fit and a minimum number of factors and items, with a representative sample of the target population. Lastly, (3) the convergent validity of the questionnaire was evaluated, showing the existing correlations with other instruments that have been previously validated for the same purpose (CEFI-R and UDL Checklist Test), using a common sample of participants.

2. Materials and methods

2.1. Study population and sample

The study population comprised in-service teachers within the compulsory education stages of the common European education framework. To form the study sample, we initially recruited 183 in-service teachers from four distinct countries, namely Spain, Turkey, Latvia, and Poland. Our goal was to ensure geographical, linguistic, and cultural diversity among participants, thus enhancing the representativeness of our sample. However, it's worth noting that, in the final analysis, only 153 teachers successfully completed all the tests and comprised the ultimate analysis sample.

Despite the considerable diversity within the selected sample, it's essential to highlight that all participants demonstrated a strong command of the English language, which served as the primary language for this research. This language proficiency was consistently demonstrated across all applied tests, thereby eliminating the possibility of measurement errors arising from language barriers.

The sample was obtained through cluster sampling. To set up the sample, voluntary participation was requested (including previous written informed consent, following the recommendations of the World Medical Association[29] from different educational centres, which were previously selected based on their proximity and availability in each of the selected countries. According to the regulations of the Research Ethics Committee of the Autonomous University of Madrid, the anonymized questionnaires are not within the application scope of Article 2.3. This is a non-experimental study that guarantees the anonymity of the participants, following Organic Law 7/2021, of May 27th, on the Protection of Data and Guarantee of Digital Rights[30].

The final sample was constituted by 122 women (79.7%), 29 men (19%) and 2 (1.3%) persons who did not wish to classify their gender, with an age range of 25 to 69 years (mean age = 44.4 years; SD = 9.43). The distribution of the sample according to the main genders was 4 to 1, thus its disproportion as a function of gender is representative of the population that it represents, which shows the same gender tendency in the current data. Next, **Figure 1** presents the distribution of the sample according to gender and age in a population pyramid:

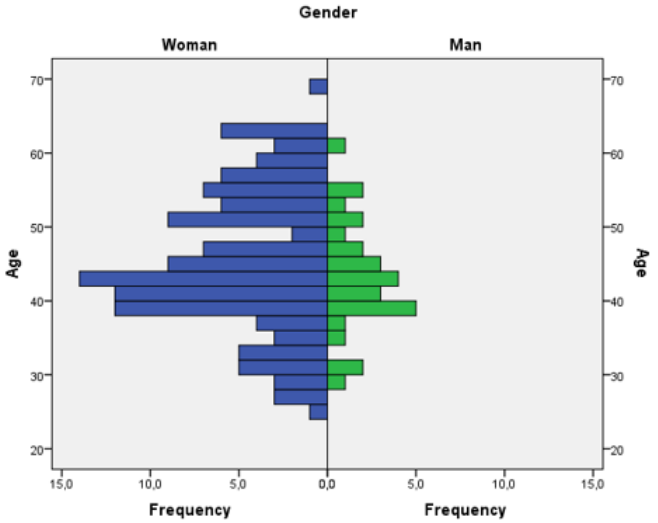

Figure 1. Population pyramid.

As is shown in **Figure 1**, the sample had a greater proportion of participants in the age range of 38–47 years for the main sexes, with few young and near-retirement participants.

With respect to the distribution as a function of the variable country of origin, the sample followed a very balanced distribution, since the percentage range was between 22.2% from Turkey (*N* = 34) and 27.5% from Spain (*N* = 42), with 24.8% from Poland (*N* = 38) and 25.5% from Latvia (*N* = 39). Next, **Figure 2** presents this distribution, also considering the distribution as a function of gender:

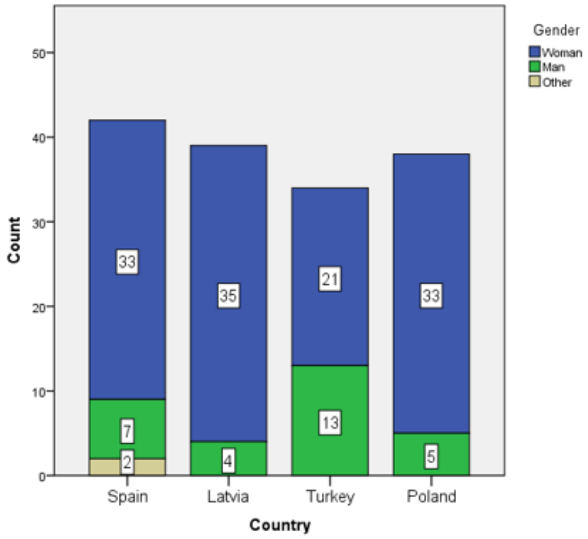

Figure 2. Distribution of the sample of participants according to country and gender.

It is worth highlighting that the distribution as a function of gender is slightly more balanced in Turkey, where the proportion of men was 38.2% (*N* = 13), and the only country with non-binary participants was Spain (*N* = 2), although their presence was very low (4.8%).

Lastly, as the last descriptive variable of the sample, the distribution of teaching experience among the participants ranged between 1 and 46 years, with a global mean of 19.61 years (SD = 9.93), thus it is possible to assert that this is mostly a very experienced sample in the professional scope of teaching. Next, **Figure 3** presents this distribution through a histogram as a function of age and years of teaching experience.

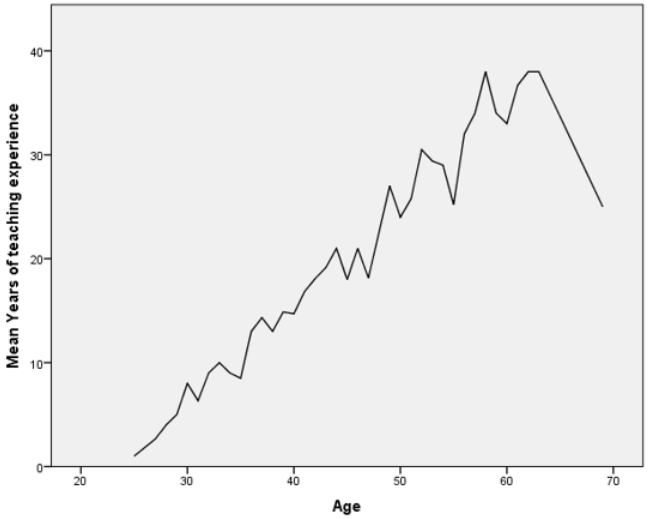

Figure 3. Distribution of the sample as a function of age and years of teaching experience.

As can be observed in **Figure 3**, the distribution of teaching experience as a function of age represents the study population, since experience shows a clear positive tendency to increase with age, up to retirement age, with a small anomalous distribution above retirement age.

2.2. Research instruments

This study includes the analysis of the results obtained from three measurement instruments. Two of them had been previously validated, and the third instrument, the *CCIEQ*, had its psychometric properties evaluated in this study, and its content, construct and concurrent validity was assessed with the other two instruments. Next, we describe the main characteristics and psychometric properties of each of these instruments.

CCIEQ: 1): This is the main instrument of this study. It consists of 54 items with four response options (from 'strongly disagree' to 'strongly agree'). It evaluates some of the relevant conditions, according to literature, related to the implementation of inclusive education through nine theorical dimensions: support role, family-school relationship, teacher concept of diversity, teacher collaborative work, evaluation for everyone, multilevel teaching, inclusive methodology, students collaborative learning and students' participation. This instrument shows excellent reliability, measured through Cronbach's alpha with the sample of this study ($\alpha = 0.968$). (Supplementary Material 2).

CEFI-R[23]: This instrument was used in this study to assess the convergent validity of the previous instrument. It consists of a total of 19 items grouped into four dimensions: concept of diversity, methodology, support, and community participation. The dimension "concept of diversity" (5 items) values the beliefs about diversity, knowledge and perceptions about schooling modalities of the students, and educational policy on inclusion. The dimension "methodology" (5 items) addresses the aspects related to the design and development of an inclusive curriculum and an inclusive classroom. The dimension "support" (4 items) delves into the role and value granted to co-teaching in the ordinary classroom. Lastly, the dimension "community participation" (5 items) measures the collaboration of the educational community with all services and agents within reach. The items of this instrument are valued with a Likert scale from 1 to 4 (1 = "strongly disagree" and 4 = "strongly agree"). CEFI-R has adequate psychometric properties, with a reliability value of 0.79[23]. In subsequent validations with Primary Education teachers, the questionnaire had two items removed, maintaining excellent psychometric properties and reaching reliability data between 0.75 and 0.94[31].

Verification list of the principles of UDL (UDL-checklist Test)[24,25]: This is a measurement instrument that assesses the implementation of the principles of the UDL-checklist Test, in which the indicators of all guidelines

were reformulated into questions. This questionnaire consists of 26 items and three dimensions associated with each of the three principles of the UDL test. The items are valued with a Likert scale, with four response levels: (0) never; (1) sometimes; (2) almost always; and (3) always. The instrument shows good reliability values, between 0.86 and 0.90.

All the instruments used in this study were administered in their English version to a sample of participants with a broad understanding of English language.

2.3. Experiment design and data analysis

The aim of this study was to respond to three specific objectives, which required qualitatively different experimental procedures to attain the main objective, i.e., to validate the *CCIEQ* questionnaire.

Firstly, to guarantee the correct design of the instrument and an adequate content validity, we reviewed the literature on instruments that evaluated aspects which, in our opinion, should be included in the new questionnaire. One of the reference instruments was, as previously mentioned, CEFI-R[23], based on its broad view of the diversity of the classroom scope, mainly, and the test for the verification of the UDL Principles, as it is the most thoroughly analyzed methodological approach in the literature[32]. In addition, our measure was based on the Index for inclusion[33]. The dimensions and items that make up this measure take this guide as a theoretical reference, and decisions about whether or not to include questions are based on the content of the Index. We believe that the vision that this guide offers on inclusive centres is relevant.

Given all this information, a system of indicators was generated, and these indicators led to the drafting of the items. For example, the Index For inclusion dimension "Inclusive practices" which refers to school activities that promote inclusion was very present in the development of our items. Similarly, the Index dimension "Inclusive culture" inspired the dimension referring to the perception of diversity. In relation to the CEFI-R, we found that the four dimensions of this instrument: supports, concept of diversity, community and inclusive methodologies are covered in our measure. It is worth highlighting that, according to the literature, the dimension "distributed leadership" is relevant[34,35]; however, it was decided not to include it, as it could generate response bias, due to the fact that it refers to the managerial teams of the centres.

The items were described avoiding statements that would encourage answers influenced by social desirability. Once drafted, the final theorical configuration were qualitative and quantitatively validated. Qualitatively, with a group of four experts (faculty members with an extensive background in the scope of inclusive education), who were asked to assess the relevance and clarity of each item to evaluate the performance of a teacher for the creation of an inclusive classroom. Quantitatively, we validated the goodness-of-fit of the nine dimensions to the items selected in the *CCIEQ* by means of an adequate Minimum Discrepancy of the Chi-square Value Divided by Degree of Freedom Index (CMIN/DF).

Secondly, regarding the construct validity of *CCIEQ*, a Robust Exploratory Factor Analysis[36] and a Hull Method were conducted for selecting a model with an optimal balance between model fit and a minimum number of parameters and items, since Hull Method is specially efficient when the number of measured variables per factor is large[37]. To this end, the univariate descriptors of each item were calculated, the significance of Bartlett's sphericity test was determined, and the Kaiser-Meyer-Olkin Sampling Adequacy test was carried out. Then, the principal components with a self-value above 1 were calculated, and a Robust Exploratory Factor Analysis[36] of the final setting of *CCIEQ* was performed, following the recommendations of Lorenzo-Seva and Ferrando[38], applying the Measure of Sampling Adequacy (MSA) to highlight the items with values below 0.5, since such value suggests that these items do not measure the same domain as the other elements in the group, thus it must be removed.

Finally, to verify the goodness of fit statistics which aims to find a model with an optimal balance between model fit and number of parameters *Hull Method* was conducted for verify the number of common factors[37].

Lastly, to evaluate the concurrent validity of the designed instrument (*CCIEQ*), all three instruments (*CCIEQ*, *CEFI-R* and *UDL-checklist Test*) were applied in a representative sample of the target population, which was accessed through an ad hoc online questionnaire. Once the results were gathered, Pearson's correlation coefficient was used to compare each of the dimensions of *CCIEQ* with those of *CEFI-R*[23] and *UDL-checklist Test*[24,25]. We analysed the size and orientation of each correlation between the different dimensions of *CCIEQ* and those of *CEFI-R*[23] and *UDL-checklist Test*[24,25], with 95% confidence interval ($\alpha = 0.05$).

For the analysis of these data and all the necessary calculations, we used the statistical software *IBM SPSS* (v25.0) and *FACTOR* (v12), designed by Ferrando and Lorenzo-Seva[39].

3. Results

3.1. Content validity

To respond to the first specific objective of the study, i.e., to evaluate the content validity of the questionnaire, we established the most frequently cited conditions in the literature, based on different authors and validating them through expert judgement. Then, we validate quantitatively this theorical configuration by means of the *Minimum Discrepancy of the Chi-square Value Divided by Degree of Freedom Index* (*CMIN/DF*). Results show an adequate model fit measure (CMIN/DF = 2,692).

3.2. Construct validity

To respond to the second specific objective of this study, i.e., to evaluate the construct validity of the questionnaire, a *Robust Exploratory Factor Analysis* and *Hull Method* were performed, starting from the variance distribution of each item, as is shown in **Table 1** below.

Table 1. Univariate descriptors of the items of the instrument.

Item	Mean	C.I. (95%)	Variance	Asym.	Kurtosis	Item	Mean	C.I. (95%)	Variance	Asym.	Kurtosis
1	3.196	(3.07–3.33)	0.393	−0.655	1.565	28	3.261	(3.15–3.38)	0.311	−0.001	−0.424
2	3.203	(3.08–3.33)	0.371	−0.488	1.134	29	3.373	(3.26–3.49)	0.312	−0.162	−0.794
3	3.601	(3.48–3.72)	0.344	−1.377	1.853	30	3.118	(2.98–3.25)	0.431	−0.268	−0.165
4	3.425	(3.30–3.55)	0.375	−0.741	0.453	31	3.261	(3.16–3.37)	0.258	0.313	−0.387
5	3.333	(3.22–3.44)	0.288	0.057	−0.773	32	3.105	(2.97–3.24)	0.420	−0.105	−0.634
6	3.248	(3.12–3.38)	0.396	−0.567	0.877	33	3.216	(3.10–3.33)	0.313	0.018	−0.253
7	3.092	(2.95–3.23)	0.462	−0.367	0.044	34	3.078	(2.95–3.21)	0.373	−0.043	−0.334
8	3.242	(3.11–3.38)	0.419	−0.574	0.636	35	3.111	(2.98–3.24)	0.373	−0.238	0.325
9	3.248	(3.11–3.39)	0.448	−0.470	−0.204	36	3.065	(2.92–3.21)	0.466	−0.331	−0.024
10	3.235	(3.10–3.38)	0.454	−0.581	0.310	37	3.137	(3.00–3.27)	0.406	−0.584	1.252

11	3.386	(3.27–3.50)	0.315	−0.431	0.602	38	3.294	(3.18–3.41)	0.312	−0.039	−0.551
12	3.379	(3.27-3.49)	0.275	0.086	−1.102	39	3.072	(2.94–3.21)	0.433	−0.632	1.244
13	3.373	(3.26–3.49)	0.299	−0.083	−0.867	40	3.124	(2.99–3.26)	0.422	−0.273	−0.102
14	3.340	(3.22–3.46)	0.316	−0.122	−0.697	41	3.386	(3.27–3.50)	0.289	−0.041	−0.985
15	2.974	(2.81–3.14)	0.614	−0.200	−0.763	42	3.216	(3.10–3.33)	0.326	−0.029	−0.311
16	3.052	(2.90–3.21)	0.559	−0.369	−0.361	43	3.072	(2.93–3.21)	0.446	−0.349	0.158
17	3.412	(3.29-3.53)	0.334	−0.572	0.560	44	2.961	(2.82–3.10)	0.443	−0.358	0.383
18	3.229	(3.10–3.36)	0.373	−0.172	−0.529	45	2.915	(2.79–3.04)	0.365	−0.318	0.694
19	3.105	(2.99–3.22)	0.303	0.051	0.186	46	3.176	(3.04–3.31)	0.407	−0.324	0.032
20	3.118	(2.99–3.24)	0.352	−0.229	0.550	47	3.268	(3.15–3.38)	0.301	−0.197	0.904
21	3.268	(3.15–3.39)	0.327	−0.076	−0.478	48	3.176	(3.06–3.30)	0.328	−0.015	−0.207
22	3.242	(3.13–3.36)	0.301	0.057	−0.318	49	3.176	(3.06–3.30)	0.341	−0.049	−0.282
23	3.039	(2.92–3.16)	0.338	−0.003	−0.038	50	3.078	(2.94–3.21)	0.425	−0.223	−0.142
24	3.268	(3.16–3.38)	0.288	0.114	−0.426	51	2.974	(2.84–3.10)	0.391	−0.304	0.545
25	3.124	(2.99–3.25)	0.396	−0.261	0.110	52	3.131	(3.03–3.24)	0.257	0.212	0.546
26	2.993	(2.86–3.13)	0.412	−0.144	−0.096	53	3.379	(3.27–3.49)	0.275	0.086	−1.102
27	3.386	(3.28–3.49)	0.276	0.061	−1.116	54	3.163	(3.04–3.29)	0.346	−0.440	1.472

C.I. (95%): 95% confidence interval / Asym.: Asymmetry.

The univariate descriptors presented in **Table 1** show a distribution of means in the different items between M = 2.915 of item 45 and M = 3.601 of item 3, which poses great stability in the different scores within a very small range.

Following the recommendations of López-Aguado and Gutiérrez-Provecho[40], it was observed that both the significance of Bartlett's sphericity test (χ^2= 5339.17; p = 0.000) and Kaiser-Meyer-Olkin sampling adequacy test (KMO = 0.921) confirm that this setting of the questionnaire in 54 items is optimal and valid.

The results of the Principal Component Analysis show 11 components that exceed a self-value of 1.0, explaining 67.205% of the total variance (see **Table 2**). However, the generated sedimentation graph (see **Figure 4**) allowed verifying that, due to the disproportion of the relevance of the first component, the relevance of the rest of the components was clearly lower. Therefore, we analysed the robustness of this setting of 54 items[36], shortening the spectrum of the instrument to a single component, thus reducing the number of items.

Table 2. Variance of the 54 items explained through the components with a self-value above 1.

Component	Initial self-values			Extraction sums of squared loadings		
	Total	**% variance**	**% accumulated**	**Total**	**% variance**	**% accumulated**
1	20.702	38.337	38.337	20.702	38.337	38.337
2	2.805	5.194	43.531	2.805	5.194	43.531
3	2.542	4.707	48.238	2.542	4.707	48.238
4	1.574	2.914	51.152	1.574	2.914	51.152
5	1.477	2.735	53.887	1.477	2.735	53.887
6	1.331	2.465	56.352	1.331	2.465	56.352
7	1.282	2.374	58.726	1.282	2.374	58.726
8	1.255	2.324	61.050	1.255	2.324	61.050
9	1.168	2.163	63.212	1.168	2.163	63.212
10	1.133	2.098	65.310	1.133	2.098	65.310
11	1.023	1.895	67.205	1.023	1.895	67.205

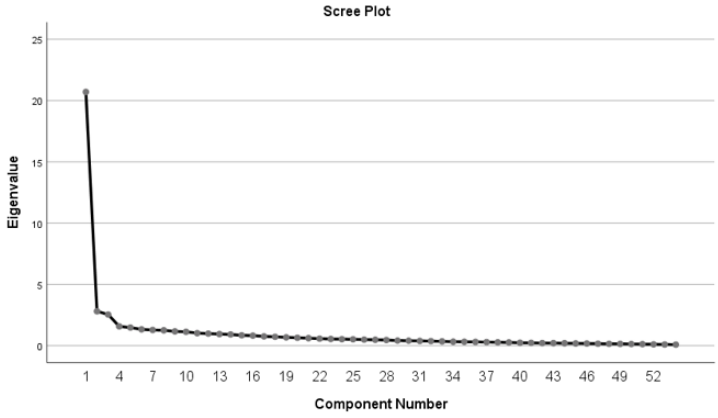

Figure 4. Sedimentation graph of the principal component analysis.

After obtaining the results of the initial factor exploration by Principal Component Analysis, we conducted a Robust Exploratory Factor Analysis for a setting of a unique main factor to evaluate the internal consistency of the *CCIEQ*. Following the recommendations of Lorenzo-Seva and Ferrando[38], the Measure of Sampling Adequacy (MSA) was applied, discarding the items with MSA values below 0.5, which suggest that those items do not measure the same domain as the other elements in the group, thus they should be removed. The results indicate that no item should be discarded, as can be seen in **Table 3**.

Table 3. Factor Loadings and Normed Measure of Sampling Adequacy.

Item	Factor 1 loadings	Normed MSA	Item	Factor 1 loadings	Normed MSA
1	0.405	0.842	28	0.685	0.944
2	0.441	0.853	29	0.747	0.948
3	0.556	0.936	30	0.658	0.922
4	0.509	0.896	31	0.695	0.946
5	0.677	0.945	32	0.740	0.935
6	0.553	0.927	33	0.684	0.947
7	0.551	0.906	34	0.743	0.948
8	0.506	0.895	35	0.682	0.900

9	0.720	0.929	36	0.582	0.895
10	0.637	0.938	37	0.625	0.883
11	0.648	0.933	38	0.722	0.955
12	0.659	0.944	39	0.503	0.927
13	0.649	0.937	40	0.619	0.921
14	0.602	0.917	41	0.634	0.902
15	0.621	0.921	42	0.695	0.908
16	0.619	0.898	43	0.596	0.907
17	0.707	0.924	44	0.448	0.895
18	0.679	0.954	45	0.501	0.904
19	0.584	0.927	46	0.463	0.860
20	0.608	0.930	47	0.648	0.914
21	0.612	0.881	48	0.671	0.913
22	0.654	0.945	49	0.656	0.916
23	0.659	0.932	50	0.515	0.888
24	0.637	0.922	51	0.437	0.923
25	0.725	0.923	52	0.585	0.929
26	0.551	0.920	53	0.563	0.889
27	0.719	0.957	54	0.526	0.906

To verify the number of common factors for this selection of 54 items, Hull Method was conducted applying the Root Mean Square Error of Approximation (RMSEA) as a fit index for selecting a model with an optimal balance between model fit and a minimum number of parameters. Results show, as can be seen in **Table 4**, a unique common factor is the optimal configuration for *CCIEQ*.

Table 4. *Hull method* for selecting the number of common factors for *CCIEQ*.

Number of factors	Goodness-of-fit values	Degrees of freedom	Scree test values
0	0.371	1431	0.000
1	0.080	1377	37.837*
2	0.072	1324	1.032
3	0.065	1272	3.708
4	0.063	1221	0.000

* Advised number of common factors: 1

3.3. Convergent validity

To respond to the third specific objective of this study, i.e., to evaluate the convergent validity of the *CCIEQ* questionnaire with similar instruments that had been previously validated, the global results of *CCIEQ* and CEFI-R[23] show a global correlation of 0.572, with significance above 99% confidence interval. In regard with the specific dimensions, **Table 5** shows the existing correlations between the different dimensions of *CCIEQ* (with their global score) and those of CEFI-R[23].

Table 5. Pearson's correlations between the different dimensions of *CCIEQ* and *CEFI-R*[23].

CCIEQ	***CEFI-R***[23]			
	Concept of diversity	**Methodology**	**Support**	**Community**

Support role	0.209**	0.231**	0.436**	0.305**
Family-school relationship	0.141	0.294**	0.318**	0.333**
Teacher concept of diversity	0.300**	0.282**	0.490**	0.331**
Teacher collaborative work	0.213**	0.218**	0.439**	0.438**
Evaluation for everyone	0.150	0.272**	0.303**	0.278**
Multilevel teaching	0.241**	0.327**	0.375**	0.265**
Inclusive methodology	0.251**	0.365**	0.397**	0.335**
Student collaborative learning	0.168*	0.285**	0.309**	0.235**
Student participation	0.258**	0.325**	0.367**	0.331**
GLOBAL	0.671**	0.478**	0.793**	0.562**
**Significance <0.05 / ** Significance <0.01*				

The results presented in **Table 5** show strong, direct and significant correlations between *CCIEQ* and CEFI-R[23], which is consistent with an adequate convergent validity. Obviously, the correlations between specific dimensions are less significant than the global correlations; however, it is worth highlighting that they are all direct, that most of them are significant (with 99% confidence level), and that the lowest score (family-school relationship and concept of diversity) corresponded to a direct correlation of 0.141.

Regarding the UDL-checklist Test, the global results of CCIEQ and UDL-checklist Test[24,25] show a global correlation of 0.547, with significance above 99% confidence interval. With regard to the specific dimensions, Table 6 shows the correlations between the different dimensions of CCIEQ (with their global scores) and those of UDL-checklist Test[24,25].

Table 6. Pearson's correlations between the different dimensions of *CCIEQ* and UDL checklist Test[24,25].

CCIEQ	***UDL Checklist Test***		
	UDL Principle I	**UDL Principle II**	**UDL Principle III**
Support role	0.364**	0.379**	0.321**
Family-school relationship	0.438**	0.359**	0.254**
Teacher concept of diversity	0.442**	0.411**	0.356**
Teacher collaborative work	0.432**	0.455**	0.392**
Evaluation for everyone	0.452**	0.480**	0.482**
Multilevel teaching	0.422**	0.435**	0.409**
Inclusive methodology	0.469**	0.487**	0.443**
Student collaborative learning	0.423**	0.442**	0.334**
Student participation	0.426**	0.471**	0.450**
GLOBAL	0.506**	0.519**	0.458**
***Significance <0.05 / ** Significance <0.01*			

Once again, the results presented in **Table 6** show strong, direct and significant correlations between the two questionnaires, which is in line with an adequate convergent validity. Obviously, the correlations between specific dimensions are slightly less significant than the global correlations, although it is worth highlighting that all of them are direct and significant (with 99% confidence interval), and that the lowest score (family-school relationship and UDL Principle III) corresponded to a direct correlation of 0.254, thus being statistically significant.

4. Discussion

The main objective of this study was to validate a scale that allows evaluating the conditions required to transform a classroom into an inclusive context. Validation is approached from a triple perspective, evaluating the content, the construct, and the convergent validity.

4.1. Content validity

Regarding the first objective, i.e., to evaluate the content validity of the instrument, it can be asserted that the creation process of *CCIEQ* was thorough. The review of the current literature on inclusive education led to determining the use of nine theoretical dimensions to capture all essential aspects of the conditions under which inclusive classroom practices occur[41–44]. These nine dimensions were quantitatively assessed by means of by means of an adequate CMIN/DF. Besides, in this sense, we reviewed the literature on instruments that evaluate similar aspects with respect to *CCIEQ*[18,22–24] confirming that these nine dimensions should be taken into account in the design of items on inclusive practices. Moreover, once the instrument was created, it was revised by a group of four experts, who were asked to assess the relevance and clarity of each of the items. This group of experts was constituted by faculty members with an extensive background in the scope of inclusive education, who verified the validity, clarity, and adequacy of the proposed items.

4.2. Construct validity

In regard with the second objective of the study, i.e., the evaluation of the construct validity, the Robust Exploratory Factor Analysis and *Hull Method* showed that the design of *CCIEQ* is very robust, as it was not necessary to remove any of the 54 items that initially constituted this instrument, and a unique common factor is the optimal configuration for the instrument[36,37]. Therefore, it can be asserted that the psychometric properties of *CCIEQ* are excellent, and that this instrument is valid for the evaluation of the conditions of a classroom that favours an inclusive education[38].

Compared to the validation of previous similar instruments, the validation process followed by *CCIEQ* is much deeper than the item analysis based on Cronbach's alpha of the ACADI[18], and validation based on the Robust Exploratory Factor Analysis and Hull Method followed in the *CCIEQ* validation implies greater depth and validity than the simple Exploratory Factor Analysis followed by AVACO-EVADIE, for instance. In fact, there is currently no instrument designed to evaluate inclusive practices that include a robust analysis of the items, having generated thousands of matrices to compare and decide the final optimal configuration of the instrument.

4.3. Convergent validity

With respect to the third objective, i.e., the evaluation of the convergent validity of the instrument, our correlation analysis revealed that *CCIEQ* was associated with both CEFI-R[23] and UDL-checklist Test[24,25]. This result was expected, since *CCIEQ* was designed from the other two instruments. Moreover, such correlation was logical, as the three instruments were linked to a broader concept of diversity and to the implementation of inclusive practices in the classroom. However, due to the fact that the validated instrument combines the objectives of CEFI-R[23] and ULD Checklist Test[24,25], it was necessary to ensure that such objectives were not lost with this new contribution. This was confirmed, and it can be asserted that *CCIEQ* measures what it was designed to measure; more specifically, it helps to determine the necessary conditions to create an inclusive classroom, and to verify the extent to which the principles of UDL are present in teacher performance.

5. Conclusions and limitations

Thus, the contribution of the *CCIEQ* is considered to reflect the trends that have been followed to date in determining whether teacher performance is inclusive. As discussed in the theoretical framework, although teacher education influences attitudes, values and beliefs towards inclusion, there are other factors that have a greater or lesser impact on inclusive classroom performance[13]. The *CCIEQ* reveals the conditions that may facilitate or hinder more or less inclusive practice.

It's important to interpret the findings of this study within the context of its inherent limitations. The sample used in this research was derived through a non-probabilistic sampling method. While the inclusion of 153 participants may appear relatively small when assessing the validity of a new scientific instrument, it's crucial to recognize that the international nature of this sample introduces a significant degree of cultural diversity. This international diversity far exceeds that found in studies limited to a single cultural context, where a larger sample size might be advisable for homogeneity[45].

This study's unique strength lies in its European culture sample, consisting of teachers with similar training but representing different countries. This approach acknowledges the need for assessment tools that can transcend cultural differences, as highlighted in prior research, such as the review by Chang and Cochran-Smith[20].

Looking ahead, future studies seeking to replicate the analyses conducted in this study could consider expanding the sample size. This expansion could enhance the generalizability and construct validity of the results by incorporating a broader array of European countries, increasing the number of participants from each country, promoting greater male representation, and providing a more comprehensive representation in terms of years of teaching experience, among other factors[46].

Lastly, to further improve *CCIEQ*, three possible lines of work are identified. The first line of work is related to the dimension "family-school relationship", since it was the factor with the least robust psychometric properties. Of all the dimensions included in *CCIEQ*, this showed the weakest correlation with both CEFI-R[23] and UDL-checklist Test[24,25]. This could be explained by the dimensions and items used, since CEFI-R[23] is focused on the self-perception of teachers, whereas UDL Checklist Test[24,25] is focused on teacher practices, leaving the family partially excluded from these questionnaires. Considering this, we propose improving this dimension as a future objective.

The second line of work would be expanding the focus of *CCIEQ*. In the present study, the context of *CCIEQ* was the classroom. However, despite knowing that social desirability could interfere with the answers given by the participants, it would be interesting to include some dimension related to "distributed leadership"[35]. Therefore, instead of being exclusively focused on the classroom, *CCIEQ* would also contemplate the educational centre. Lastly, the third line of work is related to factor analysis. As a future research line, it would be enriching for the factor structure of *CCIEQ* to perform a factor analysis in each of the dimensions found.

Considering all of the above mentioned, we can state that *CCIEQ* is a reliable and valid instrument for the evaluation of the classroom climate required to implement an inclusive education, through nine dimensions that gather the role of teachers as support, the relationship between the family and the centre, the concept of diversity, teacher collaborative work, student participation, collaborative learning, inclusive evaluation, multilevel teaching, and inclusive methodologies in the classroom.

Taking into account all the factors mentioned above, it is reasonable to assert that the *CCIEQ* has demonstrated both reliability and validity as an instrument for assessing the classroom climate necessary for the successful implementation of inclusive education. This assessment is based on the questionnaire's ability to comprehensively address nine key dimensions:

1) The supportive role of teachers.
2) The interaction between the family and the educational institution.
3) The understanding and embrace of diversity.
4) Collaborative efforts among teachers.
5) Student involvement and participation.
6) Fostering collaborative learning.
7) Implementing inclusive evaluation practices.
8) Utilizing multilevel teaching strategies.
9) Incorporating inclusive methodologies within the classroom.

The *CCIEQ*, by encompassing these dimensions, proves itself as a robust tool for evaluating the essential components of an inclusive classroom climate, thereby contributing to the advancement of inclusive education practices.

Appendix

CCIEQ and *CCIEQ* dimensions can be downloaded freely together with this paper for consultation or scientific use.

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Author contributions

Conceptualization, R.S-C. and M.S-M.; methodology, R.S.C., M.S-M., GP.S-S and E.L-P; software, R.S.C., M.S-M., GP.S-S and E.L-P; validation, R.S-C.; formal analysis, R.S-C.; investigation, R.S.C., M.S-M., GP.S-S and E.L-P; resources, M.S-M.; data curation, R.S-C. and GP.S-S; writing—original draft preparation, R.S.C., M.S-M., GP.S-S and E.L-P; writing—review and editing, R.S.C., M.S-M., GP.S-S and E.L-P; visualization, R.S-C.; supervision, R.S-C., M.S-M.; project administration, M.S-M.; funding acquisition, M.S-M. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest

The authors declare no conflict of interest.

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