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Research Article

Prospective of Intercultural Teaching Competencies in Relation to Technology and Neuroeducation

Alina de las Mercedes Martínez Sánchez [1*]
0000-0003-1170-6976

Antonio Hernández Fernández [2]
0000-0002-7807-4363

Rosa María Esteban Moreno [1]
0000-0002-5462-9571

[1] Pedagogy Department, University Autonomous of Madrid, Madrid, SPAIN
[2] Pedagogy Department, University of Jaén, Jaén, SPAIN
[*] Corresponding author: alina.martinez@uam.es

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ABSTRACT

The objective of this research is to analyze the prospective of intercultural teaching competence in relation to technology and neuroeducation. The research design is nonexperimental, descriptive, explanatory and regression. The sample, by convenience, is formed by students from Spanish and foreign universities, in 605 participants. A Likert scale questionnaire, constructed ad hoc, was applied. The quantitative methodology was developed through automatic linear regression modeling and a decision tree. The most relevant results show that this prospective is possible, determining that it is necessary to promote inclusion and to know the different cultures in the classroom, since they are the reason why intercultural teaching competence will undoubtedly develop, on the other hand, if we want to promote intercultural teaching competence, we must adopt neuroeducation as a basis, being of great help to use technological teaching competences, which in turn must have a neuroeducational character.

Keywords: foresight, teaching competence, interculturality, technology, neuroeducation

INTRODUCTION

Teachers in the 21st century cannot turn their backs on technologies because they coexist in the world and are a resource, never an end, for the development of teaching. Their use has been standardized as an essential tool for the improvement of the educational process and quality, since they adapt teaching processes to the times in which we live (Armas-Alba & Alonso-Rodríguez, 2021). On the other hand, Cebrián de la Serna and Gallego Arrufat (2011) state that the irruption of ICT is modifying educational processes at all levels and is causing a new revolution, that of knowledge. This revolution requires a different reconfiguration of the social, cultural, and economic aspects of institutions in order to improve the interaction and communication of the different strata to create a collective thinking (Cabero, 2008), being necessary to have innovative materials and resources that contribute to active learning (Armas & Alonso, 2013).

Competencies can be developed to employ knowledge and skills focused on the various projects that can be undertaken in the classroom. Consequently, they are also carried out to solve certain problems that may arise and even in situations that require prior knowledge. However, on specific occasions, the competencies may not be as effective in the short term as the teacher expected, therefore, the teacher may tend to be demotivated by the lack of time that this may entail to reach their achievement, or because the result in the acquisition of competencies has not been acquired in its entirety by the students as expected. According to

Monereo and Pozo (2007), competencies can be concentrated in three categories: person, society-knowledge, and systematic skills. On the other hand, in the personal area, this can be classified into two competencies, the learning to learn competency and the sense of initiative and entrepreneurship competency. If we focus on the category of society, this is grouped in the social and citizenship competence, since this competence allows the individual to be able to interpret various problems that may be focused on society, in order to solve these problems satisfactorily and therefore the students can make decisions.

According to Espinoza-Freire and León-González (2021), since the 1990s, the topic of interculturality has gained special relevance worldwide; an interest awakened by several factors, namely, the current migratory currents, the technological development that has had an impact on communication at a global level and the vindication of native people. Meyer (1994) enriches this concept, understanding intercultural competence, as part of a broad competence of the speaker of a foreign language, identifies a person's ability to act appropriately and flexibly when confronted with actions and expectations of people from other cultures. Bartolomé (2002) has stated that education has to assume two fundamental responsibilities: the fight against all forms of social exclusion and the search for educational strategies that favor the development of values, and participation in a common project of society where each person has his or her place, responsibility, and task.

On the other hand, neurosciences are growing research centered on the neural foundations of learning, memory, emotions and different functions of the brain, the outcomes of which have high pertinence in the field of learning (Bowers, 2016; Howard-Jones, 2014). The development of neuro-education promotes to the progression of educational innovation, including the development of educational systems. Besides, teacher students must master high-skill competences (higher-order thinking capabilities and cooperation competences) and information and communication technologies (ICT) competences (technological, pedagogical, and ethical) because this resource is crucial for student education (Prat et al., 2004). The purpose of this research is to show the relationship between teaching competencies, specifically social, through intercultural competence with technology and neuroeducation.

THEORETICAL BACKGROUND

On Technological Competence, Neuroeducation, Intercultural Education, and Teacher Training

The university, since the Bologna plan, has conceived teaching based on the competencies that are also reflected in early childhood and primary education. The competencies have been and continue to be a main source of development so that everyone can acquire these competencies, and therefore be able to know and acquire a series of knowledge through various resources, so that students can be able to cope with certain problems that may arise throughout their life path or even in the activities they intend to perform in their daily lives.

In the field of education, according to Pérez (2007) argues that emotional, affective and instrumental skills must be worked on constantly and on a daily basis in educational centers. In schools, competencies can be developed to use knowledge and skills focused on the various projects that can be undertaken in the classroom.

According to Monereo and Pozo (2007), competencies can be concentrated in three categories: person, society-knowledge, and systematic skills. On the other hand, in the personal sphere, this can be classified into two competencies, the competency of learning to learn and the competency of the sense of initiative and entrepreneurship.

Regarding the first competence, it should be noted that the person can learn by him/herself and acquire knowledge during the time he/she needs, while, if we focus on the second competence, it allows organizing the projects that are intended to be carried out in the future, with the objective that the students can achieve the planned objectives.

If we focus on the category of society, this is grouped in the social and civic competence, since this competence allows the individual to be able to interpret various problems that may be focused on society, in order to solve these problems satisfactorily and therefore the students can make decisions. Finally, the

category of systematic skills is grouped into various competencies: linguistic competence, mathematical, scientific, and technological competence, ICT competence and competence of cultural and artistic expression. Regarding the ICT competence, the use of technologies in a safe and effective way for the acquisition of knowledge is allowed in the classrooms of the educational center.

Levi-Montalcini (2016), Nobel Prize in physiology in the year 1986, stated that the goal is "to see the members of the new generation become actors and not just spectators on the world stage of life" (p. 25) and to achieve that goal it has been fundamental in recent years the development of neuroeducation that gives prominence to cognitive processes from what we know of the brain.

Neuroeducation, which arises through psychology, neuroscience, and education (Tokuhama-Espinosa, 2010), is bringing to the field of education a favorable development for student learning and that this learning is optimally organized, since the brain is structured so that we, humans, can learn actively (Sousa, 2014).

The "Definition and Selection of Competences (DeSeCo)" project of the OECD (2002), tried to set out a common framework for the definition of competences so that people can lead a social and personal life in a conscious and successful way. The basic competency allows all students to reach the minimum content they need to know in order to understand the contents proposed in the training stage. The competence allows teachers to raise a series of questions to develop a learning process in the students as favorable and optimal as possible, therefore, they must be carried out before, during and after the content to be taught.

One of these basic competencies are digital competencies, and specifically technological and pedagogical competencies since these affect the teaching profession to a greater extent. Technological competence relates to their ability to use technology in a fluent way to encourage students to reflect that use in their academic and personal lives (Rúa Rodríguez et al., 2022). Following Vanek (2017), this competence is evidenced as fundamental in the so-called 21st skills (21st century skills) (P21-Partnership for 21st Century Learning, 2017). This set of competencies have been developed with input from teachers, education experts and business leaders to define and illustrate the skills and knowledge that people need to succeed in work, life, and citizenship, as well as the support systems needed for 21st century learning outcomes, with their development being an increasingly present claim in adult education (Boeren, 2016; Holford et al., 2012). This digital competence has to be put at the service of the type of school, where students with different origins, cultures, backgrounds, values… have to interact on a daily basis, so that intercultural competence becomes very necessary.

It seems to us that intercultural competence is a valuable and undeniable resource for this purpose (p. 36). In this way, intercultural competence, due to the knowledge attitudes, and skills it entails, its effects on the person and on the environment in which it manifests itself, can be a key resource for the exercise of citizenship in a plural society (Aneas, 2005).

Mora (2013) states that teachers and neuroscientists should contribute to develop activities, knowledge, and strategies, in order to undertake and improve learning at school. In addition, this author emphasizes that children should begin to learn through sensations, emotions, movement, and that play fosters curiosity towards learning. According to Segovia (2016), neuroeducation is based on neuroscience, which develops the connection and functions of the brain. This pedagogical discipline allows guiding teachers in their teaching, since it allows them to know and deepen their knowledge about the functioning of the brain, to be able to design and use various activities for their students to work on. As for the student, neuroeducation allows him to enhance his way of thinking, learning, and developing various useful activities throughout his life.

Neuroeducation allows research into how the human brain can develop and promote people's learning to the maximum, since all learning involves changes in brain structures (Cosenza & Guerra, 2011). Neuroeducation focuses on the various changes that can occur in the human brain in terms of educational strategies and technologies, so it provides as a fundamental competence the technological competence that must be developed in both teachers and learners to reach learning in an optimal way.

METHODOLOGY

This research is based on the general objective of analyzing the prospective of intercultural teaching competencies in relation to technology and neuroeducation. It is based on a non-experimental, descriptive,

Table 1. Dimensions and items

Dimensions	Items
A.-Cultural competence	A1.-Knows the different cultures in the classroom. A2.-Uses methodologies that involve all students. A3.-Foster the knowledge of diverse cultures among all and for all. A4.-Fosters educational inclusion in their teaching practices. A5.-They are concerned about investigating the different ways of thinking and reasoning of students from other cultures.
B.-ICT	B6.-Implements technology in the didactic programming. B7.-Uses computers and software in the classroom. B8.-Integrates mobile applications in their daily work. B9.-Knows not only the technologies but also how to apply them in the classroom. B10.-Investigates the brain mechanisms that facilitate access to technologies by their students.
C.-Neuroeducation	C11.-Neuroeducational knowledge is necessary in intercultural classrooms. C12.-The contributions of neuroeducation are key in current technology. C13.-A 21st century teacher should be trained in neuroeducation. C14.-The intercultural competence of a teacher depends on his or her knowledge of neuroeducation. C15.-The technological competence of a teacher depends on his or her knowledge of neuroeducation.

explanatory and regression design, using decision trees. The methodology is quantitative, and the reference is an interpretative paradigm. To carry out the research, an *ad hoc* Likert scale was used as a research instrument, dimensioned and with five response options. **Table 1** shows the questionnaire to examine cultural competence, ICT competence, and neuroeducation relationship.

The research context focuses on final year students from Spanish and foreign universities, of which, for convenience, the universities of Jaén, Complutense de Madrid, and a group formed by (Universidad Camilo José Cela, Universidad International de la Rioja, Universidad de Alcalá de Henares, Universidad de Granada, Universidad Autónoma de Barcelona, Universidad de Alicante, Universidad Alfondo X El Sabio, Universidade Estadual de Pernambuco (Brasil) have been selected, which makes up three samples, the first with 370 subjects (Jaén), 160 participants (Universidad Complutense de Madrid) and a third of 75 students from the rest of the universities. A total of 605 participants were enrolled in this study.

The dependent variable is intercultural competence, and the independent variables are technological competence and neuroeducation. The hypotheses established are, as follows:

1. **H0:** It is not possible to establish a prospective of intercultural teaching competencies in relation to technology and neuroeducation.
2. **H1:** It is possible to establish a prospective of intercultural teaching competencies in relation to technology and neuroeducation.

The Likert scale was designed with a table of operationalization, considering the research objective and the study variables, with response options from 1 (lowest value) to 5 (highest value), on the other hand, the validation was carried out, in a first stage of content, with an expert judgment and pilot test, secondly, a factor analysis was performed to validate the scale in its construct using SPSS v25 software. The reliability analysis was calculated with Cronbach's alpha, giving a score of 0.962 for the fifteen items that make up the scale, which is considered excellent (George & Mallery, 2003).

RESULTS

The research results, presented here, come from automatic linear regression modeling and decision tree modeling. To respond to the research objective, an automatic linear regression model has been proposed (**Figure 1**), since an automatic linear model predicts a continuous target, based on linear relationships between the target and one or more predictors, for this case dimension A (intercultural teaching competence) has been selected, with the weight of the analysis being the participating universities.

Target	A.- Intercultural teaching competence.
Automatic Data Preparation	On
Model Selection Method	Forward Stepwise
Information Criterion	-1.370,273

The information criterion is used to compare to models. Models with smaller information criterion values fit better.

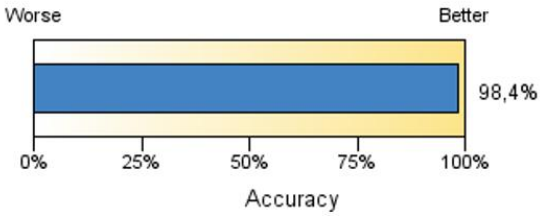

Figure 1. Model summary

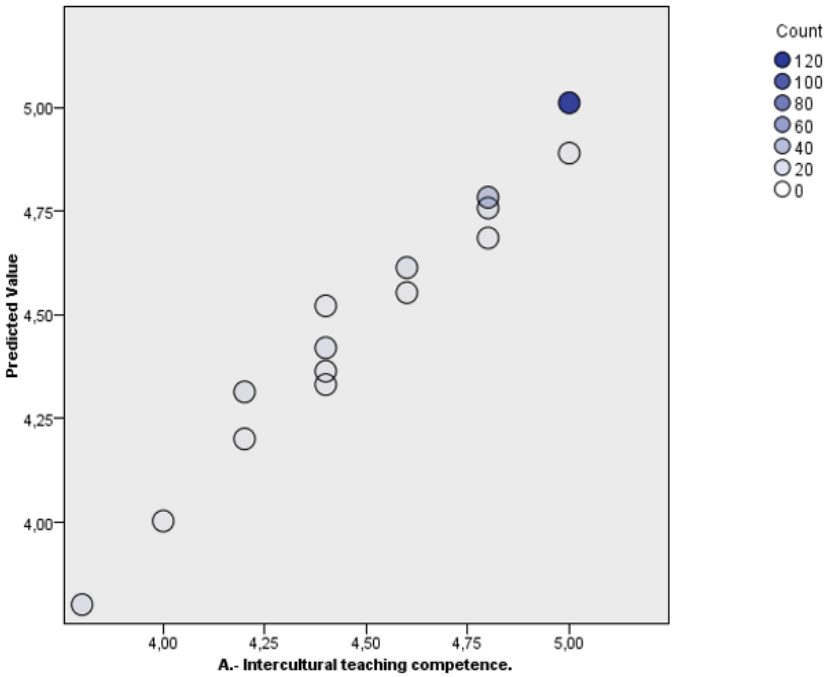

Figure 2. Scatter diagram

The accuracy of the model is 98.4%, so there is no need to modify it and we can say that the effect is good, with a very high accuracy. On the other hand, the dispersion of the data has been determined, which can be seen in **Figure 2**. The scatter plot shows a 45-degree line distribution, so the effect is good.

Lastly, **Figure 3** shows the importance of the predictor.

Finally, it was decided to corroborate the results obtained by the regression model with a decision tree. The decision tree is a graphical way of representing the events that may arise from a decision taken at a certain time, i.e., it helps in decision making based on probabilistic support (Berlanga et al., 2013). The dependent variable selected is dimension A (intercultural teaching competence), the independent variables being dimensions B and C, and as an influence variable the participating universities have been taken, the result is shown in **Figure 4**.

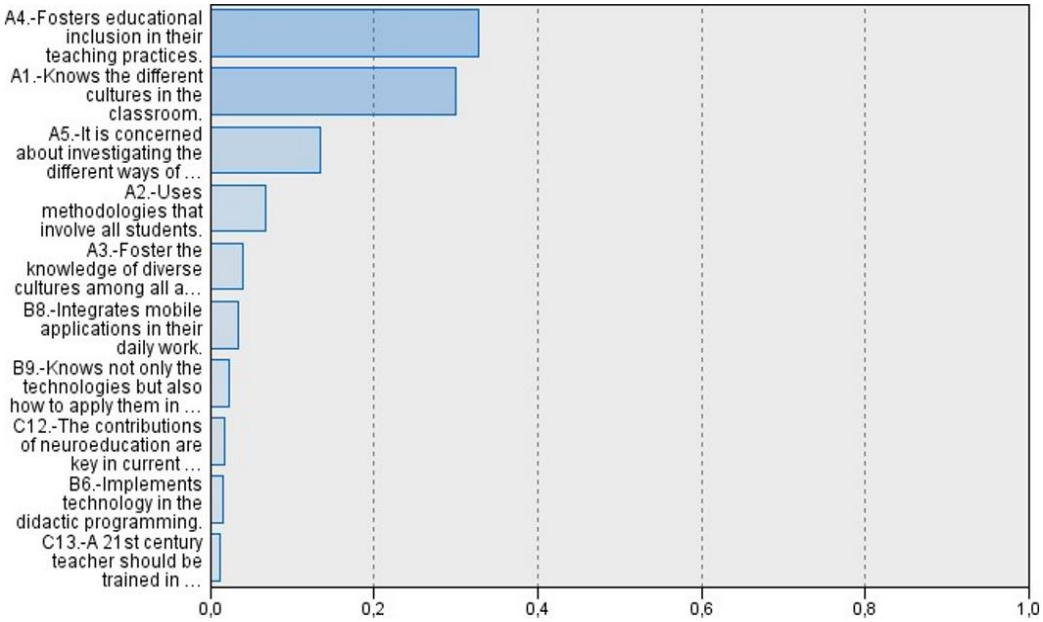

Figure 3. Importance of the predictor

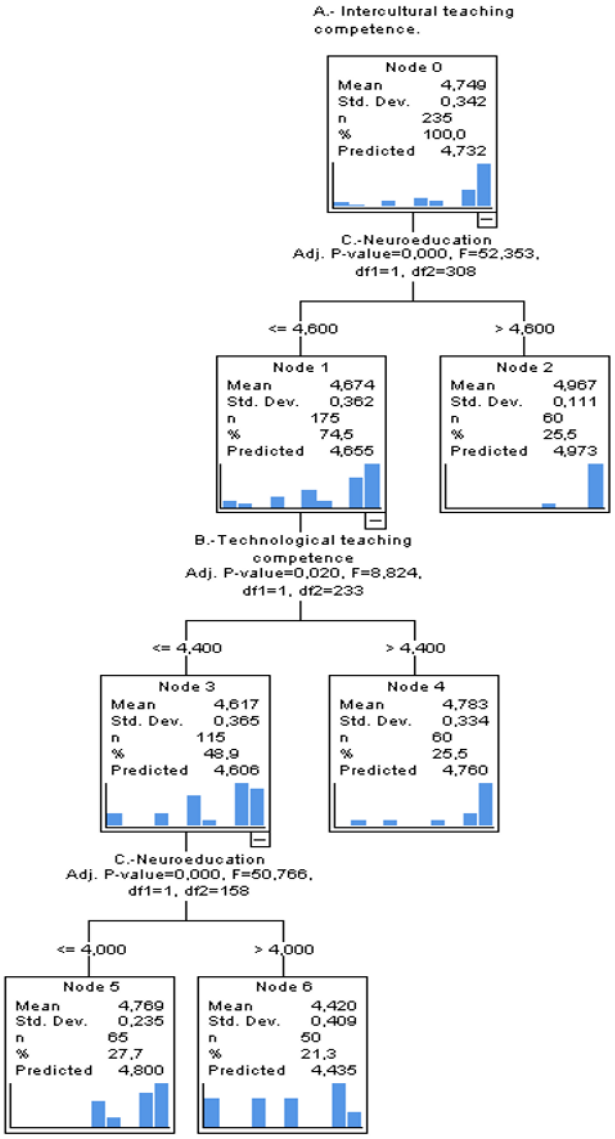

Figure 4. Decision tree

The decision tree starts from intercultural teaching competence, node 0, observing that the students at the different universities consider that they "strongly agree", 100%, on the importance of neuroeducation in intercultural competence. Nodes 1 and 2 are derived from node 0. We take node 1, where 74.5% of students "strongly agree" on the importance of technological teaching competence. From node 1, node 3 and node 4 are derived, of which we take node 3, observing that 48.9% of the participants "strongly agree" on the need for neuroeducation within the technological teaching competence.

DATA ANALYSIS

The first data come from the exploratory factor analysis to which the scale was subjected, so that, first, the correlation matrix was studied to check whether the data are suitable for a factor analysis. For this purpose, the matrix must have a certain structure.

To check this, the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO coefficient) was used, in this case the value is .939, following Kaiser (1974) the value is excellent, Bartlett's test of sphericity has a significance of .000, and the value of the determinant is 4.441. On the other hand, the analysis of communalities showed that no item had to be eliminated, and the extraction of factors resulted in two factors, where the first one gives a reliability of .963, higher than that of the original scale, and only with thirteen items, and not the original fifteen.

In contrast, the automatic linear regression modeling, with an accuracy of 98.4%, informs us about which variables we must take into account to confirm the success of the model, thus, the key is to promote educational inclusion in teaching practices, as well as to learn about the different cultures in the classroom. On the other hand, in order of importance, teachers should be concerned about investigating the different ways of thinking and reasoning of students from other cultures; use methodologies that involve all students; promote knowledge of different cultures among all and for all; integrate mobile applications in their daily work; know not only the technologies but also how to apply them in the classroom; take into account that the contributions of neuroeducation are key in current technology; implement technology in the didactic programming; and finally, a 21st century teacher should be trained in neuroeducation.

On the other hand, with the intention of clarifying the prospective of intercultural teaching competence in interaction with technological teaching competence and neuroeducation, the decision tree shows that, if it is decided to take intercultural teaching competence into account, neuroeducation accompanies this decision, and in turn, implies technological teaching competence, which to a large extent implies neuroeducation.

DISCUSSION

The relationship between intercultural teaching competence, technological teaching competence and neuroeducation, from a prospective point of view, is the key to this research or, in other words, do neuroeducation and technology have a positive influence on the future development of intercultural competence. The results allow us to confirm the alternative hypothesis and answer the question posed in the affirmative. The most interesting contributions of this research can be placed in three key ideas.

To be able to work in a multicultural setting, people in every industry should have intercultural competence (Durko & Martens, 2021; Stefanova & Jiménez, 2019). For instance, teachers need to have an individual intercultural skill to react to learner's needs founded on their understanding for otherness and difference (Smolcic & Arends, 2017).

Consequently, raising intercultural awareness of professionals regarding the target population, culture, or behavior, will assist them better correct to work setting (Limoges et al., 2019; Wang et al., 2020). There are some studies in which scholars stated their positive experiences on applying educational technology to generate intercultural learning situations across specific academic or professional settings. For instance, a study by Shadiev et al. (2020) showed that intercultural learning supported by virtual reality technology helped facilitate intercultural competence development. Akdere et al. (2021) suggest the importance of immersion (even when mobility is not possible) in developing intercultural competence and the potentials of VR technology in advancing intercultural learning. Likewise, telecollaboration offers an effective teacher training venue that affords teacher trainees with first-hand intercultural encounters to engage with otherness and

prepare for their ethnolinguistically diverse classrooms (Uzum et al., 2020) The first is the possibility of having a Likert-type questionnaire, reliable and validated not only in content but also in its construct, which allows research to be conducted on these competencies and their relationship. Secondly, that fostering inclusion and knowing the different cultures in the classroom are the reason why intercultural teaching competence will undoubtedly develop, and finally, if we want to foster intercultural teaching competence, we must adopt neuroeducation as a basis, being of great help to use technological teaching competences, which in turn must have a neuroeducational character.

These results are in line with Senkbeil (2022) showing the underlying relationships between the motivational constructs and the development of ICT competence, in consequence, intercultural teacher training continues to be a challenge (Figueredo-Canosa et al., 2020). Some researchers (Fong, 2020; Sjøen, 2021; Zhu et al., 2019) demonstrate that cross-cultural practicums can facilitate intercultural learning in teacher education.

The results are in line with the ideas of Espinoza-Freire and León-González (2021) on the relevance of interculturality, as well as the ideas of Meyer (1991), where intercultural teaching competence identifies the ability of a teacher to act appropriately and flexibly when confronted with actions and expectations of people from other cultures. According to Romijn et al. (2021), the there is a need to increase the intercultural competence of teachers, for example, through the development of service-learning activities.

CONCLUSION

The objective of this work to investigate the prospective of intercultural teaching competences, in relation to teaching competence in technology and neuroeducation, has been investigated in a population of 605 university students from Spanish and foreign universities, shows the viability of this prospective, taking into account the importance of adopting neuroeducation as a basis in interculturality, and the support of technological teaching competence, to which neuroeducation is assumed to give it a scientific character. The first conclusion that can be highlighted is the need to promote educational inclusion in the classroom, as well as the knowledge of the different cultures in the classroom. Thus, a teacher who is not inclusive or who is unaware of the diversity of the student body will not be able to develop intercultural competence. The second conclusion revolves around the use of methodologies that promote not only inclusion but also technologies, in this way mobile applications and having training to integrate technologies into the teaching program are key to intercultural teaching competence. Finally, neuroeducation is the basis, both in interculturality and in technology itself, to consider a teacher trained in interculturality.

With all this, we can highlight as a conclusion, derived from the quantitative research data, that being able to make a future forecast is somewhat complicated, but based on the data obtained, it is possible to say that by training teachers in educational inclusion and knowing the different cultures that coexist, it is possible to acquire and develop intercultural teaching skills. This idea, although it may seem obvious, is not, because when a teacher attends a training course or works on inclusion in the classroom, he/she is not going to develop intercultural competencies, to reach this point, he/she needs to interact inclusion with culture, something that is not usually done. On the other hand, a teacher does not usually take neuroeducation into account when working on inclusion or multiculturalism. Our study reveals the need for neuroeducation and technological competence for this intercultural teaching competence, something that had not been investigated so far.

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Data availability: Data generated or analyzed during this study are available from the authors on request.

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