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Taming the duality of disability. Critical cultural-historical tools to disrupt equity paradoxes

Mitigando la dualidad de la discapacidad. Herramientas histórico-culturales críticas para desestabilizar paradojas de equidad

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Abstract:

I build the core argument of this article on the premise that disability has a dual nature: it affords protections to people with disabilities while it can also be used as an artifact of marginalization; thus, creating justice paradoxes. For instance, disability's potential to oppress tends to target already marginalized groups, such as racialized people and students from nondominant linguistic, socioeconomic or ethnic backgrounds. Thus, a concept available to safeguard vulnerable groups (i.e., disability) can be deployed to segregate or deny educational opportunities. The purpose of this article is to offer theoretical tools to dissect disability's potential for harm and inspire alternatives to address equity paradoxes that may emerge from this phenomenon. I focus on racial disparities in disability identification as a case in point to contextualize the presentation of theoretical tools. First, I contextualize my analysis with an overview of racial disparities in disability identification. Next, I outline three theoretical tools to advance a critical cultural-historical framework: (1) trace the fluidity of disability, (2) expose the color of knowledge and its implications, and (3) make visible the role of ideologies through a DefectCraft lens. I close with reflections for the next generation of scholarship.

Keywords: disability, intersectionality, difference.

Resumen:

Desarrollo el argumento central de este artículo sobre la premisa de que la discapacidad tiene una naturaleza dual: ofrece protección a las personas con discapacidades, pero también puede utilizarse como un artefacto de marginación y, por tanto, crear paradojas de justicia. Por ejemplo, el potencial de la discapacidad para oprimir tiende a dirigirse a grupos ya marginados, como las personas racializadas y los alumnos de entornos lingüísticos, socioeconómicos o étnicos no dominantes. De este modo, un concepto disponible para

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proteger a grupos vulnerables (por ejemplo, la discapacidad) puede aplicarse para segregar o negar oportunidades educativas. El propósito de este artículo es ofrecer herramientas teóricas para diseccionar el potencial dañino de la discapacidad e inspirar alternativas para abordar las paradojas de equidad que pueden emerger de este fenómeno. Me centro en las disparidades raciales en la identificación de discapacidades como un ejemplo concreto para contextualizar la presentación de las herramientas teóricas. En primer lugar, contextualizo mi análisis con una descripción general de las disparidades raciales en la identificación de discapacidades. A continuación, defino tres herramientas teóricas para desarrollar un enfoque histórico-cultural crítico: (1) explorar la fluidez de la discapacidad, (2) exponer el color del conocimiento y sus implicaciones y (3) visibilizar el papel de las ideologías mediante una lente de *DefectCraft*. Termino con varias reflexiones para la próxima generación de investigaciones.

Palabras clave: discapacidad, interseccionalidad, diferencia.

1. Introduction

Disability has been present throughout the history of humanity (Stiker, 2009). It is interesting that despite the ubiquity and vulnerabilities associated with this condition, responses to disability across societies and communities have been ambiguous. That is, disability often becomes an object of protection that triggers responses such as legal protections and access to resources. At the same time, however, it has been used as a tool of oppression; e.g., to segregate and limit educational opportunities. As disability historian Baynton (2001) explained, "the concept of disability has been used to justify discrimination against other groups by attributing disability to them" (p. 33, emphasis in original). I have described this ambiguity as the dual nature of disability (Artiles, 2011).

Disability's duality is at the center of various forms of educational inequities that have persisted for generations. For instance, racial, ethnic or linguistic disparities in disability identification rates have been documented in the U.S.A. since at least the 1960s. These disparities, in turn, forge equity paradoxes in which the protective facet of disability (i.e., access to services and interventions) can create inequities for other groups (e.g., racial, ethnic, or linguistic groups) (Artiles, 2003). For instance, researchers have documented how minoritized students can be placed in more segregated programs than their white peers with the same diagnosis (Skiba et al., 2008). Disability identification patterns have also been associated with differential access to services across racial groups (Artiles et al., 2016). Other factors also shape the stratifying power of disability identification. English learners, for example, have a greater likelihood of disability diagnosis than English proficient peers in low-poverty schools (Artiles et al., 2005).

I should note paradoxes of equity stemming from societal responses to disability are also found in the literature on inclusive education. For instance, inclusive education systems in certain European societies may be used as a mechanism for segregation (Artiles et al., 2011) or legitimize the othering of certain groups; see for example studies conducted in Spain (García-Sánchez, 2016; Harry et al., 2008). In the Global South, inclusive education has spread rapidly from Western nations. Indeed, the adoption of inclusive education policies in the Global South can be regarded as a sign of progress. However, an emerging literature suggests we must deploy a cultural historical perspective to understand whether these processes of knowledge transfer are truly enhancing educational opportunity (Artiles et al., in press). Evidence from Global South nations offer cautionary notes and remind us that inequities can be reified in the name of inclusive education (Kalyanpur, 2020; Singal & Muthukrishna, 2014).

To summarize, disability encapsulates a duality that protects and marginalizes vulnerable groups. This duality creates justice paradoxes that educational leaders, policymakers and researchers must anticipate and address across geographical regions. The purpose of this article is to offer theoretical tools to dissect and (re)frame disability's duality and inspire alternatives to address equity paradoxes that may emerge from this phenomenon. I focus on racial disparities in disability identification as a case in point to contextualize the theoretical framing and discussion of tools. I invite readers to consider adjusting and applying this analytical lens to other markers of difference (beyond race) and permutations of educational inequalities (different from identification disparities). My expectation is that these contributions will offer productive options to engage with this multidimensional phenomenon and transcend polarized and color-neutral views that only perpetuate unjust conditions (Skiba et al., 2016). Next, I present an overview of the wicked problem of racial disparities, followed by a discussion of three theoretical contributions to frame and address this problem.

2. Setting the context: Racial disparities in disability identification

Racial disparities in disability rates have been debated in the U.S. for over half a century. These disparities are observed in the categories described as *subjective* due to the role of clinical judgment involved in diagnosis. These categories include specific learning disabilities (SLD), emotional disorders (ED), and mild intellectual disabilities (ID). African Americans and Native Americans are the most affected groups at the national level. Nevertheless, alternative patterns of over- and under-representation are observed at different scales of the education system (region, state, city, school district, school). The National Academies of Sciences, Engineering, and Medicine (NASEM) commissioned two consensus panel reports in a two-decade period (Donovan & Cross, 2002; Heller et al., 1982) and confirmed the persistence of this problem. The 1982 panel emphasized identification and offered a thoughtful framing. Specifically, Heller et al. (1982) stipulated that disproportionality

> is a problem (1) if children are invalidly placed in programs for mentally retarded students; (2) if they are unduly exposed to the likelihood of such placement by virtue of having received poor-quality regular instruction; or (3) if the quality and academic relevance of the special instruction programs block students' educational progress, including decreasing the likelihood of their return to the regular classroom. (p. 18)

Explanations of the problem cover a range, though two stand out. One stresses racial biases driven by historical deficit views of these groups which add stigma to already marginalized groups. In contrast, others assert that racialized learners are overidentified because of disproportionate poverty rates affecting these groups, which in turn inflict developmental threats to these children, ultimately resulting in disabilities. Racial disparities have been described as an equity paradox: the equity response afforded by the Individuals with Disabilities Education Act (IDEA) to protect the rights of learners with disabilities can constitute a new inequity for racialized students, particularly if disability identification results in segregation or differential access to services compared to white peers (Artiles, 2019).

Myriad factors mediate racial disparity patterns such as policy and administrative procedures (including compliance), racial bias, access to quality education and teachers, shortcomings in assessment tools and procedures, socioeconomic barriers at home or communities, structural and cultural-historical factors (Donovan & Cross, 2002; Heller et al., 1982). There is a lack of attention to the role of contextual and structural influences. For instance, the following findings suggest contextual analyses are needed to refine our understanding of this complex problem: identification odds for racial groups vary depending on their representation in the school or district enrollment, the disability category under consideration, or the location of the school (Fish, 2019; Oswald et al., 2002). The role of poverty in the prediction of disability identification depends on the measures used (Cruz & Rodl, 2018) and histories of race relations in the community are associated with school racial disparities (Tefera et al., 2023).

The persistent visibility of this problem led to amendments in IDEA to monitor and correct racial disparities in disability identification and discipline (IDEA, 1997). States submit to the federal government annual reports with rates of identification, placement outside general education classrooms, and discipline patterns by race/ethnicity. Early implementation of these policy requirements made evident the need for additional guidance. Despite subsequent policy refinements, questions and concerns have been raised in the intervening years (Albrecht et al., 2012; Cavendish et al., 2014). For instance, *significant disproportionality* is not defined in IDEA. Thus, there is variability in how states make this determination. This means there is a range in the thresholds used to mark disproportionality across states. "The latitude afforded to states in defining, monitoring, and addressing disproportionality results in significant variance in terms of what counts as disproportionality and whether it is sufficiently addressed through IDEA" (Tefera et al., 2023, p. 371).

In summary, racial disproportionality is a problem of policy and practice that has affected the U.S. educational system for generations. Technical, historical, cultural, and contextual forces shape the magnitude and longevity of this phenomenon (Artiles, 2019).

3. Critical cultural historical (re)framings

I submit that a critical cultural historical lens is needed to examine and understand the duality of disability and its concomitant equity paradoxes. Attention to the critical helps us catalog the role of power and hierarchies that permeate human affairs. Considering that people with disabilities have been historically marginalized and that the idea of disability has been deployed to discriminate groups in the past, it is imperative to account for a critical dimension when studying racial disparities in disability identification. In addition, framing disability through a cultural lens enables us to situate analyses in the contexts of school local practices and staff's interpretive processes when engaging with the notion of disability. Finally, a historical perspective is required to document how the meanings and uses of disability have changed over time in the settings we analyze. This will help elucidate whether narrow or color neutral framings might mediate current local uses and practices germane to disability. In addition, a historical mindset is necessary to account for the genealogy of disability and its common sense; i.e., how legacies of disability that may empower or oppress this group might be sedimented in local contexts. These assumptions permeate the three theoretical interventions I describe next that can be used to analyze the dual nature of disability and attendant equity paradoxes in the context of racial disparities in special education.

3.1. Of boundary objects: tracing the fluidity of disability

I conceptualize disability as a boundary object given its shifting meanings and uses across contexts. Boundary objects

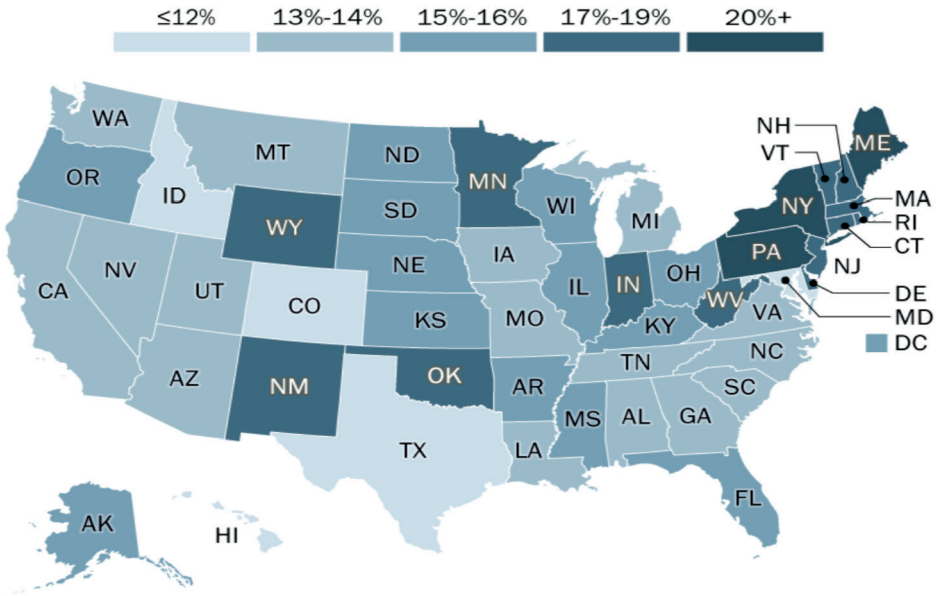
> have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means to translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds. (Star & Griesemer, 1989, p. 393)

In the context of the U.S. special education system, disabilities have standard definitions and identification parameters. At the same time, states create their own administrative guidelines and operationalize definitions. This allows states to coordinate the work of special education systems across school districts and when providing reports to the federal government, though substantial variability is embedded in these systems. This is reflected in the proportions of students with disabilities identified in the nation. Figure 1 shows a substantial range from less than 12% to over 20% of all students identified with disabilities across states. How do we interpret the variability between states like Colorado and Pennsylvania showing substantial differences in disability identification rates? Is it explained by the assessment guidelines or eligibility criteria of each state? The range of diagnostic rates illustrates the nature of disability

as a boundary object that is shaped by local histories, policies, and practices; as Star and Griesemer (1989) explained, a boundary object "does not accurately describe the details of any locality or thing" (p. 410).

We find, therefore, that state definitions and guidelines to identify disabilities at the state level are overlaid with the federal policy definitions and requirements. Additional sources of variability might be infused at the school district level, which may not fit neatly with scientific definitions. The overlaying of alternative views of disability with their attendant procedures and practices across settings as if they have the same meaning is described as "categorical alignment" (Epstein, 2007). In turn, these alignment processes facilitate the coordinating work

FIGURE 1. Students with disabilities as a share of all public-school students, 2021-2022.



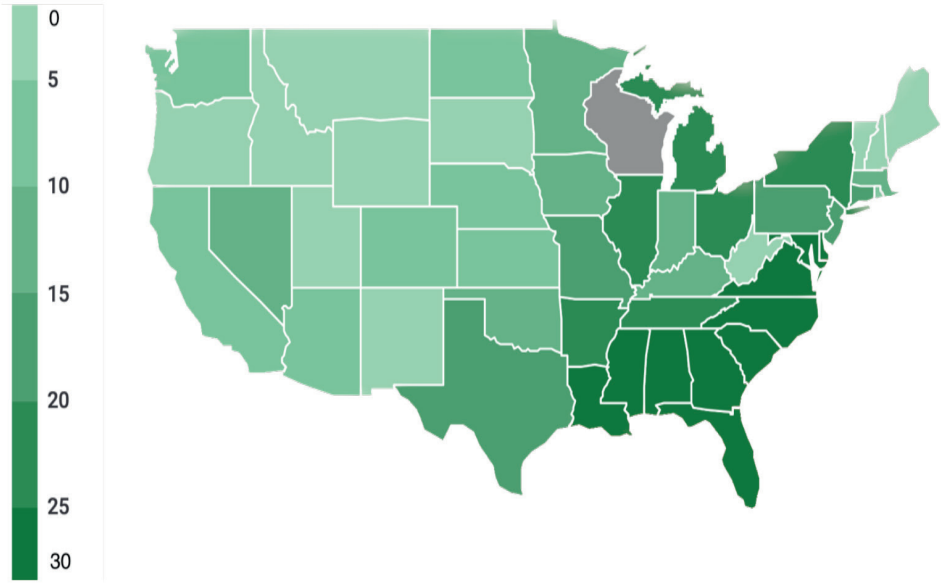
Source: National Center for Education Statistics (as reported by Schaeffer, 2023).

of boundary objects like disability. Categorical alignment smooths out the liminal spaces and opacities among differences in meaning and alternative procedures to monitor or measure the concept of disability; we know categorical alignment has been successful when "it becomes invisible in hindsight" (Epstein, 2007, p. 92). However, categorical alignment is not necessarily a harmonious and coherent process. To illustrate, the definition of SLD that prevailed for many years in the U.S. focused on a significant and unexpected discrepancy between ability and performance levels. Gradually, researchers documented the limits of the discrepancy model and began to examine how students responded to systematic evidence-based interventions and monitoring as a means of identification (Bradley et al., 2002). Nevertheless, evidence suggests school districts continue to struggle to address equity issues in the contexts of these intervention models (Cavendish et al., 2016; Sabnis et al., 2019).

The concepts *boundary object* and *categorical alignment* make visible the multiple interpretive spaces and ambiguities that coexist to coordinate the labor of professionals across organizational contexts (i.e., schools, districts) and preserve the coherence of institutional systems. Needless to say, such systems leak and have equity consequences. Let us return to the problem of racial disparities in disability identification (Donovan & Cross, 2002). Figure 2 presents the proportion of African American students with disabilities relative to their representation in the school population. There is considerable variability in these data though it is clear that Southeastern and some Midwestern states tend to identify a larger proportion of African American learners with disabilities. Beyond questions of diagnostic accuracy, heterogeneities within student groups, and educational opportunities, I argue we should also analyze the shades of disability in these states at the micro (classroom), meso (school, district), and macro (state) levels. In other words, as a boundary object, disability has slightly different meanings and operationalization practices across scales and settings. We should trace how understandings of disability, interpretations of student behaviors, kinds of activities and routines used to index competence at the classroom level align (or not) with the views, interpretations and activities used to diagnose disability at the school and district levels, and how these understandings align (or not) with the state's classificatory framework. In short, we must document the categorical alignment of disability across these spheres of activity to chart potential discoordinations, misinterpretations, and misunderstandings that might mediate schools' and districts' recording and reporting practices.

The analysis of disability identification by race represents a form of "niche standardization" (Epstein, 2007) in which the educational system organizes populations into standardized objects for scientific, administrative, and equity purposes. The standardization normalizes at the group level, thus avoiding universalist and individualist framings (Epstein, 2007). For equity purposes, the education system tracks disabled learners by types (e.g., intellectual,

Figure 2. Percentage of African American students with disabilities by state and state population estimates of African American (ages 6 to 21) school year 2018-19. Evidence for Wisconsin was not included due to questionable data quality.

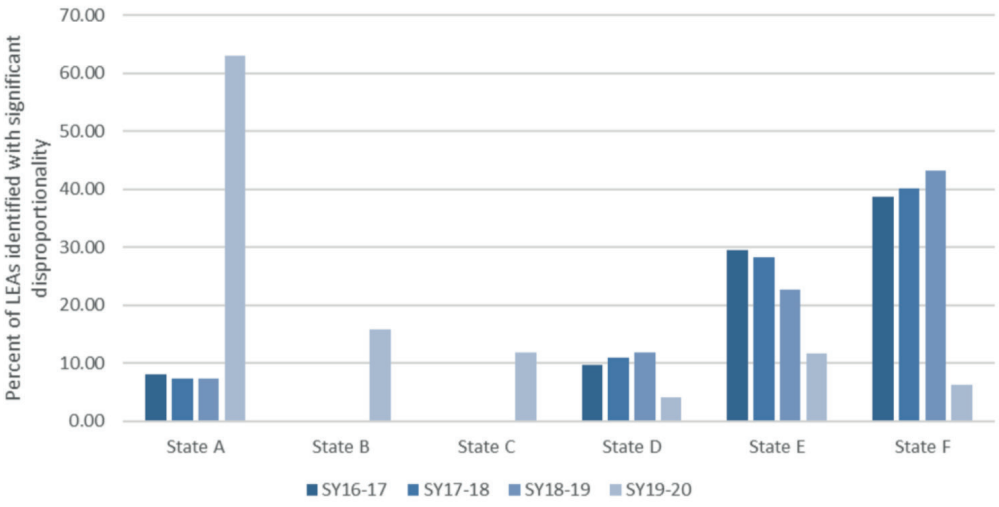


Source: OSEP (2020).

behavioral, learning) to document who has access to services and how they fare. Racial groups are included in this niche standardization to monitor potential inequities in identification rates. Other groups are also monitored (e.g., gender, social class, language). The federal government requires states to report annually school district placement rates to monitor significant racial disproportionality. The implementation of this niche standardization relies on definitions and indicators that are fraught with technical and ideological issues; see Albrecht et al. (2012), Artiles (2011), Cavendish et al. (2014) and USDOE (2023). National data suggest that a relatively low proportion of districts report disproportionality (Government Accountability Office, 2013). However, there have been increases in these statistics (Arundel, 2023). As the data get disaggregated, unique and unsettling patterns are unveiled. Consider, for instance, the data reported in Figure 3 on the percentage of school districts identified with significant disproportionality for six states across a four-year period (2016-2020). This evidence shows rather unique patterns with state D reflecting a stable low proportion of districts (around 10%), while states B and C had about 10-15% of their districts reporting disproportionality in the last year of this period, after having zero disproportionate districts in the preceding three years. State E reported decreasing number of disproportionate districts from about 30% to slightly over 10%. In contrast, State A shows an unusual pattern, first reporting a relatively low percentage of districts (below 10%), but then experiencing a sharp increase in the last year to over 60% of disproportionate districts. Finally, state F shows the opposite pattern, decreasing from a consistently high percentage of disproportionate districts (hovering around 40%) to a sudden drop below 10% in the last year of this period.

Unsettling questions emerge from the review of these data. One crucial issue is embedded in a recent USDOE (2023) report's recommendation: the Office of Special Education programs must

Figure 3. Percentage of school districts identified with significant disproportionality for selected states.



Note: LEAs = local education authorities, SY = school year.

Source: USDOE, 2023.

> assess the risks associated with the quality of data reported by [state education agencies] and [school districts] on significant disproportionality, and design and implement control activities as appropriate to mitigate against any identified risks and ensure that reported data are accurate and complete. (p. 2)

I would add to this recommendation conducting contextualized analyses to understand the stable and shifting patterns in the proportions of disproportionate school districts over time. Did some states change the thresholds to index significant disproportionality during this period? What was the variability underlying the categorical alignments of definitions, policies, local theories of ability differences, and practices in these states? Considering that disability is a boundary object and that such objects are "abstracted from all domains and may be fairly vague" (Star & Griesemer, 1989, p. 410), how might disability's laminated meanings and fluid conceptual boundaries as well as local enactments of this notion mediate disproportionality trends over time?

An important implication of this critique is that although the monitoring systems in these states was based on a niche standardization model organized around disability and race, we must rely on situated analyses to illuminate the fluidity of disability along with the contextual histories and cultural practices in schools and districts that surround patterns of disproportionality over time. A potential risk when using the notion of standardization niche is that it implicitly depends on essentialist conceptions of groups; thus, pushing to the background intersectional considerations or attention to group heterogeneities. I return to this point in a subsequent section.

3.2. The color of knowledge and its implications

The second theoretical intervention to advance a critical cultural-historical perspective is to address epistemological barriers in the study of racial inequality in the special education field. I start by acknowledging two facts in contemporary U.S. society. First, ten years ago the student enrollment in U.S. public schools became majority-minority, particularly in the West and South (Maxwell, 2014) and those districts with the most students of color tend to receive significantly less funding (Morgan, 2022). Second, socioeconomic inequality is on the rise. In this vein, Raj Chetty et al. (2016) concluded that

> absolute mobility has declined sharply in [the U.S.] over the past half-century primarily because of the growth in inequality. If one wants to revive the "American Dream" of high rates of absolute mobility, one must have an interest in growth that is shared more broadly across the income distribution.

A direct implication of these facts is twofold, namely educational knowledge should be relevant and responsive to the experiences and dreams of students of color, and educational research cannot afford to ignore the ubiquity of inequality in educational contexts and beyond. Unfortunately, careful analyses of research over long periods of time demonstrate the special education research community has not delivered on these obligations (Artiles et al., 1997; Lindo, 2006; Moore & Klingner, 2012; Trent et al., 2014; Vasquez et al., 2011). For example, the National Academies of Sciences reported that intervention research "findings for [students of color] ... are rarely, if ever, disaggregated and compared to majority students with [learning disabilities] or [behavioral disabilities] (Donovan & Cross, 2002, p. 329). The erasure of racial and other differences has also been documented in special education grant funding (Artiles et al., 2016) as well as in other fields such as psychology, public health and medicine (Graham, 1992; Krieger et al., 2021; Syed et al., 2018). For instance, in a paper that attracted significant attention, Steve Roberts et al. (2020) reviewed over 26 000 studies in top psychology journals published between 1974 and 2018. They reported:

> First, across the past five decades, psychological publications that highlight race have been rare, and although they have increased in developmental and social psychology, they have remained virtually nonexistent in cognitive psychology. Second, most publications

> have been edited by White editors, under which there have been significantly fewer publications that highlight race. Third, many of the publications that highlight race have been written by White authors who employed significantly fewer participants of color (p. 1295).

The implications of these epistemological practices are troubling for special education and allied disciplines as it means that curriculum, pedagogy, assessment, academic interventions and other intellectual resources in special education are grounded in a mythical universal learner that privilege White students. Again, at a time when schools are increasingly heterogenous and inequality is on the rise, we should not risk sustaining this status quo. This is particularly urgent in areas like intellectual, learning and emotional disabilities where contentious policy, technical and practice debates have ensued for decades around race, racism, and bias (Artiles et al., 2016). Stated differently, the study of racial disparities in disability identification must interrogate the knowledge base that informs the practices and policies of this field and increasingly pressure the research community to change epistemological practices including sampling and analytic procedures. Equally significant, the field must broaden its theoretical toolkit to benefit from interdisciplinary developments taking place in allied fields that frame human development and learning as cultural phenomena and place equity at the center of the research process (Artiles & Trent, 2024). These shifts will undoubtedly leave deep marks in the epistemology of this area of inquiry, starting with a new generation of research questions.

3.3. DefectCraft: The tangle of ideologies in practice

Thus far I have argued that a critical cultural-historical approach to understand the dual nature of disability and its concomitant equity tensions requires framing disability as a fluid notion that must be examined in situated in cultural and historical contexts. A related requirement is to bring a reflexive awareness about the epistemological practices underlying knowledge in this field. There is evidence that the literature on disability has ignored intersections with other markers of difference and has often treated equity (beyond ability differences) as an afterthought (Artiles & Trent, 2024). Researchers ought to bring a critical stance to the knowledge they use in their studies and question its epistemological roots to foreground historical intersectionalities and center equity considerations.

I turn in this section to the role of ideologies [i.e., "meaning in the service of power" (Bonilla-Silva, 2006, p. 25)] in the formation of the dual nature of disability, particularly regarding the use of ability differences as a means of marginalization. I conceptualize the practices and structural dynamics that produce such marginalization with the notion of *DefectCraft*, which draws from an interdisciplinary knowledge base (Artiles, 2003, 2011, 2019; Bal et al., 2018; Fields & Fields, 2012; Harris, 2001; Lamont & Pierson, 2019; Omi & Winant, 2014; Powel & Menendian, 2016; Tefera et al., 2023). We see DefectCraft at work when practices and processes pin deficits to already stigmatized individuals and groups (Artiles, 2011), thus contributing to their othering. This is illustrated in the historical and systematic identification of racialized groups as disabled, particularly in subjective disability categories. Note that DefectCraft does not necessarily stem only from the actions of biased or prejudiced actors. Indeed, DefectCraft crystallizes as the consequence of institutional policies, practices and procedures that are encoded with ideological assumptions about certain individuals and groups as damaged. This contributes to the historical portrayal of communities of color as broken and in need of remedial interventions (Artiles, 2011; Scott, 2007). For instance, a favored argument in DefectCraft work is that disproportionate poverty rates in communities of color explain racial disparities in disability rates. An unsettling implication of this reasoning is that it biologizes race; thus, perpetuating a deficit mindset about learners of color. Of significance, DefectCraft compels its practitioners to regard the deficiencies ascribed to these groups as intrinsic attributes; thus, reproducing ideology-ontology circuits; i.e., repeatedly framing certain groups with deficit views (ideologies) which are assumed to be innate traits of these individuals (Artiles, 2022).

Tracking DefectCraft is a fundamental requirement to understand the role of power, culture and history in the racialization of disability. A core resource of DefectCraft is its reliance on

the ideology of color neutrality to obscure the structural power of race in the formation of differences. Colorblindness also erases the cultural-historical conditions that mediate the experiences of racialized groups in an unequal society (e.g., opportunity gaps, discriminatory labor system, historical health and wealth disparities) (Darity, 2011). This racial ideology relies on frames that filter the interpretation of information (Bonilla-Silva, 2006) to "ignore, deny, or erase the role, meaning, or impact of race in a racially stratified society" (Tefera et al., 2023, p. 400). In this way, DefectCraft preserves the status quo and intensifies the marginalization of groups by resorting to culturalist explanations that justify racial disparities—e.g., socioeconomic deprivation, faulty linguistic socialization, inadequate parenting. Alas, culturalist justifications with racist origins have an age-old lineage in the social sciences (Benjamin, 2017). Moreover, culturalist explanations normalize racial disparities and flatten people's intersectional identities. This leads to a binary logic that oversimplifies researchers' analytic work; e.g., are racial disparities the result of child poverty or racial bias? A complementary analytic strategy upholding the stratifying project of DefectCraft is the privileging of aggregate evidence, thus dismissing the crucial role of local contexts and histories (Tefera et al., 2023).

Next, I outline five assertions that offer guidance for tracing the choreographies of DefectCraft in research and practice.

- **Trace the formation and meaning of differences and their consequences.** Education systems are organized around identity categories of race (or other relevant category that drives the othering of groups) and ability differences. Trace how these categories have evolved over time. Do the category definitions rest on binary thinking (normal/deviant); are social, cultural, historical, economic and political forces considered? What are the meanings ascribed to these categories and what are the equity consequences for students after they receive these designations? Are the categories organized around hierarchies that invoke alternative consequences for educational opportunity? What are the roles of biology and culture when explaining the roots of these differences? Do these explanations vary depending on the group under examination? Is access to opportunities and resources differentially distributed across groups? (Artiles, 2011; Omi & Winant, 2014; Shifrer & Frederick, 2019).
- **Unveil the roles of ideologies in identity constructions.** Ideology is at play when meanings serve to build hierarchies of domination (Bonilla-Silva, 2006). Identify policies, processes, or practices that may marginalize or create inequalities (e.g., identification disparities) for racially or ability different groups. Does deficit thinking underlie explanations of inequalities that represent minoritized groups as intrinsically damaged? Are color-neutral ideologies embedded in policies and practices or in solutions to inequities? (Erevelles & Minear, 2010; Lamont & Pierson, 2019; Powel & Menendian, 2016).
- **Examine intersectionalities and cultural-historical lineages.** This scholarship typically addresses the intersection of disability and race (or other groups relevant to local contexts such as low-income or refugee learners) (Artiles, 2013). Inquire whether monitoring systems or research studies tend to place more emphasis on a single identity (i.e., unitary approach) (Hancock, 2007). For instance, does race predict disability identification? What is the history of disability-race intersections in these contexts? (Baynton, 2005). What are the roles of sociohistorical antecedents in these intersections (e.g., race relations, racialized opportunities)? Professional tools are used to create abstractions of learners such as IQ quotients, metrics of poverty, or language proficiency scores. Many abstractions have been systematically produced to perpetuate deficit portrayals of marginalized groups that erase the contexts where they experience structural inequalities; thus, normalizing historical injustices (Ross, 1990). What abstractions are used to represent groups? How is contextual information used to complement abstractions? (Artiles, 2019).

- **Include spatial analysis.** Attention to space has afforded a deeper understanding of social and cultural processes, including growing societal inequalities (Soja, 2010; Tate, 2008). Racial disparities in disability rates must account for the role of spatial forces (Artiles, 2003). Start by asking how are school spaces set up to create, reproduce or deepen injustices? (Galster & Sharkey, 2017). Previous research suggests school location and racial configurations of settings shape racial disparities (Oswald et al., 2002; Shifrer & Fish, 2020; Skiba et al., 2008). How are deficit intersectional identities associated with particular kinds of spaces (urban, suburban)? (Tefera et al., 2023) Are there marginalizing practices?
- **Map social mechanisms underlying corrective measures.** Social mechanisms play a central role in the production and perpetuation of educational inequities (Tefera et al., 2023). Examples of mechanisms include evaluation (i.e., practices that order students in hierarchies that ultimately reify stratifications that systematically privilege certain groups) and quantification (i.e., the use of quantitative indicators that support or reinforce inequalities) (Lamont & Pierce, 2019). Another social mechanism is legitimization, i.e., predispositions to normalize existing inequalities and, thus, validating biases against people of color (Lamont & Pierce, 2019). Social mechanisms can be mapped through the scrutiny of everyday practices and organizational cultures of schools, particularly in contexts in which educators and leaders work to address the racialization of disabilities and other forms of disparities (Tefera et al., 2023).

4. The road ahead

The starting point for my argument in this paper is that disability has a duality that, contingent upon local circumstances, might afford protections and/or could be used to further marginalize individuals and groups. The challenge to leverage the empowering role of education is to minimize the debilitating power of disability at a time when diversity and inequality are on the rise. I document how disability can marginalize groups through a discussion of racial disparities in disability rates. The literature on this equity problem has been embroiled in technical discussions, mostly about methodological concerns. Notably absent in this body of work are theoretical considerations about the role of historical legacies of discrimination, structural factors, as well as identity markers such as race, poverty or migrant background in the production and perpetuation of this enduring problem. Equally important, this literature has ignored how historical inequalities in society permeate educational contexts and likely mediate the construction of racial disparities in disability rates.

I devoted the bulk of this manuscript to describe three theoretical tools framed through a critical cultural-historical frame that can inform analyses of racial disparities. First, it is necessary to trace the fluid nature of disability (a boundary object) to conduct situated analyses. This will enable researchers to examine disability in its sociocultural and organizational contexts. Second, researchers must bring a critical mindset when using the available knowledge base in research and practice. This is crucial considering the color neutral nature of knowledge in this field and allied disciplines. We should not condone a reliance on colorblind knowledge in a society that is increasingly heterogenous and fraught with inequalities. Finally, I called attention to the role of ideologies in the production of racial disparities using the lens of DefectCraft and the social mechanisms that reproduce this problem.

Ultimately, the research community needs to transcend the traditional focus on static demographic markers to study these educational inequities. Diversifying samples will not be enough. A-cultural and color neutral research perspectives will only water down our understanding of disabilities in unequal worlds of cultural differences. At the heart of this work should be a theory of human development and learning that acknowledge their cultural nature (Gutierrez & Rogoff, 2003). This means future research should aspire to integrate systematically conceptions of *mind*, *culture*, and *equity* in disability research (Ferrell & Artiles

in press). Alternative units of analysis are needed, particularly a situated unit, to obtain a more comprehensive and nuanced understanding of the fluid and ideological dimensions of disability. The next generation of research on the dual nature of disability should transcend the emphasis on documenting inequalities and advance formative interventions that rely on culturally responsive partnerships (Afacan et al., 2021; Mawene et al., 2024).

Author's contributions

Alfredo J. Artiles: Conceptualization; Writing (original draft); Writing (review and editing).

Artificial Intelligence (AI) Policy

The author does not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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Environmental education, culture of sustainability and climate emergency

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Monograph: Environmental education, culture of sustainability and climate emergency

Introduction

The climate emergency is one of the main exponents of the socio-environmental crises that we have suffered since the Industrial Revolution. Such emergency place us before a new era characterized as the *anthropocene* or *capitalocene*, whose scientific evidence includes the exponential increase in the levels of greenhouse gas emissions from the fifties of the last century to the present. Faced with this exceptional situation, the culture of sustainability is offered as an essential piece for the achievement of environmentally sustainable human development, in interaction with a wide and diversified range of social, ethical, territorial and technological elements to which educational research should pay priority attention.

When we launched the call for this monograph about a year ago, we began by highlighting that the European Parliament had declared a climate emergency in November 2019 and that the Spanish Government did the same on January 21, 2020. In both cases, the objective was to achieve climate neutrality by 2050, affirming the need to align all public policies, and not only those most directly related to the energy transition and adaptation to climate change, with the objectives of the 2015 Paris Agreement.

In this perspective, all international guidelines consider that education, in all its manifestations, should play a key role in two ways. Firstly, to ensure that the seriousness and potential threat of the climate crisis is socially internalised in order to generate the necessary involvement and civic consensus to promote more ambitious mitigation and adaptation policies. And, secondly, as a cultural strategy to promote profound changes in lifestyles that significantly reduce the environmental impact they generate, in addition to facilitating the transition towards more sustainable and just ways of life, socially and environmentally.

In line with these objectives (and given the evident gap between the knowledge generated in the last five decades on the biophysical dimensions of climate change and the knowledge generated on its social and cultural dimensions), this monograph was conceived as an opportunity to modestly contribute to promoting and disseminating basic and applied educational research aimed at enhancing responses to the climate crisis from school education and the community education.

Between the announcement of this monograph and its final publication, the manifestations of the advance and potential threat of the climate crisis have multiplied. The year 2024 has been declared by the European Union and the World Meteorological Organization as the warmest year since records began. In addition, the threshold of +1.5 ºC increase in average atmospheric temperature compared to the pre-industrial period has been exceeded. A milestone that climate simulation models from five years ago predicted would not be reached until the 2030s, confirming the suspicion that these models are calibrated downward. The recent phenomenon of extreme rainfall in the Spanish

Mediterranean, the devastating fires in many regions of the planet or the prolonged drought in others, are increasingly pressing reminders of the risks and dangers to which the climate crisis exposes us.

This situation, in which everything indicates that climate change will decisively condition human evolution during this century and, if not remedied, during the next millennium, forces us to do everything possible to accelerate the social and cultural changes necessary with two priority objectives: to significantly reduce greenhouse gas emissions, on the one hand, and to minimize human vulnerabilities to the impacts, many already inevitable, of climate destabilization, on the other. Given the urgency of this situation, the relatively secondary role that the climate crisis occupies in educational research agendas is surprising, as well as the evident disconnection, especially in the most developed countries, between climate policies (when they exist and are ambitious) and educational policies.

With the intention of alleviating this deficit, the set of articles that make up this monograph are fully aligned with the priority lines of the European Union's (EU) Horizon Europe framework programme for research and innovation (R+i) for the period 2021 -2027. This programme revolves around three key pillars: research excellence, global challenges and innovative Europe. In the second one, "Global challenges and European industrial competitiveness", the central axis marks the cluster of thematic priorities that will cover the scientific agenda in the next seven years. Among others, there are several aspects particularly relevant to contemporary educational research, to which continuous efforts should be devoted in this period: health; culture, creativity and inclusive society; climate, energy and mobility; food, bioeconomy, natural resources, agriculture and the environment. Although if you think carefully the climate collapse articulates with all of them.

We warned when we convened this monograph that another relevant dimension for focusing educational responses to the climate crisis is the temporal one. In this regard, the UN's Intergovernmental Panel on Climate Change (IPCC) highlights in its latest reports the urgent need to leverage education, information and community approaches in order to accelerate social and cultural changes that will allow any chance of achieving the goals set in 2015, in the Paris Agreement, to limit the increase in the planet's average temperature to 1.5 °C or, as a lesser evil, to 2 °C by the end of this century. Objectives of limitation, especially the first, which now seem a chimera and whose feasibility is in the face of an evolution of global geopolitics chained to a perverse paradox: on the one hand, climate sciences are increasingly alarming and restrictive in diagnosing the seriousness of the problem and the anthropic factors that cause it, but, on the other, skeptical or climate change denial policies are expanding and gaining more and more echo in the spheres of political and economic power. Climate education and, in general, environmental education focused on the construction of fairer and more sustainable societies, suffer from this situation.

In correspondence with this reality, the monograph presented here brings together eight articles that combine research and pedagogical reflection. Together, they offer theoretical, methodological and empirical clues that aim to inspire and guide educational responses that are increasingly congruent with the magnitude of the climate crisis, with the structural nature of the social changes necessary to face it and with the urgent need to address these changes from an educational perspective to minimize the worst social and environmental scenarios of a hostile climate, whose evidences are already part of our present. The concepts *urgency* and *emergency* are a common denominator of all of them, the result of the shared conviction that it is necessary to place the climate crisis at the centre of educational research and action agendas.

The monograph begins and concludes with two panoramic articles that illustrate the breadth of approaches and the magnitude of the problems that climate education studies have focused on. Thus, they point out some of the most notable patterns, the most explored

topics and showing trends in the contemporary research agenda. The first, signed by Harumi Takano, Alicia Castillo and Pablo Meira, presents us with a critical review of the educational potential of the theory of social representations applied to climate change, marking challenges for future inquiry in the exploration of some less attended areas together with a cartography of the impact of Moscovici's theory and its explanatory potential. In the last article, Marta Segade, Antonio García, Ana Rodríguez and Júlio Conde provide us with a complete characterization of educational research on climate change in the era of climate emergency (2017-2024).

The remaining six articles delve into some of the most current lines of research. Leticia Velasco, Juan Jesús Martín and Juan Carlos Tójar analyse the assessment of participatory competences in the design of educational itineraries, taking climate change as a reference in training plans in higher education. José Antonio Caride, José Gutiérrez and Pablo Meira provide an exploratory look focused on the value of time and its implications for pedagogical research, environmental policies and climate narratives predominant in educational agendas and international reference documents with the greatest impact. Susana Sastre, Cristine Zanarotti and Marvin Josué Izaguirres provide a sample of pedagogical initiatives to promote school education for sustainability and climate action, focusing their analysis on the Community of Madrid and offering proposals for continuous improvement of these initiatives, programs and resources. M.ª Rosario Mendoza and Belén Sáenz Rico analyse the reconstruction of the identity of compulsory secondary education teachers in the different dimensions of curricular sustainability. Sara Serrate, Judit Alonso, Carmen Patino and José Manuel Muñoz review the discourses of the nature deficit in the face of the overuse of technology in childhood, from a correlational methodological approach, paying special attention to the gender dimension and analysing its influence on the sustainable identity construction of childhood. Finally, M.ª de Fátima Poza, Susana Ripoll and M.ª Teresa Pozo address the place of vocational training as a context little explored in the field of climate education. They provide guidelines to give greater prominence to this educational level in the agendas on the climate emergency, considering its outstanding value in the different professional families that connect the world of work to training areas closely linked to reality scenarios.

Taken together, the eight articles that make up the monograph provide a broad and integrative panoramic perspective on some of the trends in contemporary research in the field, identifying a representative range of relevant responses that allow the topic to be placed in a research agenda that is barely emerging, although dynamic and fertile. The evidence shown in these articles shows that their answers do not exhaust the multiple questions initially collected in the call for contributions, being rather crossed foci of *thematic flashes* that mark the path on which we must continue to build solutions to educate in a rigorous and well-founded way until they become lines of educational inquiry that will be progressively shaped over time. To the extent that contributions are increased and consolidated as stable lines of research, sufficient critical mass will be available to face the challenges of the climate emergency and the socio-ecological transition.

In light of the findings presented in the different articles and the conditions of persistence with which climate alterations manifest themselves, we can affirm that much remains to be done in the scenario of contemporary climate education. That educational options are not conclusive and require sustaining the strategic effort from an evidence-based practice. That more practical research is needed to provide sound results on the effectiveness and efficiency of interventions, resources and programmes. Consistent evaluation proposals focused on the different levels of the education system are required, which explore the demands and training needs of teachers in training and in practice and that are complemented by alliances and with the multiple socio-educational agents and agencies that operate both outside and in collaboration with the field of social education.

However, this is not enough. Integrative review studies are also necessary to show progress and build rigorous theoretical-conceptual frameworks, which help guide intervention

decisions, validate educational work methodologies, illuminate climate curricular policies and provide convincing ideas to overcome obstacles, resistance and unnecessary delays to which to take changes. The studies presented open a necessary space to continue exploring different territories and contexts, either with replication research based on some of the instruments already validated, or with proposals of greater profusion and intensity, which urgently need to be reinforced and responsibly addressed by scientific journals in the educational field. That is why we do not want to conclude this presentation without thanking the editorial board of the Spanish Journal of Pedagogy for the trust placed in it, hoping that, with these and other future contributions on climate education, the journal will honour its identity motto of promoting an "education interested in the society in which it develops".

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The educational potential of the theory of social representations applied to climate change: A critical literature review

El potencial educativo de la teoría de las representaciones sociales aplicada al cambio climático: una revisión crítica de la literatura

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Abstract:

The theory of social representations provides a theoretical framework for comprehending how information about climate change is transformed as it moves from the scientific realm and becomes intertwined with people's everyday lives. It also explores the relationship between this knowledge and the shared values, beliefs, and ideas within a specific social group. This article critically reviews 67 papers on social representations of climate change in diverse settings, identifying and analysing their main contributions, the methodological approaches used, and future research opportunities. This review offers a broad vision of the wealth of knowledge provided by the theory of social representations to understand climate change from a socio-educational perspective.

Keywords: social representations, social psychology, climate crisis, education, media, social action.

Resumen:

La teoría de las representaciones sociales ofrece una aproximación teórica que permite entender cómo se reelabora el conocimiento sobre el cambio climático al salir de la esfera científica e insertarse en la cotidianidad de las personas. Así, muestra cómo se articula con los

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valores, las creencias y las ideas compartidas por un grupo social en un contexto particular. El presente documento ofrece una revisión crítica de 67 artículos sobre representaciones sociales del cambio climático en diferentes contextos. Se identifican y analizan las principales contribuciones de los artículos, las estrategias metodológicas utilizadas y las oportunidades que abren para futuras líneas de investigación. La revisión brinda un panorama amplio de la riqueza que ofrece la teoría de las representaciones sociales para entender el cambio climático desde una perspectiva socioeducativa.

Palabras clave: representaciones sociales, psicología social, crisis climática, educación, medios de comunicación, acción social.

1. Introduction

Earth system science has alerted us to the threat posed by climate change (CC), to the consequences if the current rate of greenhouse gas emissions remains steady (Pörtner et al., 2023) and to the dangers that this could have for human society, the habitability of the planet and the continuity of life here (Rockström et al., 2023). This potential threat makes CC a priority social problem. CC, and socio-environmental crises in general, are phenomena that have revealed the shortcomings of the predominant economic model (Pelling et al., 2012), as production and consumption patterns driven by a globalised aspiration for a Western lifestyle have prompted the plundering of the resources on which life depends and are generating a systemic alteration of the biogeochemical cycles needed to maintain the ecological functioning of the planet (Batel et al., 2016; Pelling et al., 2012). These imbalances further widen the gaps of inequity and social injustice generated by the capitalist economic model (Schipper et al., 2020), inevitably necessitating a change of paradigm that enables us to transform our relationship with the environment and with other people, promoting a transition toward more just and sustainable kinds of societies (González-Gaudiano, 2012).

This transition requires profound cultural changes in our way of being and existing in the world. The complexity of CC forces us to question implicit assumptions about the global market economy. It requires a reassessment of the political and social mechanisms for solving a global problem with locally diverse consequences, demands that ecological and social problems be considered as interrelated, and calls for us to bear in mind cultural and psychological aspects related to cognition and public appreciation of the problem in order to encourage individual and collective action (Dryzek et al., 2011; Jamieson, 2012). In this regard, the contributions of social science are crucial for understanding the factors that facilitate or block individual, collective and institutional responses to CC (Norgaard, 2011; Poma, 2018). Aiding in the articulation of educational responses that are consistent with the potential threat of the climate crisis is particularly important. In other words, such responses should be proportionate to the magnitude and urgency of the social changes required to avoid the worst future scenarios and to adapt the different human societies to the impacts rendered inevitable by the inertia inherent to the climate system.

The theory of social representations (TSR), originally proposed by the psychologist Serge Moscovici in 1961, offers a theoretical framework for understanding how people give meaning to socially relevant objects, particularly those that are new to them, which generate social controversy or in some way represent a break from prior knowledge, such as those emerging from the scientific realm (Howarth, 2006; Höijer, 2011). Thus, the TSR can be a useful theoretical proposal for studying how CC is understood and the social response to it, and also for guiding educational actions aimed at intervening in the processes of reflection, cultural appropriation and social reaction.

1.1. Theory of social representations

The TSR is based on the premise that people in contemporary society construct their knowledge of the world from the information spread through the media, in their schooling and in individual and collective experiences. This information is interpreted according to a group's shared ideas, beliefs and values, guiding their practices, behaviour, language and interactions and affecting the way in which they cope with daily life (Moscovici, 2008; Jodelet, 1986; Flick et al., 2015). These systems of values, ideas and practices are called *social representations* (SR), and they function as filters for the discovery, interpretation and organisation of what we understand as reality (Höijer, 2011).

The TSR states that representations consist of three dimensions: information, representation and attitude. The *information* dimension refers to the knowledge that a certain group has of the object represented (Banchs, 2000).

The *representation* dimension refers to the elements involved in the representation, categorisation thereof and the way in which these elements interact to afford meaning to the object (Terrón, 2010). According to Abric (1996), these elements are arranged into a central core, containing elements not subject to negotiation, and peripheral elements, where variable elements are found that make the representation flexible in certain situations (Moliner and Abric, 2015; Wachelke, 2011).

Finally, *attitude* refers to the favourable or unfavourable approach that the subjects take toward the representation object (Jodelet, 2008). According to Moscovici, attitude is the first dimension that appears at the origin of a representation. This means that, even if the subjects have not acquired in-depth knowledge about an object or arranged its contents, there may be a general attitude with regard to that object, which is influenced by the shared ideas and values in the group to which they belong (Moscovici, 2008).

SRs are formed through two complementary processes: anchoring and objectification. In *anchoring*, certain elements of the object are compared and related to previously formed, culturally familiar representations, which facilitate interpretation of the object (Abric, 1996; Höijer, 2011; Jodelet, 1986). Through this categorisation, it is possible to *make the unfamiliar familiar*. Through *objectification*, in turn, an abstract idea is converted into a concrete concept through the materialisation of images, concepts or people that are associated with the representation object and make it tangible (Jodelet, 1986; Höijer, 2011). These processes become clear in language through the use of metaphors, associations or analogies used by individuals in their discourse.

SRs are classified as hegemonic, emancipated or polemic, depending on the consensus that exists about them. *Hegemonic* representations are those that feature a high degree of social consensus and are therefore coercive and influence the practices of a large group of people (Gillespie, 2008). *Emancipated* representations share features of hegemonic representations, but also have certain distinctive elements related to the values and practices of the groups that share them (Ben-Asher, 2003). In turn, *polemic* representations contradict hegemonic representations, thus giving rise to conflict (Ben-Asher, 2003; Gillespie, 2008).

The aim of this paper is to conduct a critical review of the literature published on social representations of CC (SRCC) and to identify the findings of this research, its methodological approaches and the future lines of research and action identified. This is done primarily for the purpose of identifying contributions to the socio-educational field.

2. Methodology

A search was conducted of articles about social representations of CC published in the *Scopus* and *Web of Science* databases for papers in English, and in *Dialnet, Redalyc* and *Scielo* for contributions in Spanish.

The search took place from 13 February to 10 March 2023, using the following terms: "*cambio climático*/climate change" or "clima/climate" and "*representaciones sociales*/social representations" or "*teoría de las representaciones sociales*/social representations theory" throughout the document. In a preliminary review, the duplicates found in the search engines were eliminated and the following inclusion and exclusion criteria were applied:

1. Research articles, review articles and book chapters that discussed the study of SRCC were included.
2. Documents with a corpus written in the English or Spanish language were included.
3. Documents published between 1961 (when Moscovici proposed his theory of social representations) and January 2023 were included.
4. In addition to documents about SRCC, documents about SR of related objects explicitly linked to climate change in the body of the text were included (e.g., social representations of adaptation and mitigation strategies, sustainability, meat consumption, fracking, geoengineering and energy).
5. Documents with themes that are not related to climate and/or CC, and those that do not explicitly mention the TSR were excluded (e.g., those that use the term representations in a broader sense, without referring to the TSR).
6. Whole books were not included because, given their length, they could not be analysed as closely as the other documents examined.

After applying these criteria, a total of 67 documents was obtained. In each document, the research aims, data collection techniques and analysis methods used were identified. At the same time, the bibliometric information was systematised (year of publication, country or countries where the research took place, type of document, title, authors' keywords), which can be found in the Appendix.

Taking an interpretative approach (Cantrell, 1996) and following the methodological recommendations of Varguillas (2006), a thorough content analysis of each document was conducted using the Atlas.ti software (version 8). To analyse the results retrieved, analysis categories were generated using the TSR as the basis, thus identifying the SRCC contents and distinguishing their dimensions (information, representation and attitude), processes (anchoring and objectification), structure (core and peripheral) and representation types (hegemonic, emancipated or polemic). The first author was responsible for constructing the categories and analysing the documents. Subsequently, the other authors reviewed the relationships between categories and offered suggestions for interpreting and explaining the relationships. An example of how the coding was done is shown in Table 1.

In the first example in Table 1, the *dimension_representation* code makes it possible to identify that the result reported refers to a content of the representation of climate change. In turn, the *anchoring_pollution* and *structure_core* codes indicate that an anchoring process in which climate change is linked to pollution is identified in the unit of analysis and that, because of its prevalence, this relationship is identified as part of the core of the representation. Likewise, in the second example, the *objectification_seasons, objectification_weather*, and *objectification_experiences* codes indicate that the excerpt reports objectification processes in which people give meaning to climate change based on their direct, observable experience of changes in seasons and in weather conditions.

Through a detailed reading of the documents and use of the Atlas.ti tools (Varguillas, 2006), shared and variable elements of SRCC were recognised, as well as the existence of key recurring themes around which the research revolves. These latter were taken as the basis for organising the results of the review.

Table 1. Example of the coding process in Atlas.ti

Ref.	Unit of analysis	Category	Code
[28, p. 15]	The representation core among the students from both universities was pollution, which was the word that the subjects evoked first most frequently.	Dimension Processes Structure	dimensión_ representación anclaje_contaminación estructura_núcleo
[54, p. 289]	Experiences of changing seasons and curious weather give evidence of a presently changing climate.	Dimension Processes	dimensión_ representación objetivación_estado del tiempo objetivación_ estaciones objetivación_ experiencias

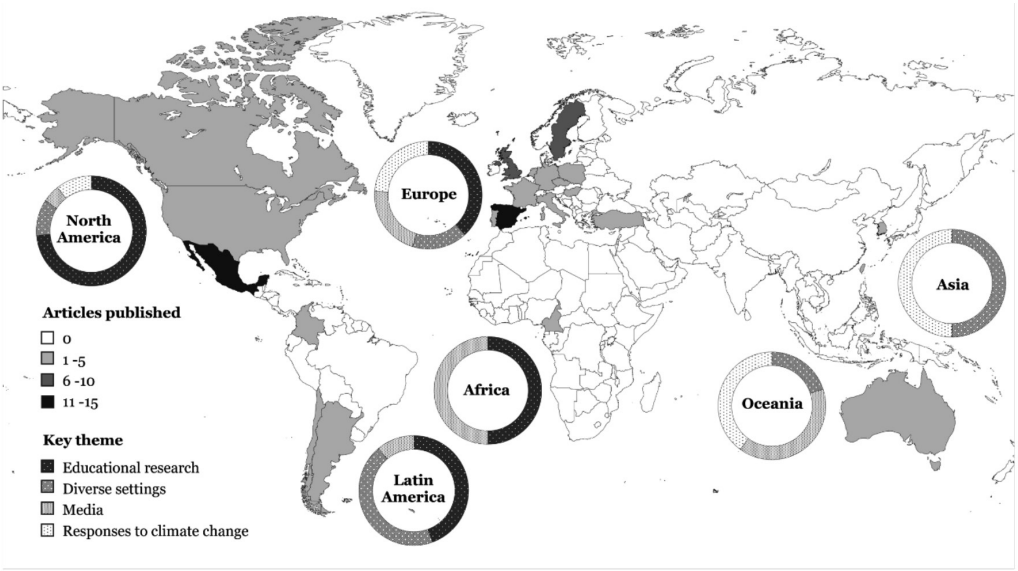
Note: two examples of the coding done in Atlas.ti are shown. The reference (Ref.) refers to the list in the Appendiz and the page from which the quote was taken.

3. Results

Five key themes were identified in the analysis of the documents (Figure 1). The research trends and geographic distribution are shown below, followed by the findings arranged as follows: sections *3.1. Use of the TSR in CC research* and *3.2 SRCC*: *shared elements* discuss the first key theme. They describe the theory's potential for CC research, its methodological approaches and the SRCC contents identified in the coding that appear repeatedly in the documents analysed. The second key theme relates to findings in the field of educational research, which are outlined in section *3.3. SRCC in educational research*. Section *3.4. The importance of context in SRCC* highlights those contextual elements that are crucial in the formation of SRCC. These findings mainly stem from research that compares the representations of social groups in a single setting or in diverse settings. Another key theme revolves around SRCC in the conventional media, whether print or audio-visual. These findings are shown in section *3.5. SRCC in the media*, which includes research on SRs of science and climate scientists in the media and the implications thereof for SRCC among the general public. Finally, section *3.6. SRs of responses to CC* discusses the final key theme, which deals with research on the SRs of certain adaptation or mitigation strategies implemented in diverse settings.

The map in Figure 1 shows that Europe and North America are the regions in which the most research has been done and the greatest variety of key themes exists. It is worth highlighting that a large percentage of this research is from Spain and Mexico, respectively, where projects in the field of educational research are prevalent. In Asia and Africa, on the other hand, the lowest number of projects is seen regionally, and several key themes have not yet been explored. Research projects were found in just four countries in Latin America (Argentina, Brazil, Chile and Colombia), and the key theme of responses to climate change was missing. In turn, Australia is the only country in the Oceania region where research on SRCC was reported. However, no papers addressing the theme of educational research were found.

FIGURE 1. Regional research trends in social representations of climate change.



Key theme	References [Article ID]
General reviews	[1-3]
Educational research	[4-29]
Diverse settings	[30-44]
Media	[45-56]
Responses to climate change	[57-67]

Note: the grey scale represents the number of research papers reported in each country. This differs from the number of documents analysed (n = 67) because there are some trans-regional research projects that report results for more than one country. The graphs indicate the relative frequency of documents in each key theme per region, excluding general reviews. Below the graph, the total number of documents in each key theme and the references (the article ID in the list in the Appendix, where the bibliometric information of each document can also be found) are indicated.

3.1. Use of the TSR in CC research

The articles reviewed seek two primary objectives (Table 2): to understand the SRCC (contents or processes) in one or more social groups, and to recognise the role of mediators (curriculum, the media, etc.) in spreading the SRCC and how the climate science they spread is received and reinterpreted by diverse audiences. Some research has focused on the study of the SRs implicit in different adaptation and mitigation responses, while other projects offer surveys of diverse aspects of the SRCC.

Quantitative, qualitative and mixed research techniques (Table 3) have been used to study the SRCC. The quantitative techniques include statistical testing to identify trends in numerical data based on word lists, surveys, interviews or text analysis. These methods have proven useful in identifying generalisable contents of SR, recurring themes and associations, and, particularly, in distinguishing core and peripheral elements of the representations. They also make it possible to compare and contrast the SRCC between groups.

Prevalent among the qualitative techniques is the use of semi-structured interviews and focus groups (Table 3). The first of these enables the participants to elaborate on their

responses, making it possible to identify nuances, links and relationships between SRCC elements or dimensions, which may not be evident in quantitative approaches. Focus groups allow researchers to observe exchanges and the negotiation of ideas and to identify shared and contrasting elements in reasoning. Free word association has also been used to reveal contents of the representation and organisation thereof, in addition to the creation of graphs, drawings and accounts of experiences (Table 3), which enable participants to express themselves freely and to establish relationships between the representation elements and their daily lives.

Table 2. Objectives sought in the research of the articles analysed.

Objective	**RF**	**References [Article ID]**
Identifying elements and/or processes of SRCC in a study group (*n* = 31)	0.30	[4, 5, 7, 8, 9, 10, 11, 12, 13, 17, 18, 20, 23, 24, 25, 27, 29, 30, 31, 32, 34, 35, 36, 38, 39, 41, 42, 44, 47, 48, 62]
Understanding the role of the media in spreading SRCC or SR of topics related to CC (*n* = 17)	0.16	[18, 24, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 56, 58, 61, 64, 65]
Comparing the SRs of two or more study groups (*n* = 16)	0.15	[4, 5, 6, 7, 14, 15, 18, 23, 28, 31, 33, 34, 39, 45, 46, 57]
Understanding the SR of responses to CC adaptation or mitigation or SR of topics related to CC (*n* = 16)	0.15	[29, 42, 43, 59, 55, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67]
Discerning whether SRCC affect the social practices of the study group (*n* = 8)	0.08	[26, 27, 30, 35, 36, 37, 62, 63]
Literature reviews about diverse aspects of SRCC (*n* = 6)	0.06	[1, 2, 3, 16, 19, 40]
Assessing the relationship between the climate literacy rate and the SRCC (*n* = 5)	0.05	[4, 13, 14, 17, 23]
Identifying emotions in SRCC (*n* = 2)	0.02	[48, 10]
Others (*n* = 3)	0.03	[15, 22, 21]

Note: the article ID matches those in the list in the Appendix. The relative frequency (RF) of each objective is indicated.

Table 3. Methodologies used in the research of the articles analysed.

	Methodology	RF	References [Article ID]
Data collection	Survey (*n* = 28)	0.36	[4, 5, 6, 7, 8, 9, 13, 14, 15, 17, 18, 20, 23, 24, 25, 26, 30, 34, 35, 36, 37, 38, 42, 43, 56, 62, 63]
	Interview (*n* = 15)	0.19	[5, 8, 9, 10, 32, 33, 34, 37, 38, 41, 46, 55, 57, 58, 59]
	Bibliographic/press/audio-visual media collection (*n* = 12)	0.15	[45, 47, 48, 49, 50, 51, 52, 53, 60, 61, 64, 65]
	Focus group (*n* = 8)	0.10	[21, 22, 29, 33, 34, 44, 54, 67]
	Free word association (*n* = 7)	0.09	[11, 12, 27, 28, 31, 39, 62]
	Others (e. g., accounts, drawings) (*n* = 7)	0.09	[5, 8, 9, 11, 12, 16, 40]
Data analysis	Statistical significance tests (descriptive, inferential, statistical testing) (*n* = 27)	0.29	[4, 6, 7, 9, 13, 14, 15, 17, 18, 20, 23, 24, 26, 28, 30, 31, 35, 36, 37, 38, 39, 41, 42, 43, 60, 62, 63]
	Discourse analysis (*n* = 22)	0.27	[8, 9, 11, 12, 5, 21, 27, 31, 33, 40, 41, 44, 46, 47, 48, 49, 54, 55, 58, 59, 64, 65]
	Content analysis (*n* = 17)	0.19	[4, 5, 11, 10, 22, 23, 26, 29, 31, 32, 34, 37, 40, 46, 53, 58, 67]
	Others (e. g., bibliometric analysis, social media analysis, semiotic analysis, thematic analysis, ALCESTE method) (*n* = 12)	0.25	[1, 3, 25, 40, 45, 50, 51, 52, 56, 60, 61, 67]

Note: the data collection techniques and analysis tools reported by the authors are shown. The article ID matches the numbering in the Appendix. The relative frequency (RF) of each tool is indicated.

Regarding the use of the TSR in CC research, articles by González (2012), Jaspal et al. (2014) and Batel et al. (2016) offer enlightening reviews and reflections. They stress that the TSR owes its acceptance among the wide-ranging trans-disciplinary community of researchers to its social and cultural recognition in the construction of meanings, exceeding the limitations of individualistic perspectives that lead to reductionism (Batel et al., 2016). It also acknowledges that this construction is context-dependent and places the subject as an agent capable of influencing while also influenced by the socio-cultural setting (González, 2012; Jaspal et al., 2014). Another valuable feature of the TSR is that it recognises the functionality of common-sense knowledge, which is constructed on and responds to needs that differ from those of scientific knowledge, but which must not be underestimated or simplified as a distortion of the latter (Jaspal et al., 2014). For CC research in particular, the TSR offers an ideal framework because it was proposed for the purpose of understanding how objects emerging from the scientific realm are reinterpreted, resignified and grasped socially when they spread into the public sphere.

3.2. The SRCC: shared elements

In the analysis of these 67 documents, the uniformity in the SRCC of the groups studied, regardless of their social or cultural context (Table 4), is striking. This finding points to a strong degree of generalisation of the SRs of this object. The core contents of the representations consist of elements related to the causes and consequences of CC, focusing mainly on biophysical aspects, with few references to the social dimension. Except for the groups of denialists, who share a polemic representation of CC, most of the social groups studied share a hegemonic representation that acknowledges the existence of CC and its anthropogenic causality. However, that does not necessarily imply an understanding of the complexity of the matter or a meaningful connection to the dominant production-consumption model.

Table 4. Frequently reported SRCC contents.

	Representation		
	Code	**RF**	**References [Article ID]**
Causes and consequences	The anthropogenic origin of CC is acknowledged (*n* = 22)	0.19	[4, 5, 6, 9, 11, 12, 13,14, 17, 20, 21, 23, 25, 30, 33, 35, 36, 38, 40, 47, 50, 60]
	The economic model is mentioned as a cause of CC (*n* = 7)	0.06	[5, 20, 21, 29, 37, 54, 67]
	Biophysical consequences of CC are mentioned (e. g., cold/heat, melting, increase in sea level) (*n* = 27)	0.23	[5, 6, 7, 9, 11, 12, 18, 20, 22, 23, 25, 28, 34, 42, 47, 30, 33, 37, 38, 39, 40, 44, 48, 52, 53, 54, 62]
	Social consequences of CC are mentioned (e. g., diseases, famine, weak harvests) (*n* = 8)	0.07	[7, 9, 20, 22, 38, 40, 42, 50]
	CC is linked to other environmental problems (e. g., deforestation, urban development, water and/or resource shortages) (*n* = 10)	0.08	[2, 4, 5, 7, 11, 19, 20, 25, 30, 37]
	CC is linked to pollution (*n* = 17)	0.14	[4, 5, 9, 11, 12, 18, 20, 21, 23, 28, 30, 33, 37, 38, 39, 40, 59]
	CC is acknowledged as an aggravating factor of social and environmental problems (*n* = 7)	0.06	[4, 9, 11, 20, 38, 41, 42]
	CC is considered geographically remote (*n* = 14)	0.12	[5, 7, 9, 14, 17, 18, 21, 28, 38, 40, 44, 49, 50, 53]
	CC is considered remote in time (*n* = 6)	0.05	[5, 14, 18, 19, 21, 40]

Erroneous notions	The hole in the ozone layer is mentioned as a causal agent of CC (*n* = 16)	0.61	[5, 11, 12, 13, 14, 18, 20, 23, 25, 28, 33, 38, 39, 40, 49, 50]
	Indiscriminate use of the terms *climate* and *weather* (*n* = 6)	0.23	[4, 5, 7, 19, 40, 49]
	Others (e. g., CC is linked to skin cancer, acid rain, earthquakes) (*n* = 4)	0.15	[5, 7, 18, 38]
Response	The mention of response measures is absent or limited (*n* = 8)	0.13	[5, 7, 18, 23, 25, 29, 37, 39]
	Individual response actions are mentioned (*n* = 14)	0.23	[2, 5, 12, 19, 20, 21, 25, 28, 29, 36, 41, 44, 48, 59]
	Collective response actions are mentioned (*n* = 4)	0.07	[22, 29, 34, 50]
	One's own responsibility to act is mentioned (*n* = 3)	0.05	[4, 38, 54]
	The responsibility to act is deferred to others (e. g., industry, government, developed countries) (*n* = 14)	0.23	[4, 5, 14, 18, 21, 23, 26, 29, 36, 37, 38, 47, 54, 67]
	The response measures are related to general respect for the environment (e.g. saving water, sorting waste) (*n* = 8)	0.13	[5, 21, 22, 23, 25, 28, 34, 38]
	Other problems are deemed more relevant than CC (*n* = 10)	0.16	[6, 11, 19, 20, 29, 37, 38, 40, 59, 64]
Emotions	Fear (*n* = 10)	0.22	[5, 9, 10, 12, 15, 18, 25 38, 48, 54]
	Guilt (*n* = 6)	0.13	[5, 15, 36, 48, 50, 59]
	Sadness (*n* = 5)	0.11	[5, 9, 10, 12, 25]
	Anger/rage/indignation (*n* = 5)	0.11	[5, 10, 15, 18, 37]
	Impotence/desperation (*n* = 5)	0.11	[5, 10, 25, 37, 59]
	Fatalism/pessimism (*n* = 5)	0.11	[9, 10, 12, 23, 25]
	Others (e. g., concern, mistrust, resignation, indifference, nostalgia, hope, compassion) (*n* = 9)	0.20	[5, 10, 15, 25, 29, 48, 50, 56, 59]
Information sources	Mass media (*n* = 12)	0.46	[11, 19, 20, 23, 26, 28, 35, 38, 44, 52, 53, 54]
	Internet/social media (*n* = 6)	0.23	[2, 12, 18, 20,28, 38]
	Television (*n* = 5)	0.19	[11, 12, 20, 28, 38]
	Press (*n* = 3)	0.11	[11, 12, 38]

Note: the article ID matches those in the list in the Appendix. The relative frequency (RF) at which each code appears in relation to the total number of elements in the category is indicated.

CC is often objectified through images of its biophysical consequences (Table 4), using a language that denotes a catastrophic vision (e. g., danger, threat). Anchoring, in turn, takes place in relation to other environmental problems, particularly through a generic reference to pollution. The persistence of erroneous notions about CC, such as its causal relationship with the hole in the ozone layer, or the indiscriminate use of the terms *climate* and *weather* even amongst groups with a university education linked to climate science, is striking.

The authors often identify a social, geographic and/or time distancing within their study groups, meaning that CC is placed in a global context, in remote places or societies, or that the reference to local implications is rare and that it is perceived as a phenomenon whose potential threat is deferred to a distant future. Thus, while CC is deemed a relevant problem, other problems are considered more urgent due to the psychological intensity and proximity with which they are perceived. According to some of the articles reviewed, this could explain why the mention of response measures is limited or absent and, when they do exist, that they are usually individual actions aimed at caring for the environment in general, which are easy to introduce into people's daily lives (saving water or sorting waste, for example). Along the same lines, in the analysis, it was detected that it is common to divert the responsibility to act to *others*, while personal and local collective responses are rarely mentioned.

While these elements are frequently reported in the research analysed, thus portraying a hegemonic representation of CC, the key themes identified shed light on other, more specific, aspects of the representations, their contents and formation.

3.3. SRCC in educational research

In the field of educational research, the contributions of the international group entitled "Respuestas educativas y sociales al CC [Educational and social responses to CC]" (Resclima; http://resclima.info/; *n* = 15) can be highlighted. This group was created in 2013 and comprises scholars from Spain, Portugal, Italy, Canada, Brazil and Mexico who recognised the need to identify the role of educational institutions in the formation of SRCC and to acknowledge the limitations of current educational models when it comes to providing and developing the skills required to respond to CC.

Among the articles analysed, several seek to determine whether there are differences between groups in line with the degree of progress in their academic studies (Calixto, 2020; Meira and Arto-Blanco, 2014), the area of knowledge in which they specialise (Escoz et al., 2019a, 2019b; García-Vinuesa et al., 2020; Méndez-Cadena et al., 2020; Parra et al., 2013), in terms of their geographic or social context (Bello et al., 2017; García-Vinuesa et al., 2022; Ramírez and González, 2016; Vargas et al., 2018), or a combination of these variables (Arto-Blanco et al., 2017). In general, the articles report that the SR are quite similar across the groups studied. However, Arto-Blanco et al. (2017) and Bello et al. (2017) report differences between the SRCC of students in Mexico and Spain, linked to differences in their cultural and curricular contexts, while Ramírez and González (2016) reported differences depending on the areas of knowledge of university students.

However, the most important difference found among students is related to their level of studies. University students at advanced stages of their degrees usually have a much broader vocabulary to express themselves about CC (Calixto, 2020); they establish more connections between CC and other social problems; they recognise its political dimension and the distinct responsibility of individuals and nations to a greater extent; they identify the production model as the root of the problem (Meira and Arto-Blanco, 2014; Arto-Blanco et al., 2017; Vargas et al., 2018; Méndez et al. 2020), all of which are notions that tend to be missing in the representations of secondary and pre-university students (Bello et al., 2017; Calixto, 2022). Despite these differences, the core contents of the SRCC are essentially the same, meaning that the differences affect peripheral elements that enrich the SR without substantially modifying it (Calixto, 2020). This is evidenced by the fact that erroneous notions about CC persist and, notably, that the contents do not have a significant influence on students' attitudes or conduct, or on their response to the problem (Meira et al., 2018). This contradiction, in which

acknowledgement and concern for the problem is reported but not reflected in attitude changes, was also observed in other population segments (Dickinson et al., 2013; Moscardo, 2012).

3.4. The importance of context in SRCC

The analysis of the documents included in this key theme reveals the influence of context on SRCC. For example, in coastal settings in France and Colombia, Doue et al. (2020) and Bertoldo et al. (2021) identified that CC objectification took place based on its global consequences, but the local impacts to which they were exposed (e. g., storms, intense rainfall, hurricanes) were mentioned.

Furthermore, they found that the familiarity of these populations with hydrometeorological events led them to underestimate the risks.

In rural areas of Mexico, Chile and Colombia, it should be noted that there is no formed SRCC or that it is in the early stages. This is seen in the fact that there is either no knowledge of the term (Cayul and Quilaqueo, 2019) or there is a lack of understanding about it. Maldonado et al. (2017) argue that this may be due to the fact that the term has only recently appeared in the cultural context of these people. The projects by Cayul and Quilaqueo (2019) with Mapuche-Pehuenche communities and by Núñez (2019) and Núñez et al. (2021) with Andean farmers highlight the knowledge that the interviewees have about climate changes in relation to their farming activities and to their daily lives. Moreover, given that their activities depend on weather and climate conditions, these groups have taken measures to adapt that do not rely on an institutional response, which, generally speaking, is insufficient and responds to interests that are not aligned with the needs and concerns of local inhabitants.

The research done by Cayul and Quilaqueo (2019) and Moloney et al. (2014) highlights the differences in SRCC of groups living in the same context. In the first case, the difference in the world view and the relationship to nature between the Mapuche communities and the decision-makers in Chile leads to different SRCC. In the second case, although elements of the hegemonic SRCC are shared by scientists and non-scientists in Australia, there are significant differences in their peripheral elements which could hinder communication between the two groups. For example, technical terms like *adaptation* are shared by members of the government and scientists but not used by the general public.

The differences in the SRCC are also evident among inhabitants of different countries. For example, when comparing the SRCC of inhabitants of France and Germany, Caillaud and Flick (2013) reported that, while CC was objectified using similar images and concepts, there are also important differences. Among Germans, the problem is related to changes in their immediate surroundings, so it is classified as a geographically close threat. Among the French, in turn, the problem is predominantly related to international political and economic issues. Coinciding with the findings of Wibeck et al. (2014) in Sweden, the French public felt that individual actions only become relevant if the majority of the population puts them into practice.

Despite the fact that CC has an impact on all economic activities, the research aimed at understanding its impact on tourism was distinctive. The projects by Moscardo (2012) and Dickinson et al. (2013) underscored tourists' resistance to modifying their practices, even when there was a concern about tourism contributing to CC. This resistance is expressed through strategies that enable tourists to cope with guilt and continue to enjoy travelling. In particular, these include compartmentalisation of holiday periods as temporary spaces unrelated to daily life, in which environmental concerns are temporarily suspended.

The study by Atzori et al. (2019) evaluated tourists' responses to the potential impacts of CC in a tourist destination in Florida. They found that travellers show an intention to continue visiting this destination despite the possible impacts of CC. However, it is possible that they are unaware of, underestimate or deny the nature and magnitude of these changes, particularly people with polemic representations of CC. Although the tourists show a willingness to return to this tourist destination after adaptation strategies are implemented that could modify the

appearance of the location, Schliephack and Dickinson (2016) suggest using caution with this data, noting that intentionality is not necessarily synonymous with behaviour.

3.5. SRCC in the media

The TSR acknowledges that the media is an important source of information and dissemination of social representations. Numerous studies have confirmed that television, the press and, recently, social media, are the main sources of information about CC among the general public (Table 3), which makes it crucial to understand their contents and the processes that motivate their spokespeople.

López et al. (2020) and Kay and Gaymard (2021) found that, in the press in Argentina and Cameroon, respectively, the media coverage is dominated by the international political agenda, disconnected from local settings and, in the case of Cameroon, linked to notions of external assistance and financial dependence.

Fernández and Águila (2015), in the Spanish press, and Caillaud et al. (2012), in a comparative analysis of the French and German press, note that the predominance of the political framework may stem from the fact that media coverage of CC increases when extreme weather events occur or when international negotiations, agreements or conferences take place. Caillaud et al. (2012) also identified different communication strategies in the German and French press. In the former, the use of religious metaphors gave rise to a representation of CC that carried a heavy moral burden, while in the latter the political and financial risks of climate negotiations are emphasised through the use of war-related metaphors. This could partly explain the differences between the populations of these two countries in the SRCC reported by Caillaud and Flick (2013).

In settings in which CC has been heavily politicised (the United States, United Kingdom and Australia, for example), where SRCC polarise political ideologies and identities, the communication strategies used by the media have been studied.

Jaspal et al. (2016) identified the construction of opposing identities in the Australian press: scientists against sceptics, associated with hegemonic and polemic representations of CC, respectively. The sceptics define climate scientists as greedy individuals whose false interests lead them to exaggerate and even make up facts at their own convenience in order to place CC as a priority issue in the social agenda. This image is reinforced by emphasising the scientific uncertainties, taking the epistemological uncertainty constantly referred to in climate science out of context. Similar strategies were identified in the analysis of the discussions about climate science in the British newspaper the Daily Mail (Jaspal et al., 2013), following the Climategate event in 2009. This episode, which consisted in the unlawful disclosure of emails from the Climatic Research Unit at the University of East Anglia, was used by diverse denialist groups to question the legitimacy of scientific work and of climate science in particular (Jaspal et al., 2013).

Similarly, Pearce and Nerlich (2017) analysed the SRCC in the documentary *An Inconvenient Truth* by Al Gore. While the value of the documentary for disclosing and drawing the lay public's attention to the climate crisis is acknowledged, it also prompted the emergence of a polemic representation, largely attributed to the political figure of Al Gore. The authors' analysis highlights that the way in which scientific information is presented can raise doubts about the validity of the contents conveyed if the messenger and his or her identity are also involved in the message (Pearce and Nerlich, 2017).

However, the documentary succeeded when it came to the speaker's ability to appeal to his audience through stories and metaphors that enable them to perceive the problem as something close to them. Callaghan and Augoustinos (2013) noted that, in the Australian press, scientists' use of technical language, with figures and statistics, to discuss climate science generated a distancing of the audience, as the topic was portrayed as something abstract and remote. On the other hand, sceptics recognise and value common-sense knowledge, try to use simple language and rhetoric and even appeal to the public's intuition, knowing

that past experience may contradict some of the key facts of the scientific representation of CC. Thus, the familiarity of sceptics' way of communicating is highly attractive, and their success is not surprising, particularly in contexts in which CC and denial thereof can become identifying features of a certain political ideology. In scenarios in which hegemonic and polemic representations of CC come into confrontation, Uzelgun et al. (2016) recognised that a constructivist vision of science that admits its limitations makes it possible to shift the debate about the accuracy and reliability of climate science toward its specific implications, focusing attention on the strategies required for action in scenarios of uncertainty.

The research on SRCC in the media has shown the relevance of emotions and the way they are manipulated. Höijer (2010) and Olausson (2011) reported that, in Sweden, CC is often characterised as a threat, which anchors the problem in fear. While it may have a mobilising effect, this emotion can lead the public to experience emotional fatigue, fostering desperation and inaction. In addition to fear, Höijer (2010) identified other emotions activated in the media, including guilt, compassion, nostalgia and hope. Similar findings have been reported in the field of educational research (Bello et al., 2017; Calixto and Terrón, 2018; García-Vinuesa et al., 2022). According to Höijer (2010), these emotions are anchored to the SRCC through discourse and images, facilitating recognition thereof and a comparison with objects that awaken similar emotions.

3.6. SRs of responses to CC

Several papers within this key theme underscore the relevance of the social dimension in SRCC, given that people most clearly take a stance and react emotionally when confronted with the specific perspective of projects or actions in response to CC.

Upham et al. (2018) and Banerjee et al. (2017), for example, argue that the assessment of SRs of mitigation or adaptation measures to be implemented in a given context is essential, because in this way it is possible to identify whether they are perceived as a threat and how they are related to a sense of attachment to a place, a decisive emotional component in people's attitudes. Banerjee et al. (2017) emphasise the use of the TSR as an alternative to NIMBY (*not in my backyard*) perspectives, which assume that local opposition to mitigation projects is the result of the inhabitants' selfishness, a stance that has been criticised as reductionist. The papers by Jaspal and Nerlich (2014) and Bigl (2020) coincide in this aspect, based on their research on the SRs of fracking in the United Kingdom.

Im et al. (2021) studied the representation of geothermal plants among residents of Pohang, South Korea. In this town, an earthquake occurred in 2017, the origins of which were linked to the activities of a geothermal plant, generating a negative view of these plants and, based on anchoring processes, this view spread, leading to the rejection of other energy sources. Similarly, Wibeck et al. (2015) found that, within a segment of the population that is unfamiliar with geoengineering, based on a limited amount of information, this term is anchored to other technologies such as cloning, cancer treatment or genetically-engineered products and, along with them, to the emotions and attitudes they prompt.

The papers by Olausson (2018; 2019) analyse how livestock farming, a significant contributor of greenhouse gases, is legitimised in the daily discourse of social media. Olausson identified strategies for justifying behaviour, minimising the problem or diverting attention when the information disclosed conflicts with people's beliefs or conduct. Furthermore, in the public sphere of social media, the reliability and accuracy of the information sources used by the posters is brought seriously into question and tends to generate polarisation in the discussion.

4. Discussion

Through the analysis of the literature on SRCC, it can be surmised that, while there is an overall understanding of CC, mediated mainly through its anchoring to the category of *environmental problems*, this comprehension is insufficient to prompt a response that is aligned with the urgency of the issue. CC remains systematically categorised as a biophysical

phenomenon rather than a socio-environmental problem, and options for responding to the problem are absent or marginal elements of the SRCC.

Based on the premise that tackling the climate crisis requires radical transformations in our way of inhabiting the world, it is urgent to develop, learn and implement tools that will enable us to move in the direction of that transformation. This task is not being addressed in the representations spread in educational contexts or broadcast in the media (González and Meira, 2020; Jones and Davison, 2021; Tavares et al., 2020). Given that lifestyles and consumer habits that are at the root of the problem are promoted in the media (Oreskes and Conway, 2010), it is unlikely that the media will encourage the public to question capitalism or promote alternative ways of behaving in the world (García-Vinuesa et al., 2020; González and Meira, 2020). Moreover, while education has the potential to drive social transformation, it is also constricted by the limitations of educational institutions (Jones and Davison, 2021; Salonen et al., 2023). In this regard, the opportunities offered by other educational agents, such as non-governmental organisations, civic associations, climate activist groups and grassroots movements, may play a highly relevant role as catalysts of more profound social transformations. Harnessing the synergies between these 'informal' agents and school institutions could be one way to strengthen the approach to the climate crisis in the curriculum, establishing connections to representations that are more complex and realistic about the potential threat (Bigl, 2020; Iati, 2008; Jones and Davison, 2021). It is imperative to address this shortcoming while taking care to avoid simplistic solutions or *false alternatives*, i.e., those that do not question the root problem and merely perpetuate the continuity of the capitalist model (Parrique, 2022; Tornel and Montaño, 2023). In educational institutions, developing projects within the educational space itself or in local spaces and institutions has proven to provide enriching experiences for students, as these projects equip them with power to take action and enable them to develop the skills they need to undertake collective action (Maldonado-González, 2022).

Regardless of the context, it is particularly important to recognise people's emotional response and to offer emotional management tools that allow them to feel fear without freezing up, to be concerned without minimising the problem, to accept responsibility without feeling overwhelmed by guilt and to discern the complexity of the problem without being overcome by desperation or impotence. Tackling CC requires individuals and societies to have the capacity to navigate uncertainty and to transform uncomfortable emotions into mobilising emotions (Brulle and Norgaard, 2019; Poma, 2018; Poma and Gravante, 2021). The studies on SRCC that explicitly included an analysis of the emotional dimension are highly enlightening in understanding, on the one hand, the motives that drive individual and collective action and, on the other, gaining a more detailed understanding of how meaning is attached and the information received is reinterpreted socio-culturally (Calixto and Terrón, 2018; Höijer, 2010; Olausson, 2011). Therefore, including this in future research is recommended.

As the effects of CC become more evident and its impacts start directly affecting a larger number of people, SRCC may evolve at a swifter pace, given that the objectification processes will be influenced by the life experience of these impacts. Longitudinal research, in which these and other changes in SRCC can be mapped, offers an area of opportunity for further understanding how people attach meaning to the problem and to devise ways of effectively responding to it.

The importance of identifying and properly arranging the knowledge that people have about their context, about changes in the environment and modifications in climate or natural cycles, and recognising them before and while implementing CC response strategies must be highlighted. This is particularly evident in historically marginalised contexts and communities that are highly socially and environmentally vulnerable, and therefore it is important to conduct research on SRCC that reveals the views of the people living in such locations, in order to avoid perpetuating reductionist narratives like NIMBY perspectives.

It is also essential to continue studying the processes of denialism and ideological polarisation regarding CC and their impact on the policies of response to the problem. As the policies for responding to the climate crisis become more ambitious, prompted by the

increasing intensity of the most harmful manifestations of the crisis, the cultural struggles to establish a certain social representation of CC could be exacerbated. The findings by Atzori et al. (2019) and Moscardo (2012), who noted that a polemic representation of CC does not necessarily entail a rejection of pro-environmental measures, since people acknowledge that it is important to care for the environment, regardless of their stance on climate change, are encouraging. In addition, authors like Norgaard (2006) and Wullenkord and Reese (2021) found that denialism may be an emotional management tool for avoiding uncomfortable emotions or a defence strategy when the information is perceived as a threat to their identity. This review reveals that profound changes must be made in the form and content of education and social communication about CC. To do this, the knowledge acquired in research about SRCC must be made available to those who disseminate this research and put it into practice: educators, instructors, speakers, scientific writers and leaders of social movements, to mention just a few potential mediators. The importance of the individuals who are responsible for drafting and implementing public policies in governments around the world must be stressed. In this regard, transdisciplinary approaches may be highly enriching, while at the same time providing the strategic groundwork for developing and strengthening social capabilities that must be urgently implemented in light of this crisis, which is already seriously affecting life on the planet.

5. Conclusions

This article offers a critical review of 67 published documents about social representations of climate change. The analysis showed the potential that the Theory of Social Representations has for studying complex socio-environmental problems like climate change and for an educational approach thereto, while also affording a broad overview of the findings published in this line of research over the last 15 years.

The study has certain methodological limitations that must be taken into account, which should be addressed in subsequent approaches. In this regard, it is worth noting the possible biases that could arise from the exclusion of documents in languages other than English or Spanish. Furthermore, the sample could be expanded by including the terms "*calentamiento global*/global warming", which is commonly used as a synonym for climate change but was not included in this search. In future reviews, terms that could offer a complementary view of the matter, such as "energy", "environmental problems", "mitigation", "adaptation" and "sustainability", to name just a few, could also be added.

One concerning issue highlighted by the research findings is the lack of social responses to climate change that address the root problem. Therefore, we believe it is important to conduct research that spans more diverse geographic and social contexts, as well as a wider variety of social stakeholders, thus affording a more in-depth view of the causes of this inaction.

In addition, we feel it is necessary to carry out longitudinal studies that aid in understanding the evolution of SRCC, in light of the pronounced effect of extreme climate events, and how this affects the social response to CC. Finally, we consider that including the emotional dimension in SR studies would be enriching because this would provide a better understanding of the processes that drive or hinder action.

Appendix

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
1	Batel, S., Castro, P., Devine-Wright, P., & Howarth, C.	Developing a critical agenda to understand pro-environmental actions: Contributions from social representations and social practices theories	2016	*WIREs Climate Change*	https://doi.org/10.1002/wcc.417	social representations theory, theories of practice, critical approach, pro-environmental actions	Review article	*
2	González, E.	La representación social del cambio climático. Una revisión internacional	2012	*Revista Mexicana de Investigación Educativa*	https://www.redalyc.org/articulo.oa?id=14024273003	medio ambiente, representación social, percepción, educación y comunicación, educación ambiental	Review article	*
3	Jaspal, R., Nerlich, B., & Cinnirella, M.	Human responses to climate change: Social representation, identity and socio-psychological action	2014	*Environmental Communication*	https://doi.org/10.1080/17524032.2013.846270	climate change, communication, social representation, identity, identity process theory, public understanding	Review article	*
4	Arto-Blanco, M., Meira-Cartea, P., & Gutiérrez-Pérez, J.	Climate literacy among university students in Mexico and Spain: Influence of scientific and popular culture in the representations of the causes of climate change	2017	*International Journal of Global Warming*	https://doi.org/10.1504/IJGW.2017.084791	climate change, global warming, causes, climate literacy, higher education	Research article	México y España
5	Bello, L., Meira, P., y González, E.	Representaciones sociales sobre cambio climático en dos grupos de estudiantes de educación secundaria de España y bachillerato de México	2017	*Revista Mexicana de Investigación Educativa*	https://www.redalyc.org/articulo.oa?id=14050493008	representación social, educación ambiental, educación media, educación media superior	Research article	México y España

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
6	Bello, L., y Cruz, G.	Profesorado universitario ante el cambio climático. Un acercamiento a través de sus representaciones sociales	2020	*Revista Mexicana de Investigación Educativa*	https://www.redalyc.org/articulo.oa?id=14065615011	educación superior, práctica educativa, cambio climático, representación social	Research article	México
7	Bello, L., Cruz, G., Meira, P., y González, E.	El cambio climático en el bachillerato. Aportes pedagógicos para su abordaje	2021	*Enseñanza de las ciencias*	https://doi.org/10.5565/rev/ensciencias.3030	climate change, environmental education, social representation, high school	Research article	México
8	Calixto, R.	Medio ambiente y educación ambiental: Representaciones sociales de los profesores en formación.	2010	*Magis. Revista Internacional de Investigación en Educación*	https://revistas.javeriana.edu.co/index.php/MAGIS/article/view/3521	medio ambiente, educación ambiental, representaciones sociales, práctica docente	Research article	México
9	Calixto, R.	El cambio climático en las representaciones sociales de los estudiantes universitarios	2018	*Revista Electrónica de Investigación Educativa*	https://doi.org/10.24320/redie.2018.20.1.1443	educación ambiental, representación social, universitarios	Research article	México
10	Calixto, R. y Terrón, E.	Las emociones en las representaciones sociales del cambio climático	2018	*Educar em Revista*	https://doi.org/10.1590/0104-4060.55684	educación ambiental, emociones, representaciones sociales, cambio climático	Research article	México
11	Calixto, R.	Mirada compartida del cambio climático en los estudiantes de bachillerato	2020	*Revista Mexicana de Investigación Educativa*	https://www.redalyc.org/articulo.oa?id=14065615008	educación ambiental, educación media superior, representaciones sociales, cambio climático	Research article	México
12	Calixto, R.	Estudiantes de bachillerato y cambio climático. Un estudio desde las representaciones sociales	2022	*Revista Electrónica Educare*	https://doi.org/10.15359/ree.26-3.14	representaciones sociales, cambio climático, educación ambiental, estudiantes, bachillerato	Research article	México

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
13	Escoz, A., Arto, M., Meira, P., & Gutiérrez, J	Social representations of climate change among Spanish university students of social sciences and humanities.	2019	*Interdisciplinary Environmental Studies*	https://doi.org/10.18848/2329-1621/CGP/v13i02/1-14	climate change, social representations, university, climate literacy, climate education	Research article	España
14	Escoz-Roldán, A., Gutiérrez, Pérez, J., & Meira, P.	Assessment of climate literacy levels and social representations in academics from three climate contexts	2019	*Water*	https://doi.org/10.3390/w12010092	goals, agenda 2030, university students, climate literacy, social representation	Research article	España y Portugal
15	Ferrari, E., Martínez, F., y Ruíz, C.	La eficiencia de un MOOC de ciencia básica en español para mejorar la representación social del cambio climático	2020	*Communication & Methods*	https://doi.org/10.35951/v2i2.81	cursos masivos en línea y abiertos (MOOCs), representación social (RS)	Research article	América Latina, España, Italia, Portugal y África
16	García-Vinuesa, A. y Meira-Cartea	Caracterización de la investigación educativa sobre el cambio climático y los estudiantes de educación secundaria	2019	*Revista Mexicana de Investigación Educativa*	https://dialnet.unirioja.es/servlet/articulo?codigo=7135281	educación ambiental, educación media, estudios bibliométricos, investigación educativa	Review article	*
17	García-Vinuesa, A., Meira, P., Caride, J., e Iglesias, M.	La representación del cambio climático en la universidad: valoraciones y creencias del alumnado	2020	*Educação e Pesquisa*	https://doi.org/10.1590/S1678-4634202046229768	estudiantes universitarios, cambio climático, representaciones sociales, alfabetización climática	Research article	España
18	García-Vinuesa, A., Meira, P., y Caride, J.	El cambio climático en la educación secundaria: conocimientos, creencias y percepciones.	2022	*Enseñanza de las Ciencias*	https://doi.org/10.5565/rev/ensciencias.3526	environmental education, social representations, high school, climate literacy, climate crisis	Research article	España e Italia

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
19	González, E. y Meira, P.r	Educación, comunicación y cambio climático. Resistencias para la acción social responsable	2009	*Trayectorias*	https://www.redalyc.org/articulo.oa?id=60712749003	educación ambiental, cambio climático, resistencias culturales, obstáculos sociales para la acción colectiva	Review article	*
20	González, E., y Maldonado, A.	¿Qué piensan, dicen y hacen los jóvenes universitarios sobre el cambio climático? Un estudio de representaciones sociales	2014	*Educar em Revista*	https://doi.org/10.1590/0104-4060.38106	cambio climático, representación social, jóvenes universitarios, Veracruz, México	Research article	México
21	Lee, K., & Barnett, J.	Adolescents' representations of climate change: Exploring the self-other tema in a focus group study	2022	*Environmental Communication*	https://doi.org/10.1080/17524032.2021.2023202	adolescents, climate change, social representation theory	Research article	Reino Unido
22	Maldonado-González, A.	Cambio climático en experiencias educativas de profesorado universitario.	2022	*Revista Electrónica Educare*	https://doi.org/10.15359/ree.27-1.14345	educación superior, educación ambiental, cambio climático, vulnerabilidad, resiliencia	Research article	México
23	Meira-Cartea, P., y Arto-Blanco, M.	Representaciones del cambio climático en estudiantes universitarios en España: aportes para la educación y la comunicación	2014	*Educar em Revista*	https://doi.org/10.1590/0104-4060.38041	educación, cambio climático, representaciones sociales, cultura científica	Research article	España
24	Meira, P., Gutiérrez, Pérez, J., Arto-Blanco, M., & Escoz-Roldán, A..	Influence of academic education vs. common culture on the climate literacy of university students	2018	*Psyecology*	https://doi.org/10.1080/21711976.2018.1483569	social representations, climate change, university, literacy	Research article	España

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
25	Méndez-Cadena, M., Fernández, A., Cruz, A., y Bueno, P.	De la representación social del cambio climático a la acción: el caso de estudiantes universitarios	2020	*Revista mexicana de investigación educativa*	https://www.redalyc.org/articulo.oa?id=14065615010	educación ambiental, cambio climático, educación superior, representación social, medio ambiente	Research article	México
26	Parra, E., Castillo, C., y Vallejos, M.	Representaciones sociales sobre desarrollo sostenible y cambio climático en estudiantes universitarios	2013	*Perspectivas de la comunicación*	-	representación social, prácticas sociales y estudiantes universitarios	Research article	Chile
27	Porras, Y.	Representaciones sociales de la crisis ambiental en futuros profesores de química.	2016	*Ciência & Educação*	https://www.redalyc.org/articulo.oa?id=251046221010	representación social, crisis ambiental, construcción social, ambiente	Research article	Colombia
28	Ramírez, Y., y González, E.	Representaciones sociales del cambio climático en estudiantes de dos universidades veracruzanas	2016	*Revista de Investigación Educativa*	https://www.redalyc.org/articulo.oa?id=283143550002	representación social, educación y comunicación, análisis comparativo	Research article	México
29	Vargas, G., Barba-Núñez, M., Carvalho, A., Vicente-Mariño, M., Arto-Blanco, M., & Meira-Cartea, P.	How do students perceive and evaluate responses to climate change?	2018	*Climate Change: Impacts and Responses*	https://doi.org/10.18848/1835-7156/CGP/v10i02/1-19	climate change, social representations, higher education, focus gropus, comparative studies	Research article	Brasil, México, Portugal y España
30	Atzori, R., Fyall, A., Tasci, A., & Fjelstul, J.	The role of social representations in shaping tourist responses to potential climate change impacts: An analysis of Florida's coastal destinations	2019	*Journal of Travel Research*	https://doi.org/10.1177/0047287518802089	climate change, social representations theory, coastal destinations, Florida, tourist responses	Research article	Estados Unidos

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
31	Becken, S.	Evidence of a low-carbon tourism paradigm?	2017	*Journal of Sustainable Tourism*	https://doi.org/10.1080/09669582.2016.1251446	dominant social paradigm, growth, social representation, low-carbon tourism, risks	Research article	Global
32	Bertoldo, R., Guignard, S., Dias, P., & Schleyer-Lindenmann, A.	Coastal inconsistencies: Living with and anticipating coastal floods risks in southern France	2021	*International Journal of disaster Risk Reduction*	https://doi.org/10.1016/j.ijdrr.2021.102521	coastal floods, social representations, climate change adaptation, risk perception, SARF, place attachment	Research article	Francia
33	Caillaud, S., & Flick, U.	New meanings for old habits? Representations of climate change in France and Germany	2013	*Revue Internationale de Psychologie Sociale*	https://shs.cairn.info/revue-internationale-de-psychologie-sociale-2013-3-page-39?lang=fr	climate change, social representations, practices, anchoring, culture	Research article	Francia y Alemania
34	Cayul, O., y Quilaqueo, D.	Cambio climático en Lonquimay: conocimiento científico y conocimiento local Mapuche-Pehuenche	2019	*Revista Austral de Ciencias Sociales*	https://doi.org/10.4206/rev.austral.cienc.soc.2019.n37-07	conocimiento científico y mapuche, cambio climático, comunidades de Lonquimay	Research article	Chile
35	Chen, M.	Social representations of climate change and pro-environmental behavior intentions in Taiwan	2019	*International Sociology*	https://doi.org/10.1177/0268580919832737	climate change, pro-environmental behavior intentions (PEBs), social representations theory (SRT)	Research article	Taiwán
36	Dickinson, J. E., Robbins, D., Filimonau, V., Hares, A., & Mika, M.	Awareness of tourism impacts on climate change and the implications for travel practice: A Polish perspective	2013	*Journal of Travel Research*	https://doi.org/10.1177/0047287513478691	climate change, behavioral change, travel practice, Poland	Research article	Polonia
37	Doue, C., Navarro, O., Restrepo, D., Krien, N., Rommel, D., Lemee, C., Coquet, M., Mercier, D., & Fleury-Bahi, G.	The social representations of climate change: Comparison of two territories exposed to the coastal flooding risk	2020	*Change Strategies and Management*	https://doi.org/10.1108/IJCCSM-11-2019-0064	social representation theory, climate change, coastal flooding, environmental psychology approach	Research article	Francia y Colombia

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
38	Maldonado, A., González, E., y Cruz, G.	Una aproximación a la representación del cambio climático en habitantes de dos cuencas del estado de Veracruz, México	2017	*Revista Pueblos y Fronteras Digital*	https://doi.org/10.22201/cimsur.18704115e.2017.23.291	educación ambiental, representación social, cambio global	Research article	México
39	Moloney, G., Leviston, Z., Lynam, T., Price, J., Stone-Jovicich, S., & Blair, D.	Using social representations theory to make sense of climate change: What scientists and nonscientists in Australia think	2014	*Ecology and Society*	http://dx.doi.org/10.5751/ES-06592-190319	adaptation, climate change, social representations theory, word associations	Research article	Australia
40	Moscardo, G.	Social representations of climate change: Exploring the perceived links between climate change, the drive for sustainability and tourism	2012	*Tourism, climate change and sustainability*			Book chapter	*
41	Núñez, R.	Effects of climate change on the resources of the rural ecosystem, a view from farmer perspectives	2019	*Journal of Physics: Conference Series*	https://doi.org/10.1088/1742-6596/1386/1/012147		Research article	Colombia
42	Núñez, R., Carvajal, J., Carrero, D., Ramírez, L., & Sánchez, J.	Representations of Colombian Andean farmers on climate change and mitigation and adaptation strategies	2021	*Revista de Economía e Sociología Rural*	https://doi.org/10.1590/1806-9479.2021.220439	agriculture, climate change, social representations	Research article	Colombia
43	Schliephack, J., & Dickinson, J.	Tourists' representations of coastal managed realignment as a climate change adaptation strategy	2016	*Tourism Management*	https://doi.org/10.1016/j.tourman.2016.08.004	climate change, managed realignment, social representations, coastal erosion	Research article	Reino Unido

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
44	Wibeck, V.	Social representations of climate change in Swedish lay focus groups: Local or distant, gradual or catastrophic?	2014	*Public Understanding of Science*	https://doi.org/10.1177/0963662512462787	climate change, focus group, interaction, metaphor, objectification, social representations	Research article	Suecia
45	Caillaud, S., Kalampalikis, N., & Flick, U.	The social representation of the Bali climate conference in the French and German media	2012	*Journal of Community & Applied Social Psychology*	https://doi.org/10.1002/casp.1117	climate change, climate conference, social representations, France, Germany, media, triangulation	Research article	Francia y Alemania
46	Callaghan, P., & Augoustinos, M.	Reified versus consensual knowledge as rhetorical resources for debating climate change	2013	*Revue Internationale de Psychologie Sociale*	https://shs.cairn.info/journal-revue-internationale-de-psychologie-sociale-2013-3-page-11?lang=en	climate change, social representations, science communication, information-deficit model	Research article	Australia
47	Fernández, R., & Águila, J.	The increase of 2° C in climate change communication in Spanish newspaper *El País*	2015	*Razón y Palabra*	https://www.revistarazonypalabra.org/index.php/ryp/article/view/839	cambio climático, medios de comunicación, objetivo climático, 2°C	Research article	España
48	Höijer, B.	Emotional anchoring and objectification in the media reporting on climate change	2010	*Public Understanding of Science*	https://doi.org/10.1177/0963662509348863	anchoring, climate change, emotions, news media, objectification, social representations theory	Research article	Suecia
49	Jaspal, R., Nerlich, B., & Koteyko, N.	Contesting science by appealing to its norms: Readers discuss climate science in the *Daily Mail*	2013	*Science Communication,*	https://doi.org/10.1177/1075547012459274	climate change, skepticism, social media, social representation, public understanding, critical discourse analysis, social psychology	Research article	Reino Unido
50	Jaspal, R., & Nerlich, B.	When climate science became climate politics: British media representations of climate change in 1988	2014	*Public Understanding of Science*	https://doi.org/10.1177/0963662512440219	climate change, communication, media, qualitative, social psychology, social representations	Research article	Reino Unido

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
51	Jaspal, R., Nerlich, B., & van Vuuren, K.	Embracing and resisting climate identities in the Australian press: Sceptics, scientists and politics	2016	*Public Understanding of Science*	https://doi.org/10.1177/0963662515584287	climate change, identity media, scepticism, social representations	Research article	Australia
52	Kay, N., & Gaymard, S.	Climate change in the Cameroonian press: An analysis of its representations	2021	*Public Understanding of Science*	https://doi.org/10.1177/0963662520976013	Cameroon, climate change, media coverage, similarity analysis, social representations	Research article	Camerún
53	López, M., Florencia, M., Müller, G., Gómez, A., Staffolani, C., & Aragonés, L.	Climate change communication by the local digital press in Northeastern Argentina: An ethical analysis	2020	*Science of the Total Environment*	https://doi.org/10.1016/j.scitotenv.2019.135737	climate change, digital press, ethical perspective, social representations	Research article	Argentina
54	Olausson, U.	"We're the ones to blame": Citizens' representations of climate change and the role of the media	2011	*Environmental Communication: A Journal of Nature and Culture*	https://doi.org/10.1080/17524032.2011.585026	news media, media effects, media audience, public, social representation theory, climate change	Research article	Suecia
55	Pearce, W., & Nerlich, B.	'An inconvenient truth': A social representation of scientific expertise	2017	*Science and the politics of openness: Here be monsters*			Book chapter	Estados Unidos
56	Uzelgun, M., Lewinski, M., & Castro, P.	Favorite battlegrounds of climate action: Arguing about scientific consensus, representing science-society relations	2016	*Science Communication*	https://doi.org/10.1177/1075547016676602	deep disagreement, climate change contrarians, representations of science, argumentation, social representation	Research article	Portugal y Turquía
57	Banerjee, A., Schelly, C., & Halvorsen, K.	Understanding public perceptions of wood-based electricity production in Wisconsin, United States: The place-based dynamics of social representations	2017	*Environmental Sociology*	https://doi.org/10.1080/23251042.2016.1272181	public perceptions of technology, bioenergy, renewable energy, place-based approach, social representation theory, bioelectricity	Research article	Estados Unidos

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
58	Bigl, B.	Stop the frack! Exploring the media's portrayal of the social representation of an anti-fracking protest at the Baltic Sea	2020	*Environmental Communication*	https://doi.org/10.1080/17524032.2019.1651367	fracking, hydraulic fracturing, media coverage, social representation theory, public protest, grassroots communication	Research article	Alemania
59	Fischer, A., Peters, V., Neebe, M., Vávra, J., Kriel, A., Lapka, M., & Megyesi, B.	Climate change? No, wise resource use is the issue: Social representations of energy, climate change and the future	2012	*Environmental Policy and Governance*	https://doi.org/10.1002/eet.1585	climate change, emotions, energy, natural resource use, normative, social representations, sustainability	Research article	Hungría, Alemania, Escocia, República Checa y Países Bajos
60	Im, D. H., Chung, J. B., Kim, E. S., & Moon, J. W.	Public perception of geothermal power plants in Korea following the Pohang earthquake: A social representation theory study	2021	*Public understanding of science (Bristol, England)*	https://doi.org/10.1177/09636625211012551	enhanced geothermal systems (EGS), nuclear power plant, Pohang, earthquake, social representations theory (SRT)	Research article	Corea
61	Jaspal, R., & Nerlich, B.	Fracking in the UK press: Threat dynamics in an unfolding debate	2014	*Public Understanding of Science*	https://doi.org/10.1177/0963662513498835	communication, fracking, media, social representations theory	Research article	Reino Unido
62	Lynam, T., & Walker, I.	*Making sense of what enables and what constrains adaptation to climate change*	2011	*19th International Congress on Modelling and Simulation, Perth, Australia*	https://www.jstor.org/stable/26269988	sensemaking, adaptation, climate change, word associations, modelling	Conference paper	Canadá y Australia
63	Lynam, T.	Exploring social representations of adapting to climate change using topic modeling and Bayesian networks	2016	*Ecology and Society*	http://dx.doi.org/10.5751/ES-08778-210416	Bayesian network modelling, climate change adaptation, narrative, sense making, social representations, text analysis, topic modeling	Research article	Australia

ID	Authors	Title	Year	Journal	DOI/Link	Keywords	Type of document	Country
64	Olausson, U.	"Stop blaming the cows!": How livestock production is legitimized in everyday discourse on Facebook	2018	*Environmental Communication*	https://doi.org/10.1080/17524032.2017.1406385	social media, environmental communication, social representation theory, climate change, meat, lay sense-making	Research article	Suecia
65	Olausson, U.	Meat as a matter of fact(s): The role of science in everyday representations of livestock production on social media	2019	*Journal of Science Communication*	https://doi.org/10.22323/2.18060201	environmental communication, public understanding of science and technology, science and media	Research article	Suecia
66	Upham, P., Johansen, K., Bögel, P., Axon, S., Garard, J., & Carney, S.	Harnessing place attachment for local climate mitigation? Hypothesising connections between broadening representations of place and readiness for change	2018	*Local Environment*	https://doi.org/10.1080/13549839.2018.1488824	public objection, land use planning, engagement, place attachment, visioning	Review article	*
67	Wibeck, V., Hansson, A., & Anshelm, J.	Questioning the technological fix to climate change: Lay sense making of geoengineering in Sweden	2015	*Energy Research & Social Science*	http://dx.doi.org/10.1016/j.erss.2015.03.001	geoengineering, climate change, focus groups, social representations, public engagement	Research article	Suecia

Authors' contributions

Harumi Takano-Rojas: Conceptualisation; Data curation; Formal analysis; Research; Writing (original draft); Writing (review and editing).

Alicia Castillo: Conceptualization; Funding acquisition; Resources; Supervision; Writing (review and editing).

Pablo Meira-Cartea: Funding acquisition; Supervision; Writing (review and editing).

Artificial Intelligence (AI) Policy

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Development of competencies for participatory evaluation of sustainability and climate emergencies through the design of educational pathways

Desarrollar competencias para la evaluación participativa de la sostenibilidad y la emergencia climática mediante el diseño de itinerarios educativos

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Abstract:

In the context of the international climate emergency, it is essential to develop and research active and participatory learning initiatives in the university context that provide solutions based on environmental education for sustainability. This can be achieved through pedagogical approaches that integrate sustainability into the educational curriculum, with the aim of promoting the development of active, committed citizens. The main objective of this research is to promote the design of socio-educational pathways by groups of university students to help them learn to evaluate sustainability and climate emergencies in diverse contexts. The design of these paths should lead to active, participatory learning and the acquisition of competencies by the students. A mixed QUAL(quan) design was applied through a qualitative research workshop and a content analysis of the student-designed paths. The descriptive results show the profile and main characteristics of the paths designed. The qualitative analyses enabled the construction of comprehensive category systems and diagrams capable of explaining the relationships between the competencies developed and the proposals for improving sustainability on the university campus. The main conclusion is that designing environmental education paths plays a key role in helping groups of university students to learn about sustainability, to evaluate it and to come up with proposals for tackling the climate emergency on university campuses.

Keywords: environmental education, transversal competencies, educational paths, active learning, urban sustainability, climate emergency, competency assessment, higher education.

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Resumen:

En un contexto de emergencia climática internacional, se hace imprescindible desarrollar e investigar sobre iniciativas de aprendizaje activo y participativo en el contexto universitario que aporten soluciones a partir de una educación ambiental para la sostenibilidad. Esto puede realizarse a través de enfoques pedagógicos que integren la sostenibilidad en el currículo educativo con la finalidad de promover la formación de una ciudadanía activa y comprometida. Esta investigación tiene como objetivo principal promover en grupos de estudiantes universitarios el diseño de itinerarios socioeducativos, para que aprendan a evaluar la sostenibilidad y la emergencia climática en diferentes contextos. El diseño de estos itinerarios debe producir aprendizajes activos y participativos y permitir a los estudiantes adquirir competencias. Se empleó un diseño mixto CUAL(cuan) mediante un taller de investigación cualitativo y un análisis de contenido de los itinerarios diseñados por estudiantes. Los resultados descriptivos muestran el perfil y las características principales de los itinerarios diseñados. Los análisis cualitativos han conseguido construir sistemas de categorías y diagramas comprensivos capaces de explicar las relaciones entre las competencias desarrolladas y las propuestas de mejora de sostenibilidad en el campus universitario. Como principal conclusión, se pone en evidencia el papel clave del diseño de los itinerarios de educación ambiental para que los grupos de estudiantes universitarios aprendan sobre sostenibilidad, la evalúen y aporten propuestas para afrontar los desafíos de la emergencia climática en el campus universitario.

Palabras clave: educación ambiental, competencias transversales, itinerarios educativos, aprendizaje activo, sostenibilidad urbana, emergencia climática, evaluación de competencias, educación superior.

1. Introduction

In light of the urgent need to respond to the real climate emergency and to promote sustainability in urban areas, especially among university students, it is crucial to integrate environmental education and critical thinking in their learning experiences (Howlett et al., 2016; Reimers, 2024). This integration not only encourages a greater awareness of environmental challenges. It also fosters the development of a *sustainability culture* in cities and contributes to the achievement of the sustainable development goals (SDGs), especially SDG 11, "Sustainable cities and communities", and SDG 13, "Climate action" (UNESCO, 2017). Within this context, universities play a key role by promoting this sustainability culture among students and helping them develop a critical vision of their urban habitat, particularly in neighbourhoods and on university campuses.

If future generations are to build truly sustainable cities, both students and society in general must be aware of their socio-environmental impact (Díez-Gutiérrez & Palomo-Cermeño, 2022). This awareness must take the shape of specific actions that promote a more responsible and environmentally friendly lifestyle. This entails consciously reducing the consumption of natural resources, especially water and energy, and adopting practices that minimise the generation of waste and pollution.

Thus, urban sustainability becomes a primary goal. Evaluating how our daily actions affect our urban surroundings is essential in guaranteeing that our cities evolve sustainably and in harmony with the environment. In this regard, it is essential to have educational resources and strategies that facilitate a detailed evaluation. From this perspective, environmental education paths become especially relevant, as they provide a practical methodology for understanding and assessing the sustainability of urban spaces (Velasco-Martínez & Tójar-Hurtado, 2022).

1.1. Socio-educational pathways as a resource for evaluating urban sustainability

An urban socio-educational path is an educational tool that combines direct exploration and investigation of the urban setting with clear educational objectives. Medina et al. (2016) note that a path is a pre-set route with different stops along the way, which can take place in a natural and/or urban setting. According to Gallastegui and Rojas (2015), unlike city walks, which are primarily for leisure and tourism, socio-educational pathways are designed to promote an in-depth understanding of socio-environmental issues and urban dynamics. These authors point out that such paths are followed as a group, with a systematic, analytical approach and using observation guides and orientation by specialists in the subject matter (interpreters, instructors, etc.). They are created in a structured manner and usually include specific stops where awareness-raising activities take place, thus promoting critical reflection, environmental awareness and a commitment to sustainable urban practices (Fernández-Portela, 2017; Griffin et al., 2022). These activities are designed to actively engage the participants, promoting experiential learning that goes beyond mere observation, thus helping the students to learn behaviour that benefits the environment.

In addition, the students can actively participate in designing these socio-educational pathways, which not only boosts their relevance and effectiveness but also promotes more meaningful and committed learning (Martín-Jaime et al., 2022). By allowing the students themselves to design the paths, their educational value is enhanced, bolstering their ability to identify and address socio-environmental challenges more effectively.

In this regard, the design of socio-educational pathways plays a key role. Beyond engaging communities in the promotion of sustainable practices, they facilitate a deeper understanding of the environmental impact and the development of proactive behaviour in response to eco-social problems (Iglesias et al., 2020).

Designing socio-educational pathways is not only essential for promoting active, experiential learning but also reflects a significant step forward in the pedagogical approach (Ortega-Chinchilla et al., 2023). Originally focusing mainly on natural science, these paths now include social science, with a growing emphasis on heritage education. Furthermore, this approach now encompasses important new topics such as environmental concerns and the gender perspective. At the same time, the teaching resources used have also become more diverse, progressing from traditional tools like field notebooks and photographs to the integration of advanced digital technologies like Geographic Information Systems (GIS), augmented reality and social media, adapting to today's social and educational demands (Alcántara & Medina, 2019; Ortega-Chinchilla et al., 2023).

To design effective socio-educational pathways, it is essential to use active methodologies such as the participatory environmental diagnosis (Basulto et al., 2017). Methods like this not only enable participants to identify and manage the socio-environmental risks linked to climate change. They also encourage collaborative learning, active participation and comprehension of the socio-environmental impacts of decision-making that affects the quality of human life and the conservation of biodiversity (Basulto et al., 2017; Iglesias et al., 2020; Moncayo et al., 2023).

From this perspective, participatory environmental diagnosis fosters an understanding of the complexity and interconnection with nature through an eco-social teaching-learning process (Friend et al., 2023). It also promotes active participation in the research and decision-making processes (Bywater, 2014). Campos et al. (2020) also point out that participatory environmental diagnosis fosters the active participation of youths in identifying problems and coming up with proposals through collaborative, intercultural processes. Thus, youth engagement generates commitment and enthusiasm and ensures that the proposals respond to communities' actual needs. Moreover, efforts can be guided more effectively, harnessing the synergies among the diverse stakeholders and facilitating the participants' appropriation of the projects (Campos et al., 2020).

Another positive aspect of participatory environmental diagnosis is that it involves teamwork, autonomous learning and observation of sustainability supported by ICTs as tools for searching for information and recording quantitative and qualitative data and real images (Pedrosa et al., 2020). For example, urban paths for which mobile devices have been used as a teaching resource have shown to improve sensitivity and a pro-environmental attitude among secondary school students (Álvarez-Herrero, 2023). By participating in the design of the educational pathways, they can also learn the value of the cultural and natural heritage found in cities (Fernández & Ramos, 2015).

By combining participatory and transdisciplinary methodologies, educational pathways not only raise awareness about climate change and its impacts, but also guide communities toward more sustainable conduct (Tójar-Hurtado et al., 2022). For example, initiatives such as "Descarboniza! Que non é pouco" have shown that addressing specific audiences like older adults or rural women can strengthen the commitment to the eco-social transition and increase resilience in relation to the climate crisis (Iglesias et al., 2020). These focused approaches enable the participants to apply knowledge about their environmental impact and to act accordingly. In this regard, the inclusion of transdisciplinary approaches in the curriculum design improves the quality of environmental education by addressing real life scenarios and promoting integrated research (Yu & Chiang, 2017). Educational paths designed in a participatory way can foster citizen engagement leading to sustainability and a decrease in the effects of climate change because they rely on cooperative work and an analysis of reality observed and experienced through the senses (Dutta, 2022). Thus, these paths facilitate critical observation of sustainability in the immediate surroundings and promote a gratifying experience of participatory discovery, which enables students and the community to adopt sustainable daily habits and to advocate for pro-environmental governmental measures (Alcántara & Medina, 2019). In addition, educational pathways lead to life experiences that can influence the attitudes of future educational professionals when it comes to discussing the climate crisis and its effects. This idea is reinforced when the paths are designed in a collaborative way, as this promotes social interaction and joint learning about the prevention of and response to socio-environmental issues, as well as sparking an individual and collective commitment (Campos et al., 2020; Guimarães & Meira, 2020). It is also necessary for the path design to include environmental citizen fact sheets, which provide information and practical activities to raise awareness in young people about the importance of sustainability and the climate emergency (Thor & Karlsudd, 2020).

In this way, designing educational pathways is deemed to be an effective tool for developing socio-environmental competencies in university programmes, given their fundamental role in conveying skills, attitudes and values within the educational sphere (Velasco-Martínez & Tójar-Hurtado, 2022).

Therefore, implementing educational pathways as a pedagogical tool in combination with active, participatory and transdisciplinary methodologies is essential when addressing the climate crisis and bolstering university students' commitment to sustainability in urban communities.

In light of this framework of reference, this research aims to assess the effectiveness of collaborative socio-environmental path design as an educational tool to help students learn to evaluate urban sustainability. To achieve the overall goal, the following specific aims are proposed:

- To analyse the sub-themes of the paths designed for the purpose of assessing whether they properly reflect the fundamental principles and values of urban sustainability, so as to determine the students' understanding and application of these concepts.
- To evaluate the diversity and relevance of the activities proposed along the paths, seeking to understand how these activities facilitate practical learning and promote critical reflection by the students, which is essential in developing sustainability competencies.

- To identify the competencies acquired by the students in the course of the design process, in order to comprehend how this educational resource aids in the development of key skills like environmental awareness and active participation in sustainable initiatives.
- To assess proposals generated by students for improving university campus sustainability, with a view to evaluating their feasibility and potential impact, thus making it possible to analyse the students' capacity to apply their knowledge to real situations.

Accomplishing these aims will help determine how collaborative design of socio-environmental paths can serve as an effective educational tool, promoting not only the acquisition of key competencies to cope with the climate emergency but also fostering active citizenship committed to sustainability. This pedagogical approach is supported by previous research (Martín-Jaime et al., 2022; Thor & Karlsudd, 2020; Torres-Porras & Arrebola, 2018), which has highlighted the need to integrate sustainability into the educational curriculum, in order to educate students that are capable of confronting today's eco-social challenges. Thus, this study aims to contribute to the academic discussion about the effectiveness of these approaches in higher education, underscoring the importance of both meaningful and collaborative learnings as a means of empowering students and making them agents of change within their communities.

2. Methodology

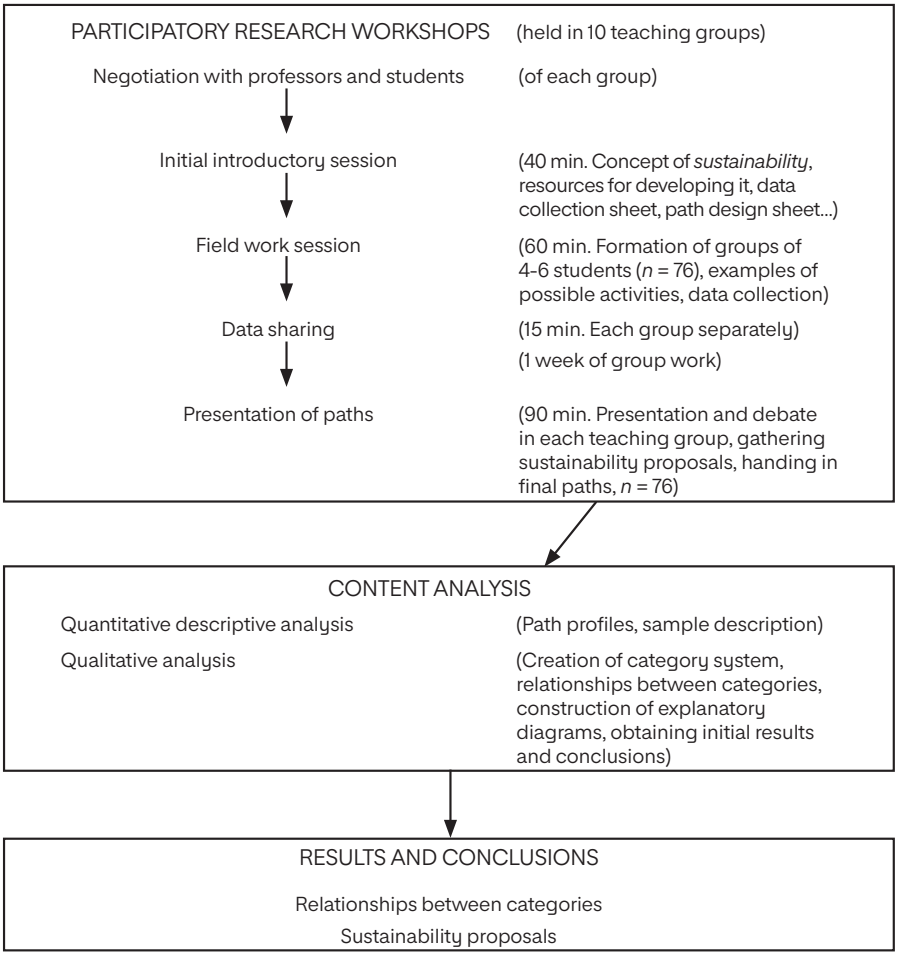
This study can be classified as a participatory action research approach (Cornish et al., 2023) in which the main methods used are the participatory research workshop (Huttunen et al., 2022) and qualitative content analysis (Mayring, 2021). Participatory research workshops are collaborative sessions that engage members of the community (in this case the educational community), researchers and other stakeholders in the research process for the purpose of tackling socio-educational problems by creating collective knowledge (Cornish et al., 2023). Qualitative content analysis is a systematic method for interpreting qualitative data, which focuses on identifying and describing the underlying meanings in texts and entails an inductive analysis of textual data to form typologies and to categorise themes (Tunison, 2023).

The research design can be classified as a mixed QUAL(quan) approach according to the classification by Creswell and Plano-Clark (2018). The quantitative part used a descriptive design that made it possible to describe the main characteristics and average profile of the paths designed. The qualitative part was present from the initial negotiation with students and professors regarding the organisation of the research workshops through to the content analysis of the paths designed by the groups of students and the public presentation thereof.

As part of several subjects in the pedagogy, early childhood education, primary education and social education degree programmes at the University of Malaga, the instructors of these programmes led participatory research workshops to equip the groups of students with resources so that the latter could design paths to evaluate the sustainability of the university campus in Malaga, bearing in mind the current climate emergency situation. Each participatory research workshop held in each subject included one initial session in the classroom (40 minutes), where diverse contextualised resources were shared for the path design and data collection. One session conducted outside the classroom (60 minutes) showed an example path for the class group (divided into teams of approximately 5 members) with materials for gathering data, such as log sheets, mobile phones, etc. At this session, they were shown options in the field for developing diverse sub-themes related to sustainability (waste, energy, adapting to climate change, mobility, connection to nature, etc.), as well as certain dynamic activities for working on and evaluating a number of aspects related to sustainability. After the session outside the classroom was finished, the students were given extra time (15 minutes) to finish gathering and coordinating the data collection, in addition to one week outside of class to prepare a complete version of their own path for evaluating sustainability in one or more specific sub-themes. The

following week, in the classroom, the student groups gave participatory presentations of the paths they had designed, opening up a debate about the competencies acquired during the course of the sessions and the proposals they made for improving the university campus. A more comprehensive description of the didactic methodology used in each participatory research workshop can be found in Martín-Jaime et al. (2022). Figure 1 shows a methodological flow chart with the different phases involved in the research.

FIGURE 1. Methodological flow chart.



In the research, 405 students and 5 instructors took part, divided into 10 teaching groups of subjects included in the pedagogy, early childhood education, primary education and social education degree programmes of the Faculty of Educational Science of the University of Malaga in the 2022/23 and 2023/24 academic years. The student groups designed a total of 76 different paths, which represented the main documentary material for the development of the content analysis (*n* = 76).

Therefore, the sample considered comprises the paths designed by the student groups in the participatory research workshops (*n* = 76). These paths, and the sustainability proposals they contain, were prepared by 76 working groups (of 4 to 6 students) in 10 groups/subjects in the pedagogy, early childhood education, primary education and social education degree programmes at the University

of Malaga. The usual sampling in the participatory research workshops and in the participatory action research fits with the collaborative and community characteristics of this approach. Unlike more traditional approaches, where statistical representativeness is crucial, in participatory research the aim is to engage the people and the community in the process. In this case, it can be said that a sampling method similar to that used by Erro-Garcés and Alfaro-Tanco (2020) was applied, based on production (paths) and the sustainability improvement proposals made by the student groups.

Table 1. Main features of the sample used.

Feature	Detail
Sectors involved (number of members)	Researchers (3), instructors (5), students (405)
Degrees considered (Faculty of Educational Science of the University of Malaga)	Pedagogy, early childhood education, primary education and social education degree programmes
Groups/subjects	10
Number of working groups (4-6 members)	76
Number of paths designed/sample size	76

The SPSS statistics package v. 29 (2022) was used for the quantitative descriptive analysis. The content analysis, reduction, categorisation, study of relationships and graphing was done with Atlas.ti 23 (2023). The graphics/descriptive and comprehensive frameworks (Miles et al. 2019) were published and enhanced in Microsoft Office Professional (2021). For the purposes of transparency, and to make it possible to replicate it, all the raw data from the research was published in the RIUMA institutional repository. The file can be found under the following link: https://hdl.handle.net/10630/32551

In conducting the research and writing the manuscript, the principles of academic integrity have been observed, such as prevention of plagiarism, falsification and fabrication of data, false co-authoring and attribution of results. The research project was also given a positive assessment by the Ethics Committee of the University of Malaga for studies involving humans (CEUMA Record No. 34. Code 47-2023-H).

3. Results

The results are presented in two separate parts. The first contains the quantitative descriptive analyses. These analyses were conducted with direct data (number of paths, path type, etc.) and with processed data (categories constructed on the basis of qualitative inductive analysis, based on the data, for the sub-themes used, the activity typologies and the learning methodologies), which were subsequently quantified. The second part contains the qualitative analyses conducted about the students' perception of the competencies acquired and the proposals for improving the sustainability of the university campus.

3.1. Quantitative descriptive analysis

A total of 76 paths designed by different small student groups were considered. Of these, 64.9% were linear paths, while the remaining 35.1% were circular. Circular paths are routes that begin and end at the same point, which facilitates integration of different stages of the journey into a single trail. Linear paths, on the other hand, have a starting point that differs from the final destination, which makes it possible to explore larger areas without having to return to the point of origin. Both path options were proposed to provide a variety of spatial and didactic experiences for the students. The groups were composed of 4 to 6 members in most cases

(mean = 5.3). The creation of groups of 4 to 6 students responds to the need for teams that were small enough to foster active participation by all the members but at the same time large enough to generate enriching discussions. Furthermore, the group size was designed to ensure fluid dynamics in the field work, enabling each student to play different roles within the team. The sub-themes addressed most often are shown in Table 2. As illustrated, the most commonly addressed themes are the connection to nature and sorting waste (72.6%). The activities in 41.1% of the paths touched on themes related to healthy spaces and low levels of pollution (air, noise, light, etc.). Recreation and community well-being (improved co-existence) figure prominently, being mentioned in 34.2% of the paths designed. Other relevant issues are mobility (31.5%), inclusiveness (27.4%) and responsible consumption (27.4%). This latter theme would become more relevant if linked to other paths dealing with the local economy and responsible trade (4.1% more). Other sub-themes represented in more than 10% of the paths (specifically 12.3%) are renewable resources and energy, urban planning and sustainable architecture.

Table 2. Sub-themes most commonly addressed by the student groups in the paths designed.

Sub-theme	Frequency	Percentage
Connection to nature	53	72.6
Sorting waste	53	72.6
Healthy spaces: low levels of environmental pollution (air, noise, light, etc.)	30	41.1
Recreation and community well-being (improved co-existence, health, etc.)	25	34.2
Mobility	23	31.5
Responsible consumption	20	27.4
Inclusiveness (disabilities, accessibility: urban barriers, adaptation of public infrastructure, etc.)	20	27.4
Adapting to climate change (climate shelters, shaded areas, green spaces and corridors, etc.)	14	19.2
Renewable resources and energy (solar panels, battery charging, etc.)	9	12.3
Urban planning and sustainable architecture	9	12.3
Recreation and community well-being (improved co-existence, health, etc.)	9	12.3
Citizen engagement and local governance	4	5.5
Art and preservation of historical and architectural heritage	4	5.5
Resilience and urban recovery capabilities	4	5.5
Local economy and responsible trade	3	4.1
Others (leisure, complexity, isolation)	3	4.1

Note: the percentages do not come to a total of 100, and the frequencies are not equal to the total number of paths (n = 76) because several sub-themes may be addressed in a single path.

The paths designed by the student groups in a participatory manner had an average duration of 169 minutes (approximately 2 hours and 49 minutes). Sketches of the route and scheduled stops were often presented (63.9%), detailed information of interest was furnished along with key concepts to be developed at each milestone (81.4%), in addition to topics for reflecting on sustainability and encouraging participation (85.9%). For the most part, the paths consisted of 4 to 5 stops or milestones where a wide range of activities was proposed, taking advantage of the resources offered in each location. The most frequent activity typologies are shown in Table 3. Cooperative or group dynamic games ranked above all other types of activities (73.7%). Activities involving the identification of flora or fauna species are also predominant (43.4%). Other types of activities commonly used in the paths designed by the students were games that trigger the senses and evaluation and closure activities (30.35% each).

Table 3. Activity typologies included in the paths designed by the students.

Activity typology	**Frequency**	**Percentage**
Cooperative or group dynamic games	56	73.7
Species identification (flora and fauna)	33	43.4
Game to trigger the senses (observing, listening, smelling, touching, etc.)	23	30.3
Evaluation or closure activities	23	30.3
Creative activities (decorating, painting, designs like bracelets, flowerpots, toys, etc. using recyclable materials)	22	28.9
Workshops (soap, composting, food, responsible consumption, road safety, etc.)	20	26.3
Urban recovery, repair or redesign (drawing the bike lane lines, planting, etc.)	17	27.4
Guided exploration activities (orientation games, obstacle courses, escape room, etc.)	16	21.1
Collaborative cleaning and waste identification/collection	14	18.4
Introduction dynamics	11	14.5
Use of mobile applications	10	13.2
Demonstrations and experiments (e.g., footprint measurement, compost testing, building small habitats for wildlife such as insects or birds, water filtering, making recycled paper, etc.)	9	11.8
Creating informative materials and channels (posters, networks, etc.)	7	9.2
Debates or round tables	6	7.9
Bicycle/scooter tours	6	7.9
Others	< 6	< 7

Note: the percentages do not come to a total of 100, and the activity frequencies are not equal to the total number of paths (n =76) because several types of activities may take place in a single path.

The most common didactic methodology is cooperative and collaborative learning (90.9%). In second place, game-based learning/gamification was used (58.45%), followed by learning based on workshops (49.4%). Ranked from highest to lowest, the master class/lecture comes in fourth place (20%), with other, more innovative, methodologies reaching percentages of less than 20%: discovery learning (14.3%), problem-based learning (e.g., researching and proposing solutions for reducing noise pollution at key points on campus) (13%), dialogic learning (e.g., discussing different approaches for dealing with environmental problems) (10.4%), movement-based learning (e.g., jumping games, running, bike races) (10.4%) and transformative learning (9.1%). The other methodologies did not reach 8% (fewer than 7 paths included them).

3.2. Qualitative content analysis

After designing the paths, the student groups reflected on what they had learnt and the competencies acquired. They also drew up proposals for improving campus sustainability based on the learning activity they had done. A qualitative content analysis was conducted of these contributions, in addition to the design of a path to evaluate the sustainability and climate emergency on the university campus. This process involved establishing preliminary categories based on the texts prepared (paths) by the student groups. These initial categories were then refined and redefined in recurring verification processes and, at the same time, relationships between them were established without losing sight of the students' literal expressions.

The process and results obtained in relation to the competencies acquired are summarised below, in addition to the proposals for improving campus sustainability.

3.2.1. Competencies acquired and learning

The process of categorising the competencies acquired led to 5 main categories:

- Environmental awareness and education (EAE): awareness about environmental damage and the interconnectedness of all life forms, recognising natural resources and the impact on the city centre, importance of social and environmental education, spotlighting biodiversity in urban settings, and awareness about the energy crisis and climate emergency.
- Personal and collective engagement (PCE): participation and importance of awareness and shared responsibility, citizen collaboration and smart urban planning, environmental impact of industry and multinationals, and assessment of individual actions for improving the planet.
- Sustainable practices and life habits (SPLH): activities such as reducing, reusing and recycling waste; water and energy savings; use of public transport and sustainable mobility; responsible and local consumption (km 0), and the importance of teamwork and cooperation.
- Urban environmental care and management (UECM): care for and maintenance of public spaces, importance of green areas and natural spaces in the city, urban renaturing and creation of urban gardens, proper waste management and use of organic fertilisers, and encouraging accessibility and healthy spaces.
- Sustainable development goals (SDGs): SDGs and protecting the planet; ending poverty and developing inclusive, safe, resilient and sustainable cities; and lifelong education and the achievement of a just society for present and future generations.

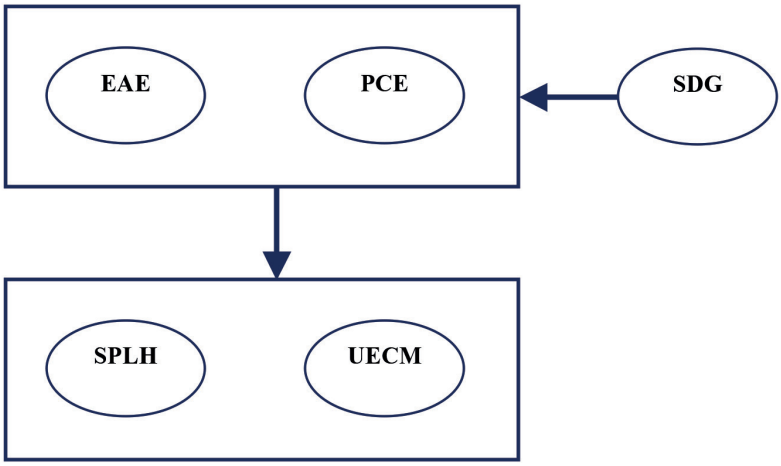
Table 4 shows these 5 categories related to learning outcomes and the competencies developed (each with the corresponding code), their definitions (in the second column) and some examples of literal statements made by the groups, based on which they were constructed.

TABLE 4. Categories constructed on the basis of the competencies acquired and learning outcomes after designing the paths for evaluating sustainability.

Category (code)	Definition	Literal statements [coding]
Environmental awareness and education (EAE)	Understanding the negative impact of our actions, recognising natural resources required for urban life, and environmental education as a key tool for change.	"Human beings are capable of transforming the environment; in this process, we often harm nature and overuse its resources." [IJC19:01]; "Thanks to what we have learnt, we can become more aware of the need to help care for the environment and to change certain structures." [IJJ00:02]
Personal and collective engagement (PCE)	Taking on shared responsibility and citizen collaboration to achieve sustainability.	"We believe the public [students, in this case] should be educated in this area because this is a collective commitment." [IJC18:02]; "Importance of personal engagement in solving problems." [IJJ14:01]
Sustainable practices and life habits (SPLH)	Performing actions like recycling, reuse, sustainable mobility and responsible consumption.	"Reusing vs recycling." [ILV00:01]; "Importance of sustainable mobility." [IJJ29:01]
Urban environmental care and management (UECM)	Maintaining and enhancing green spaces, properly managing waste and ensuring accessibility and health in urban spaces.	"Importance of trees in the city, accessibility, urban infrastructure." [IJJ04:01]; "Care for public spaces, reducing and sorting waste, urban renaturing and accessibility." [IJC00:01]
Sustainable development goals (SDG)	Relating urban sustainability to the SDGs, focusing on protecting the planet, creating resilient, inclusive cities and lifelong education for a just society.	"It should be noted that this is related to the SDGs [sustainable development goals], given that these goals help protect the planet and ensure that it prospers, as well as ending poverty." [ILV11:03]; "Going through these dynamics, we have learnt in a highly visual and entertaining way how to put many of the sustainable development goals [SDGs] into practice at our own university." [IJC14:01]

The competencies developed throughout the course of the research workshop process (including the path design by student groups aimed at evaluating university campus sustainability), which are represented by the 5 categories above, were arranged into an explanatory diagram that helped to understand the relationships between categories and macro-categories. Thus (see Figure 2), educational and environmental values (categories EAE and PCE), awareness and engagement, along with knowledge (in this case, conceptualised as SDGs), are what spark certain individual and collective activities (categories SPLH and UECM), sustainable practices, life habits, urban environmental care and management.

FIGURE 2. Relationships between categories: competencies acquired.



3.2.2. Proposals for university campus sustainability

The process of categorising the proposals for university campus sustainability within a climate emergency setting provided 8 main categories:

- Sustainable mobility (SM): increasing bicycle and scooter parking spaces, improving and maintaining bike lanes and promoting the use of public transport and vehicle sharing.
- Waste management (WM): increasing the number of recycling bins on campus and in the classrooms; including accessible bins with information in Braille; creating a specific bin in the cafeteria for composting and promoting the use of products with less packaging and greater proximity and more organic products.
- Renewable energy (RE): increase in solar panels, lighting powered by solar energy and USB charging stations with solar panels.
- Green spaces and biodiversity (GSB): this includes ideas related to planting more native and fruit trees, improving and promoting the university's vegetable gardens and encouraging use thereof, creating and maintaining gardens and green areas with local biodiversity, integrating fauna and flora in specific areas of the campus, and carrying out educational practices and activities in green spaces.
- Responsible use of resources (RUR): increasing air and water quality through regulating water use with push-button taps and toilets, improving irrigation systems, creating exclusive spaces for smokers...
- Sustainable diet (SD): eating local foods and reducing waste, donating leftover food to charity canteens, offering local and sustainable food options in cafeterias or implementing a system for selling leftover food at a discount.

- Accessibility and inclusion (AI): adapting the campus for people with reduced mobility through placing ramps and improving the paving, creating accessible bins, etc.
- Environmental awareness and education (EAE): raising awareness and participation in sustainability through workshops, seminars and educational activities; advertising and raising awareness about the importance of recycling and sustainable practices; encouraging the use of reusable utensils in the cafeteria through discounts and vouchers; promoting active participation in sustainability projects; and conducting awareness-raising campaigns about waste and energy conservation.

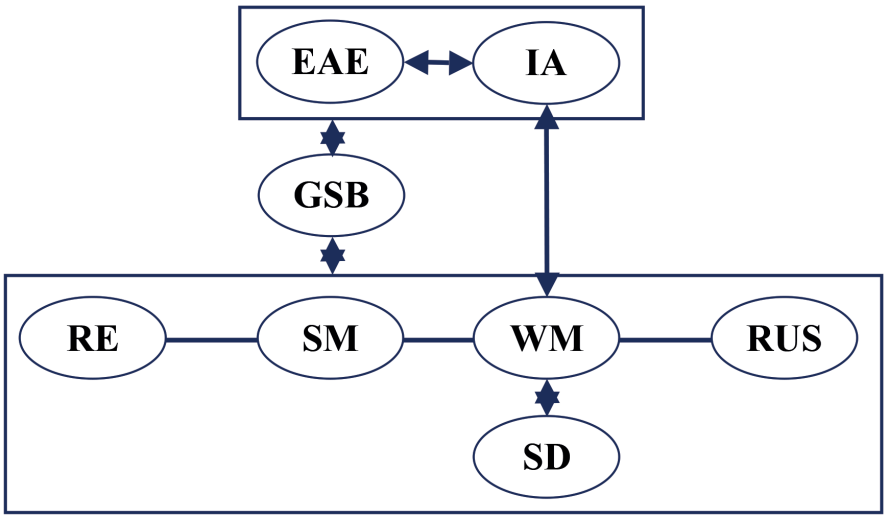
The arrangement of the groups' proposals into 8 categories shows the concerns of the students who took part in the participatory learning experience. Notably, this arrangement into 8 categories includes one category that is similar to the previous classification of the competencies developed and learning acquired, but from a different perspective. Table 5 outlines the categories and includes examples of literal statements that support their establishment.

TABLE 5. Categories constructed on the basis of the competencies acquired and learning outcomes after designing the paths for evaluating sustainability.

Category (code)	Literal statements [coding]
Sustainable mobility (SM)	"Designing safe and attractive pedestrian and cycling spaces." [IJJ25:01]; "It would be very helpful to the environment if we used individual vehicles less and took advantage of public transport." [IJJ17:03]
Waste management (WM)	"Creating a compost bin for the cafeteria." [IJC03:04]; "Placing recycling bins in many areas of the campus to avoid mixing different types of waste." [IJC09:01]
Renewable energy (RE)	"Providing more solar panels for devices." [ILV10:02]; "Regulating water: taps and toilets should run for five seconds." [IJJ22:01]
Green spaces and biodiversity (GSB)	"Caring for 'green' spaces where there are vegetable gardens and fruit trees." [IJJ04:01]; "Establishing a flora and fauna environment in specific areas of the campus." [IJC14:03]
Responsible use of resources (RUR)	"Promoting responsible use of natural resources." [IJJ38:10]; "Controls should be operated by push buttons rather than turning. This will help us properly control water and water resources." [IJJ22:02]
Sustainable diet (SD)	"Offering local and sustainable food options in the university cafeterias and encouraging a reduction of food waste." [IJJ31:01]; "Donating leftover cafeteria food to charity canteens." [IJC02:02]
Accessibility and inclusion (AI)	"Accessibility to spaces and infrastructure." [IJJ06:01]; "Adapting bins to make them accessible." [IJJ20:01]
Environmental awareness and education (EAE)	"Increasing the use of open, natural spaces and teaching classes and/or activities near nature. The aim is to encourage a connection to and awareness of nature." [ILV00:01]; "Awareness-raising programmes about recycling and climate change." [ICL01:01]

The 8 categories created from the student groups' sustainability proposals are arranged into an explanatory diagram that helps to understand the relationships between categories and possible macro-categories. Thus (see Figure 3), the categories of environmental awareness and education (EAE) and accessibility and inclusion (AI) were combined into a macro-category of *values*. The AI category is directly linked to waste management (WM), which is, in turn, related to sustainable diet (SD). These latter two categories (WM and SD), along with renewable energy (RE), sustainable mobility (SM) and responsible use of resources (RUR), form the other main macro-category: *proposals for efficient use of resources*. These two macro-categories are linked to a central category that provides the connection to green spaces and biodiversity (GSB). The category of environmental awareness and education (EAE), which is also present in the analysis of competencies developed and learning acquired, provides the link between these two explanatory diagrams (Figures 2 and 3), highlighting the relevance of this category in the development of environmental awareness and education for the promotion of sustainability on the university campus.

FIGURE 3. Relationships between categories: proposals for sustainability on the university campus.



4. Discussion and conclusions

This research analysed the paths designed by university students with the aim of evaluating university campus sustainability through a quantitative and qualitative approach.

In the first part, the quantitative results made it possible to define the profile and main characteristics of the paths designed by the student groups. As a result, the participating students proposed diverse types of dynamic, motivating activities at the different stops or milestones along the path.

Collaborative games, identifying species, themed workshops, creative activities, collaborative waste clean-up and planting for the renaturing of the campus, in particular, were proposed. The use of mobile applications for some of these activities is worth noting, especially for activities involving identification of plant species on the campus. This coincides with the study by Pedrosa et al. (2020) and highlight the educational benefits of using technology in the design and execution of educational pathways. Liceras (2013, 2018) also points out the advantages of creating paths in nearby, familiar places for the students, such as the university campus, because these familiar settings facilitate the use of prior knowledge, bolster a sense of identification with the surroundings and are easy to access.

Furthermore, the design of the paths provided some important key data that would be developed at each milestone and also an approach to thought-provoking topics for pedagogical reflection on the different sustainability sub-themes, which encourage active, shared learning. In this regard, Gallastegui and Rojas (2015) note that paths are effective in sparking curiosity and an interest in discovery. They also emphasise the importance of promoting exchanges of ideas and emotions, in addition to cooperation, because these are essential aspects in the process of constructing knowledge and solving problems. Boulahrouz (2021) also underscores that urban field outings can trigger new questions, which prompts critical thinking while at the same time applying the acquired knowledge and gaining experience in a familiar setting. The most common types of didactic methodologies were cooperative and collaborative learning, followed by gamification and workshop-based learning, which indicates a tendency toward dynamic, participatory methods (Baldwin, 2016; Martínez-Valdivia et al., 2023). It has been shown that integrating scientific knowledge, innovative pedagogical practices and community participation creates a democratic, participatory educational setting that strengthens values and competencies, thus achieving affective and emotional objectives that are aligned with the principles of environmental education (Andrade & Figueiredo, 2021).

In the second part of the study, the qualitative analysis provided crucial information about the competencies acquired by the students and their proposals for improving sustainability on the university campus (García-Hernández, 2020). In this regard, Gallastegui and Rojas (2015) emphasise that designing paths facilitates the development of competencies in ethical, socio-political and scientific areas and communication by providing a structured, contextualised setting in which students can apply and reinforce these skills through active practice and reflection. Specifically, authors like Martínez-Hernández et al. (2021), Medina et al. (2016) and Valverde-Fernández et al. (2018) agree that student-designed paths promote the development of key competencies such as linguistic communication, scientific and digital competencies and skills for learning to learn through experiential, collaborative activities. In addition, these authors found that this approach fosters social and civic competencies, as well as cultural awareness, by allowing students to explore and reflect on historical, environmental and social topics that are relevant within their urban environments.

The main conclusion is that designing environmental education paths has been found to play a key role in helping groups of university students to learn about sustainability, to evaluate it and to come up with proposals for tackling the climate emergency on university campuses. The analyses reveal that the participants developed a profound understanding of environmental education and awareness and of the importance of adopting sustainable practices and responsible life habits. The qualitative results suggest that the socio-educational path was an effective tool for achieving competencies and learning related to diverse key aspects of urban sustainability, such as saving water and energy, promoting the use of public transport for sustainable mobility, responsible and local (km 0) consumption and appreciation of green areas and natural spaces in the city, along with accessibility (Álvarez-Herrero, 2023; Fernández & Ramos, 2015). Furthermore, the students linked these actions to ending poverty and developing inclusive, safe cities that are resilient to the climate emergency, in line with previous studies by Alcántara and Medina (2019), which highlight the educational potential of paths to promote comprehensive environmental education and the acquisition of competencies for evaluating urban sustainability. These emerging categories show how the learning experiences contribute to the students' personal and professional development, highlighting their perception of the active role in sustainability and the integration of innovative methodologies in the educational process. The analysis reveals that the active approach and the participatory environmental diagnosis methodology used in the educational path not only fosters the acquisition of technical knowledge but also promotes a meaningful change in attitude toward sustainability and environmental management (Basulto et al., 2017).

Likewise, the proposals for improvement prepared by the students reflect a strong commitment to sustainability and suggest specific areas for implementation of more effective environmental practices on campus. The proposals for improving university campus sustainability focus on several key areas. When it comes to sustainable mobility,

the recommendations include fostering the use of bicycles and electric vehicles, promoting public transport and car-pooling and installing stationary bicycles to generate power for lighting. In waste management, they suggested increasing the number of recycling and composting bins, implementing accessible options with labels in Braille and adding waste bins with ashtrays for cigarette butts. Regarding renewable energy, they advocated increasing the use of solar panels and installing solar-powered lampposts and solar-powered USB charging stations. To improve green spaces and biodiversity, planting more native trees, improving the urban garden, maintaining gardens with local biodiversity and integrating flora and fauna on the campus was proposed. In terms of accessibility and inclusion, adapting ramps, placing bins at accessible heights and creating distinct paths in nature areas was recommended. To bolster environmental education and awareness, organising workshops and activities about sustainability, promoting the use of reusable utensils and carrying out awareness-raising campaigns was suggested. In terms of the responsible use of resources, improving water management by installing taps and toilets operated by push buttons, optimising irrigation systems and creating exclusive spaces for smokers was proposed. Finally, in relation to sustainable diet, the suggestions included donating leftover food, offering local, sustainable options and implementing a system for selling leftover food at a discount. Similar results were found in the study by Boulahrouz (2021), in which the students analysed the conditions of an urban area in Girona and came up with proposals for improving it in light of social and/or environmental sustainability criteria. Diverse aspects of sustainable development were addressed in the improvements, most notably, topics like urban planning, sustainable agriculture, biodiversity, energy and civic participation. Likewise, ties to a number of sustainable development topics were established, working around some of the SDGs. This author notes that, as the youths begin to identify the sustainable development problems that affect their communities, they can turn them into daily actions aimed at living sustainably.

Thus, the findings suggest that this kind of educational intervention can serve as a model for future initiatives in environmental education and urban sustainability. However, the study has also identified areas that require future research and enhancement. It is essential to more closely analyse the objectives and activity sequence, the resources used and the students' degree of engagement in implementing the proposals for improvement. In addition, through long-term monitoring it will be possible to evaluate the impact of these paths in terms of sustainable practices and university culture in general.

To conclude, the results highlight the value of active, participatory methodologies and designing educational pathways as effective tools for promoting sustainability and competency-based learning. Furthermore, these methodologies foster collaboration among students, the development of critical and analytical skills and social responsibility (Carbonell et al., 2023). The paths not only educate about environmental issues, but also inspire university students to become agents of change in their communities, promote civic commitment and bolster the ability to work as a team to resolve complex problems (López & Segura, 2013). This study offers an analysis of a promising, innovative resource for sustainability education in university settings, opening up new channels for enriching and expanding educational practice in this field.

Authors' contributions

Leticia-Concepción VELASCO-MARTÍNEZ: Conceptualisation; Formal analysis; Methodology; Validation; Writing (original draft); Writing (review and editing).

Juan-Jesús MARTÍN-JAIME: Conceptualisation; Resources; Supervision; Visualisation; Writing (original draft); Writing (review and editing).

Juan-Carlos TÓJAR-HURTADO: Data curation; Formal analysis; Funding acquisition; Methodology; Project administration; Research; Results, Software; Writing (review and editing).

Artificial Intelligence (AI) Policy

The authors do not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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Climate narratives in educational agendas: On the value of time for pedagogical research and environmental policies

Las narrativas climáticas en las agendas educativas: sobre el valor del tiempo para la investigación pedagógica y las políticas ambientales

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Abstract:

A matter of time. This could be, in its connotations that are most open to scientific, pedagogical and social interpretation, the principal claim referred to by arguments in which are projected the reflective, methodological, empirical, and documentary concerns of the text we present regarding climate narratives in the educational agendas of the third millennium. In any case, the fact that their approaches raise a wide and varied range of questions about the *value of time* for pedagogical research and socio-environmental policies cannot be ignored. From this perspective, the aim of this article is to emphasise the importance of educating in time, without further delay, about the challenges posed by the climate emergency, promoting systematic and rigorous research on key issues so that they are addressed in education and society; especially when the slow convergence between climate and education policies can be observed, illustrated here by the Spanish case. We conclude by highlighting that educational research must take into account the rhythms of the crisis: from the temporal dimension (synchronic and diachronic) inherent to anthropogenic climate change, up to the dimension that must be incorporated, as a key factor, in any socio-ecological transition that promotes lifestyles that are ecologically and socially sustainable, fair, and equitable.

Keywords: educational policies, environmental policies, environmental education, climate emergency, pedagogical research, social times.

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Resumen:

Cuestión de tiempo. Esta podría ser, en sus connotaciones más abiertas a una interpretación científica, pedagógica y social, la principal afirmación a la que se remiten los argumentos en los que se proyectan las inquietudes reflexivas, metodológicas, empíricas y documentales del texto que presentamos en torno a las narrativas climáticas en las agendas educativas del tercer milenio. En todo caso, sin poder obviar que sus planteamientos suscitan una amplia y diversificada gama de cuestiones sobre el *valor del tiempo* para la investigación pedagógica y las políticas socioambientales. Con esta perspectiva, el objetivo principal del texto reside en enfatizar la importancia de educar a tiempo, sin más demoras, en los desafíos que impone la emergencia climática y de promover investigaciones sistemáticas y rigurosas en torno a cuestiones clave para su afrontamiento en la educación y la sociedad; sobre todo cuando se está constatando la lenta convergencia que existe entre las políticas climáticas y educativas, ejemplificado aquí con el caso español. Concluiremos destacando que la investigación educativa debe tener en cuenta los ritmos de la crisis: desde la dimensión temporal (sincrónica y diacrónica) inherente al cambio climático antropogénico hasta la que deberá incorporarse como un factor clave en cualquier transición socioecológica que promueva estilos de vida sostenibles, justos y equitativos en términos ecológicos y sociales.

Palabras clave: políticas educativas, políticas ambientales, educación ambiental, emergencia climática, investigación pedagógica, tiempos sociales.

1. Introduction

Beyond the characterisation of time as something biological, physical, or mathematical, we invoke it as a social and cultural construct that is present in every individual, starting with our own existence, which is in itself temporal (Merleau-Ponty, 1975; Safransky, 2017). Nothing or almost nothing is foreign to it in our readings of the world and its realities, whatever our perspective on them, historical or forward-looking, circumstantial or universal.

Almost all scientific fields (Araujo, 2020) concern themselves with the time and times into which their symbolic and material components are implicitly or explicitly arranged, not just as an object of study but also as an indicator (more or less objectifiable, measurable or perceptible) of our particular ways of relating to nature and life, including everything that concerns education (Gimeno, 2008).

Temporal coordinates are undoubtedly inseparable from any judgement we make of sustainability. Also from a political position, when this expression is included in proposals regarding sustainable development, essentially since the preparation and publication of what is known as the *Brundtland report*, originally entitled *Our common future*, which defines it as that which meets the needs of the present without compromising the capacity to satisfy the possible needs of future generations (World Commission on Environment and Development, 1992).

The Declaration approved at the Rio de Janeiro Earth Summit of June 1992 used this definition, which was incorporated years later into the main axes of the World Summit on Sustainable Development, held in September 2002 in Johannesburg. Since 2015, it has been one of the principal identifying and conceptual references of the 17 sustainable development goals (SDG) adopted at the 70th General Assembly of the United Nations, with the 169 economic, social, and environmental objectives set out in the 2030 Agenda, converging with the strategies aimed at fighting global warming and climate change.

Time is a fundamental vector in development processes and their links to growth, with the ambiguities that have arisen regarded the maintenance of the rhythms in which it is projected

diachronically and synchronically. The desire to be ecologically and socially sustainable is a risky experiment in the complicated task of giving ourselves time to survive, in a context where any tangible present matters much more than any more or less foreseeable future (Roca, 2016). Insisting that humankind is threatened, however much its crises (economic, environmental, social, health, etc.) worsen, still does not activate ways of thinking and acting that meet up to the urgency of a future that is as uncertain as it is inevitable (Innerarity et al., 2024).

We allude, among other circumstances, to those that since the late 20th century have insisted on decisively and without delay confronting the main socio-environmental problems that the planet and humankind face, subjected (as never before) to the tensions provoked by poverty, hunger, social inequality, armed conflicts, loss of biodiversity, pandemics, the retreat of democracies, and demographic imbalances caused by migratory processes and the displacement of rural communities to cities. The world's population exceeding 8.2 billion people urges us to scale the transitions (ecological, demographic, energy, digital, cultural, etc.) in a way that looks to the future, and as such is temporal, with criteria of justice, equity, honesty, etc., that require changing everything for everyone (Klein, 2015).

The grounds she refers to in her arguments are not new. They come from long ago. So much that we give ourselves the opportunity to read, explain, and interpret the cycles of nature, ecosystemic interactions, processes of development, or the very evolution of humankind and its civilising dynamics, long fostering modes of production, consumption, life, etc., that are damaging for the biosphere and life in all of its diversity. As Riechmann (2004) argued when analysing the ecological crisis in its temporal dimension, the long-time scales of nature, its equilibriums and transformations run into neo-liberal financial markets, political dealings, cyberspace, and the technological networks of globalisation. While we cannot ignore them, we agree that the culture of sustainability demands a different culture of time to the one that has shaped the path of what we identify as progress, development, or well-being.

2. When time dresses itself as climate change: implications and complications for the future of humankind

Climate change (CC), the mirror and reflection of the ecological and anthropological disasters in which we find ourselves, is one of the principal examples of contemporaneity, positioning us before a new era known as the Anthropocene or Capitalocene depending on the radicalism of the positions adopted, as shown in the story of environmental historians such as Foster (1999), Patel (2010), Wallace-Wells (2019), Malm (2020), Merchant (2020), and Moore (2020). The times of the cosmos, of the Earth, and of hominisation seem to have accelerated, meaning that the haste and the "quick, quick" of a society that is open 24-hours-a-day, marked by timelessness (Castells, 1998), becomes a silent enemy, a cause of ecological unsustainability and of the climate risks inherent to it.

The obsessive concern with timing ourselves in the incessant striving to measure, monitor, represent, reinvent, or give new meanings to time (Garfield, 2017) reaches the extreme of computing everything, from the most insignificant happenings to those that will bring about the Apocalypse, calculating the time left to us as a species (Serratos, 2020). As the *Bulletin of the Atomic Scientists* reported in 2024, the clock of Martyl Langdorsf (an artist and the wife of one of the scientists who participated in the Manhattan Project to create the first atomic bomb) puts us 90 seconds from midnight, one and a half minutes from the disappearance of human life (Mecklin, 2024). If this perception is credible, delay and denial are two of the most visible elements in the ideological justification for timid responses by governments to the climate crisis; in any case, without being able to ignore their confluence with other motivations of a religious, moral, economic, etc. nature, present in this cause; as well as in others that affect people's rights individually and collectively.

Narratives that are conducive to providing solutions that mitigate climate emergencies and/or make it possible to adapt to them with a scientific basis reiterate the need for the regulatory-legal framework to be appropriate and effective in the short and medium term, even if this is not

enough. There are other elements that should play a key role in the mobilisation of committed climate action, such as education and communication. Both have fundamental strategies and/or practices for setting out lines of thought, reflection, and action that promote values, action programmes, etc. that increase the capacities of language and of its hermeneutic-interpretative and socio-critical potential. A task to which scientific knowledge, with multi-, inter-, and transdisciplinary focuses, will also have to make substantial contributions.

The importance that must be placed on time in the agendas of social and educational research contrasts with its limited presence until now in hypotheses of progression, from an ontogenetic and historical outlook, showing the indifferences and inconsistencies that both climate literacy and particular conceptions of environmental information and training have committed. As we will see, the use of alternative, disruptive, and unconventional methodologies of inquiry opens up a field of research that is little explored in educational sciences and in the humanities and the social sciences.

In this context it is no surprise that the *uncomfortable truths* revealed in recent decades pose questions that are far from being answered, expanding or diversifying the concerns that situate in time (of the present and the future) the search for viable solutions to a civilisational collapse that for some authors is irreversible (Caride & Meira, 2020; Kingsnorth, 2019; Servigne & Stevens, 2020; Bardi, 2022). This being so, many people have (for years) considered a process of degrowth to be inevitable, whether abruptly and traumatically or through conscious planning intended to reduce consumption of energy, materials, and food (particularly animal-based) to spread the costs of a transition that aspires to be socially and environmentally just (Riechmann et al., 2007; Taibo, 2020, Turiel, 2020; Bordera et al., 2024). So, as Rivas (2020) would say, encouraging refractory hope, we should commit ourselves not only to the world in which we live, but (and above all) to the one we will leave as a legacy. "Nature's mutiny" (Blom, 2019) suggests that it is not merely a matter of changing the climate, but of promoting an integral transformation of human societies: "it is no longer an option. It has become an ecological, ethical and social imperative for survival, with solutions that are viable, realistic and lasting" (Caride & Meira, 2022, p. 27, own translation). Following this path, in a collection with great reach in the media about the state of the planet and its major challenges, the Food and Agriculture Organization of the United Nations (FAO) asked whether we still have time to save it (Yeves & Javaloyes, 2018), emphasising that every one of us (albeit to unequal extents) is part of the problem and of the solution.

Warnings are accumulating both in scientific reports and in the positions taken by institutional leaders and by society itself. Coinciding with the commemoration of World Environment Day, on 5 June 2024, the European Commission's Copernicus climate change service[1] revealed that the Earth's global temperature continues to increase significantly, reaching unprecedented figures. Among other voices, Antonio Guterres, Secretary General of the UN, repeatedly called for the commitments that have already been signed to be fulfilled, reducing greenhouse gas emissions, reducing consumption, and improving energy efficiency. In addition, what is thought to be the largest survey of public opinion of the climate crisis (with 75 000 people from 77 countries participating), sponsored by the UN and carried out by a team from the University of Oxford[2], found that approximately 72% of the sample want the transition from fossil fuels to renewables to be accelerated, with more than 80% calling for their countries to engage (quickly or very quickly) in the solutions that must be provided for CC.

Fernández-Reyes (2024) observes that the social perception of CC as a key threat has grown internationally in recent years, especially in Europe, with it being seen as the most serious problem facing humankind (European Commission, 2023), although armed conflicts are displacing the climate crisis as the greatest perceived threats (Lázaro et al., 2024). Nonetheless, the high level of climate awareness or concern does not lead to a high level of action (Kollmus y Agyeman, 2002). In the case of Spain, eco-surveys and abundant research into public opinion have shown that its citizens are especially worried about CC. One factor that explains this is that Spain is one

[1] See https://climate.copernicus.eu/climate-indicators

[2] See https://peoplesclimate.vote/document/Peoples_Climate_Vote_Report_2024.pdf

of the most vulnerable countries in Europe to this challenge (IPCC, 2021), with the Spanish, after the Portuguese, being the European citizens who are most concerned by CC (European Social Survey, 2018), especially younger people (Meira et al., 2021; González-Anleo et al., 2024). This intergenerational question, which we will not go into, is another of the vestiges of the timelessness in which interpretations, social perceptions and representations of CC, its urgencies and emergencies in the future of humankind and of its civilising processes, are situated.

3. Educating and educating ourselves in time in the face of the climate emergency

As has been tacitly recognised by the UN Environment Programme, created in 1972, and explicitly in the sixth edition of the United Nations Environment Assembly (UNEA-6), held in Nairobi (Kenya) in 2024, time is a transversal element in the environmental and social sustainability of processes of development and lifestyles. For the construction of these lifestyles to be consistent with a progressively decarbonised society requires new forms of distribution and management of times (of work, leisure, transport, etc.). According to Figueres et al. (2017) "when it comes to climate, [chronological] timing is everything" (p. 386), identifying the need for public policies (economic, social, environmental, educational, etc.) to be effective in the timeframe set by the Paris Agreement (adopted at COP21 in December 2015, and taking effect in November 2016) to contain the physical inertias of the climate system. Responding *on time* is still a priority, despite the repeated breaches of the agreements signed by the 196 parties.

Looking to the future of the planet and life without ignoring the present gives time a special place in tackling CC and in the socioecological transition we require to reconcile ourselves with the ecosystems that sustain life. The challenge no longer lies in speculating about the catastrophe, but in how to construct political subjects (citizens) who are capable of accepting, with all of its consequences, a challenge full of uncertainties, without being clear about what to do when, as Ausubel would say (as cited in Rich, 2020), the past no longer serves as a guide for the future. It will undoubtedly be a matter of education and time (Caride, 2020), rethinking (pedagogically and socially) their respective meanings in the societies of the third millennium, between the real and the reified (Barnes, 2004), that which is put in objective terms and perceived:

> what we currently call time changes from one society to another and in its present form is something that members of industrialised societies learn in a process of socialisation ... Time is an expression of peoples' effort to determine positions, delineate intervals, the pace of changes, etc., in this process with the aim of serving its own orientation. (Elías, 1989, p. 51, own translation)

The emergencies with which CC is associated are fully involved in this tale.

We refer to a time of times on whose boundaries we educate and are educated from childhood to old age, in schools and communities, with all of the complexities that characterise the network society (Caride et al., 2020). It is not limited to the times of school or of the education system, of curricular or teaching-learning processes, prolonged in the formative opportunities that, starting by understanding education as a global common resource (Delors, 1996; UNESCO, 2015; International Commission on the Futures of Education, 2022), suggest alternative ways of educating and educating ourselves that are more democratic, just and peaceful, critical of and open to the ordinariness of life.

The report prepared by the International Commission on the Futures of Education (2022) for UNESCO recognises that "climate change and ecosystem destabilization affect education in direct and indirect ways" (p. 32), mentioning risks and impacts that affects learning and cognition, livelihoods, and well-being, gender inequalities, and so on, at a global level and in people's particular communities. The strategies to adopt "should draw on existing knowledge about how to foster deeper learning and the development of civic competency, and on recent research on the development of skills for life and work" (International Commission on the Futures of Education, 2022, p. 35). Curricula, they add, "must enable re-learning how we are interconnected with a living, damaged planet and unlearning the human arrogance that has resulted in massive biodiversity loss,

the destruction of entire ecosystems, and irreversible climate change" (International Commission on the Futures of Education, 2022, p. 69). There are no excuses. It is a priority: it must be done now, in time, enabling people "to correct omissions and exclusions in the knowledge commons and ensure that it is a lasting, open resource that reflects the diversity of ways of knowing and being in the world" (International Commission on the Futures of Education, 2022, p. 80). Contemporary trends in Environmental Education for Sustainability (EES) and its theoretical foundation frameworks support models of sustainability competences (Brundiers et al., 2021; Redman & Wiek, 2021; Bianchi, 2022) that integrate CC transversally in different dimensions: fostering civic values and pro-environmental attitudes (culture of sustainability, support for fairness and climate justice, promotion of nature and pro-environmental behaviours); incorporation of the paradigm of complexity (systemic epistemologies, critical thinking, contextualising problems); anticipating future sustainable scenarios (capacity for future projections, adaptability, exploratory thinking); adopting sustainable discourses and practices (political action, collective and community action, committed and responsible individual initiatives), and so on.

Rieckmann and Thomas (2024) present an international panorama from comparative research that illustrates the diversity of pedagogical trends that take charge of promoting learning that is transformational, interactive, and from innovative perspectives (Rodríguez-Marín et al., 2023) based on service learning, problem- and project-based learning, model-based inquiry, citizen science, co-design, and other disruptive methodologies. In any case, without ignoring the contributions that have been made for decades in the field of environmental education, with anthropological, ethical, pedagogical, philosophical, political, sociological, economic, communicational, etc. outlooks, that range from social reappropriation of nature invoking environmental rationalism (Leff, 2004) and the construction of the educational-environmental field with renovative future options (Arias, 2013), up to the adoption of responses that activate ecocitizenship (Limón, 2019), or that incorporate the eco-feminist viewpoint to rethink the world around the sustainability of life (Herrero, 2022).

4. The urgency of a systemic and agreed research agenda on education for the climate emergency

Research agendas in/on climate education are starting to have their own spaces and times in current scientific literature. Their reach and the achievements to which they refer illustrate the ongoing expansion of academic frontiers from transdisciplinary perspectives that break out of the classical boundaries among the two cultures (Snow, 1987): the social and natural sciences. And that without ignoring the complexity and disciplinary integration vital for training and educational practices in citizen science to transcend curricular teaching and learning processes.

The linguistic dimension has an ever more relevant role. It is undoubtedly relevant as a clear exponent of the historical testimonies that educational research could make use of to study narratives of the climate crisis. But also, in the enquiries that look forwards to predict the future. The proliferation of systematic reviews and meta-analyses reflects this, with exponential growth in scientific production in this field, above all in topics such as education for climate change and in focusses of analysis that complement or converge with its areas of influence, such as human and animal health, environmental and social vulnerability, preventing risks, respect for human rights, etc.

However, and as a counterpoint to this growth, a persistent *braking* effect can be seen, resulting in a worrying lethargy in the adoption of political responses, the burdens of which have consequences of different ecological and social magnitudes and scopes. Educating in time is a major responsibility for those who, as educational professionals, do their day-to-day work in a variety of educational settings, as it is for the scientific community when researching in and on the different circumstances in which the climate emergency demands, proposes, or arranges the pedagogical, formative, didactic, curricular, etc., endeavour inside and outside the education system.

Advocating and designing an agenda that sets priorities, analyses trends, and marks solid future lines of inquiry must make it possible to confront the substance and form of the educational and climate emergencies rigorously. And with them, the risks that its causes and/or effects have for global health, with estimates of as many as 250 000 additional deaths owing to illnesses sensitive to the climate (heat stress, malnutrition, dengue, and malaria) between 2030 and 2050[3]. In addition to these, eco-anxiety (a normal emotional response to an abnormal situation) is eroding people's identity as an effect associated with the anxiety caused by the environmental crisis and the risks it entails (Franquesa, 2024).

At this juncture, with a need to accelerate educational responses, various questions address the responsibility of pedagogical research and, by extension, of educational sciences. Important authors in the field (Reid, 2019a, 2019b) have marked the territory of what is at play in education to address the climate crisis with the required priority. Sharing their arguments, a series of questions must be formulated that guide the objectives and methodological process of the lines of research in which their initiatives could be inscribed, including: what can be learnt from the educational practices in motion to accelerate education's responses to the climate emergency? Are the current focuses of education on the climate crisis sufficient to drive the socio-ecological transition? And if they are not, what would have to change and at what pace to improve education's socio-cultural impact? How will education gain time to respond to the climate emergency and effectively address the goals of educational and climate policies? How can the different spheres of educational practice (school, community, social) be linked to activate the socio-ecological transition in different social contexts and times (family, leisure, etc.)? What role must a disruptive training play with support from technological devices that differ from conventional ones, that is prolonged beyond the school setting and integrates emotional, attitudinal, behavioural, and cognitive dimensions? What pedagogical quality requirements should be incorporated into educational programmes, resources, and materials to promote socioecological changes that are effective and real locally and globally?

Among the questions to be resolved in this emerging line of research, some key ones are absent that should inform and position topics, problems, or future focusses of interest, around which relevant questions for research agendas to resolve are posed. In this sense, and taking as structuring axes the *temporal* and *climate* semantics, new questions can be asked: why is no question asked about the required pace of these changes? When does the climate appear in the EE agenda? To what extent do the foundational documents contemplate the climate crisis from its origins as one of the most significant environmental problems? What new aspects does the idea of emergency add to the classical concept of time? What are the adjectives, signifieds, signifiers, and contexts of use? What semantic field have we constructed in the last two decades in relation to the topic of the *climate crisis*? How do these signifiers relate to the time vector in educational scenarios? Why do we procrastinate in the response to the climate crisis?

Linking EE to the culture of sustainability and the climate emergency, as this work does, considers its challenges at the same time as proposing others that are awakening the interest of research teams with prominent track records in these lines of research: what are the principal challenges that must be considered to educate in response to the climate emergency and process of socioecological transition? Are there transnational and intercultural patterns that help to increase the perceptions on the causes and consequences of climate change? What are the priority challenges to take into account to build curricular and social contexts in favour of EE, the culture of sustainability, and the climate emergency in contexts conditioned or influenced by resistance from popular culture? What formative actions, materials, and educational resources should be favoured to promote EE in people, over different levels of training? What educational and community experiences favour the transformation of lifestyles in the current socioecological transition, accentuated by the climate emergency?

The scientific community must find systematic, rigorous, and convincing responses to these questions from different types of methodological and empirical focuses, in line with the scope and scale of each question raised. It should also promote relevant research in connection to evaluation of the efficacy and efficiency of educational programmes that are associated

[3] See https://www.who.int/en/news-room/fact-sheets/detail/climate-change-and-health

with curriculum policies relating to CC. In any case, without ignoring other options for a complementary exploration through documentary analysis and historical research that allow *kilometre zero* analyses to be performed, reports on the state of the art of advances and setbacks, enquiries into the state of knowledge in the field, systematic reviews on its progress, evaluation of achievements associated with curriculum reforms, the impact of regulatory transpositions and curriculum implementation of framework legislation, institutional declarations, etc. Now is the time to "write history with accountability", in the sense that Costa (2023, pp. 108-109, own translation) gives to the term when he considers that it is a matter of interpreting what goes beyond the supposed notarial and accumulative chronicle of information, in any case seeking to position itself in the mindset of the period studied and not to fall into anachronism, that is to say, into the temptation to project current values onto past phenomena, or presentism (the present is projected and shapes the vision of the past), which would lead us to subjective recreations.

5. The demands for a transdisciplinary dialogue in the construction of temporal and climate semantics

Having a research agenda that is agreed on in the field of the climate crisis is more than justified and requires dialogue across disciplines: establishing criteria of quality, delimiting guidelines for traceability, providing reliable explanations, defining internal and external patterns of interdisciplinary and transdisciplinary comparability making the most of the shared and specialised potential of the climate sciences (social and natural, humanistic, artistic, and technological). This pathway must contribute to the construction of well-founded and justified explanations for many of the questions mentioned. They particularly require it to assess the potential for transference and impact of climate policies on educational policies and practices, aspiring (among other achievements) to construct a genealogy of the presence and treatment of the climate crisis in the institutional, regulatory, etc. declarations that are most representative of EE.

It will undoubtedly be necessary to analyse the place the temporal dimension occupies in the transposition of advances in scientific knowledge about contemporary problems. And also to identify and/or define timelines in territories, countries, etc. that delimit a particular geography; for example, in Spain and its Autonomous Communities, making visible the interactions between agencies, agents, events, and relevant facts in climate narratives and their impact on EE: "over time, these contributions are a very valuable measure that makes it possible to carry out multi-voiced studies, integrative meta-analyses, and systematic secondary reviews of longitudinal growth in the field and of the patterns of productivity that they fit" (Gutiérrez et al., 2020, p. 820, own translation).

Proposing agendas and subjecting them to continuous revision should become a practice that is cyclically revisited, as it is an action that is necessary before a topic–problem that is subject to constant tensions and controversies in a geopolitical setting that is far from being true to itself and to the severity of a climate crisis that is evolving at a faster pace than was estimated only a decade ago (Hansen et al., 2023). When observing its realities and focussing on the semantics that have been generated both from a climate-environmental reading and from readings that consider its historical-future evolution, there is an abundance of expressions that make it possible to identify a polyphonic linguistic corpus displaying the turns, interests, trends, or absences of what scientific research has explored up to now, anticipating or delineating what the primary lines of future research might be. As a whole, they comprise a rapidly growing corpus of terms, neologisms, technicisms, and resignified neoclassical terms that have become established and invaded the collective imagination over recent decades, in time with the, more or less systematic, work of scientific communities, pro-environmental organisations, government agencies, citizen groups and, above all, of the media and social networks.

In seeking to establish the preliminary levels of a conceptual demarcation that differentiates the two dimensions that are the object of study, we present some convergences and

divergences apparent in the evidence that name the temporal vector in their relationship with the evidence that mentions the climate crisis (see Figure 1).

Establishing the levels of macro and micro conceptual aggregation that exist in the broad and diverse range of words that the semantics of the climate crisis embrace, identifying the timelines that explain its genesis and evolution, contextualising uses, delimiting signifieds and signifiers, etc., are important paths for exploration in the research we propose, with two principal structuring axes:

FIGURE 1. Temporal semantics versus climate semantics.

Temporal semantics

- Chronological sequence of occurrences, episodes, events, declarations, regulations, etc.
- Outlook for projection, prevision, and anticipation of occurrences, expectations, events, threats, risks, obstacles, etc.
- Strategic axis for planning and planned and systematic intervention.
- Longitudinal reference chronology that acts as an independent variable in the comparison with other dependent variables and indicators.
- Reference of consensuses adopted between parties, register of agreements, alliances, and conventions.
- Cyclical pattern of natural phenomena and dynamics and geo-physical and biochemical processes.

Climate semantics

- Voices from the climate sciences, from the field of geology, chemistry, physics, meteorology, and the natural sciences.
- Ecosocial discourses relating to social climate movements and climate organisations.
- Sociopolitical testimonies, relating to sociological and political climate variables.
- Psychoenvironmental expressions relating to personal identity, psychological and psychosomatic aspects and mental health variables.
- Educational terms relating to curriculum policies, educational intervention, educational programmes and resources.

1. On the one hand, the axis that takes *temporal semantics* as its reference, at the very least making it possible to attribute different connotations to time, such as a) a sequence of occurrences; b) the outlook for projection and forecasting, c) the variable of evolutionary comparison; d) the strategic axis of planning and development of actions based on analysis of needs and intervention proposals; e) a temporal series of magnitudes associated with making comparisons of chronological series of measures and changes; f) a social construct or category that is the referent of the consensus between parties to register agreements, alliances, and conventions; and, finally, e) a cyclical pattern in geophysical or biochemical processes and natural phenomena.

   Among the agreements reached in temporal terms, ones promoted or backed by public policies and administrations should be noted; for example, in the case of Spain, the Plan de Acción de Educación Ambiental para la Sostenibilidad (PAEAS, Environmental Education for Sustainability Action) (Gobierno de España, 2021), the Plan Nacional de Adaptación al Cambio Climático (National Climate Change Adaptation Plan), or the LOMLOE.

2. And on the other hand, *climate semantics*. The lexicon of the climate crisis accepts levels of organisation and classification that make it possible to differentiate, as a minimum, between a) specialist voices from the climate sciences; b) eco-social discourses that embody human responses to the climate emergency; c) sociopolitical testimonies that try to identify alternative mitigation/adaptation pathways; d) psycho-

environmental expressions, that explore perceptions, representations, evaluations, and behaviours in relation to CC; d) educational voices, that try to integrate responses to the climate crisis into the pedagogical narrative.

With the due precautions, we recognise that the field is not free from uncertainties that demand revision, resignification, and/or self-criticism of the terminology used; in all cases, we are aware of the neocolonial bias engaged in by the interventions and linguistic structures installed in the collective memory (Burde, 2017; Novelli & Kutan, 2024). According to Lozano et al. (2014, p. 146, own translation),

> owing to its frequency and relevance, the planetary risk of CC provides a discourse that the media make hegemonic, questioning the items on the agenda in the struggle against CC that governments, institutions, and businesses accept. The communicative practice of the media might then contribute to creating a "second reality" that is superimposed and that involves paying greater attention to the debate on CC than to the origin of and alternatives for solving this environmental crisis.

6. Climate language and its narratives in the development of educational research

Scientific study of climate language as a field of educational research has very recently become established as a line of inquiry with its own identity and form. The team from the University of Bergen (Norway), led by Professor Fløttum (2017), has been making significant contributions to this, focussing its analysis on the role of language in the construction of narratives on CC. This author differentiates between macro- and microlinguistic analysis of the multiple voices that the climate crisis yields in order to establish typologies of rhetoric by sectors and media: either based on evidence coterminous with the discourse and literary style of its researchers, with differential shades depending on their disciplines of origin; or centred on persuasion or counter-argumentation, frequent, among others, in politics, condemnation and confrontation of climate movements, verbal and written information, communication, and journalism; a field, in this last case, with very significant contributions on different fronts (Escrivá, 2024).

Fernández-Reyes (2024) explored the lines of argument of denial and provides an exhaustive catalogue of rhetorical tactics for responding forcefully and rigorously to disbelievers and sceptics, employing counter-argumentation standards and guidelines applied to the image (television and photography), verbal messages (radio), and written information (for the press in different formats). Questions can be inferred from his analysis that relate to language, semantics, and reasoning that can be extrapolated, with the necessary adaptations, to different levels and spheres of pedagogical action–intervention:

> What should we do with people who deny climate action or call for it to be delayed?; how should we respond to them? When we do this, do we help them make their voice stronger?, what should we do about these "infectors" of doubts about the need for and urgency of climate action in the social body?, who are these "infectors"?, what subgroups exist among them?, where do their funders come from?, what different tools do they use?, what can we learn from the already long relationship and forced coexistence with these boycotters? (Fernández-Reyes, 2024, p. 5, own translation)

In Spain, the Asociación de Periodistas de Información Ambiental (Association of Environmental Information Journalists) (2023) has contributed to this inquiry with proposals from the specialist professional field of journalism, with a list of tools derived from the latest generation of studies on communication and CC. Journalistic style guides and detailed linguistic analyses that bring to light the need to increase multidisciplinary research on these topics:

> We are living in an emergency; we must say this clearly. Do not doubt it in any way. That said, we must take care not to trivialise the term, even if we do use it correctly. What does emergency mean? After what we saw with the covid-19 pandemic, which turned our lives upside down from one day to the next, we must be careful with words If we say that CC is an emergency, we must be ready to act as though it were one. There is no point in declaring a climate emergency, as so many

> governments (state, regional, and local) have done, while continuing to cause it, without changing anything other than the colour of the make-up. (Escrivá, 2024, p. 139)

Empirical works from the field of journalistic information and communication provide pathways that can be extrapolated to pedagogy in relation to methodologies to implement in educational programmes relating to communication strategies and progressive transmission of messages and counterarguments in the face of positions of denial (León et al., 2021; Fernández-Reyes, 2023; Heras, 2014, 2023; Ramos et al., 2024). The adoption and development of educational research agendas must be strengthened without delay, contributing significantly to the social responses required by the accelerated anthropogenic alteration of the climate. Reiterating what has been said in previous contributions, "if we had to select one verb to account for how to direct educational action with regards to the climate question, this would undoubtedly be *accelerate*. Educational research cannot ignore this imperative" (Gutiérrez et al., 2020, p. 823, own translation). Our position here is not original. The IPCC (2018) in perhaps the most momentous report that this body has prepared from the social viewpoint uses this verb to frame the role of education among the strategies with a possibility of limiting the scale of CC and its consequences in this century.

We are aware of the need to give the analyses a greater empirical component, and so below we address, again in an exploratory way, the existing combinations in climate policy and in educational policy in Spain, as one of the lines of educational research, that must be considered in greater depth to identify pedagogical and social keys to accelerate responses to the climate emergency in Spain.

7. The slow convergence between climate and education policies in Spain

Despite the advances recorded in the declarations and proposals endorsed by international bodies (UNESCO & UNFCCC, 2016; UNFCCC, 2016), no education system has meaningfully integrated the challenge of the climate emergency (Dawson *et al*., 2022; Eilam, 2022), fundamentally in regard to contributing to mitigating greenhouse-gas emissions to moderate the mean increase in the Earth's temperature, in accordance with the Paris Agreement. The delay in educational responses converges with the exasperating slowness of the adoption of effective global, regional, and local policies (environmental, energy, economic, food, etc.) that put humankind on the path to limit warming to +1.5 ºC or +2 ˚C by the end of the 21st century.

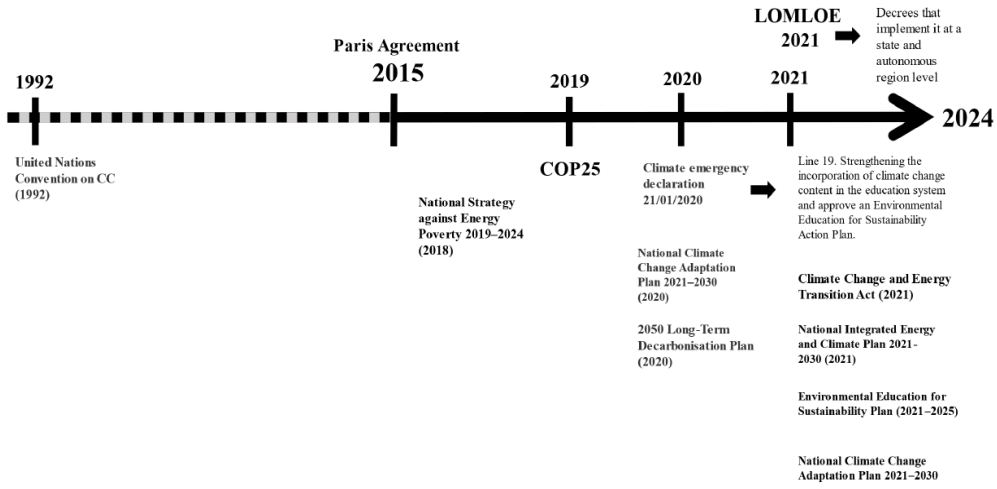
As well as the functional weakness of policies, social and educational responses to the climate crisis must overcome another major obstacle that comes from the temporal dimension: the pace of climate change caused by human interference is too fast (and becoming faster) compared to natural changes in the climate, but too slow when it comes to establishing the social perception of their risks and consequences. The effects of climate change are seemingly only visible in slow motion and too late, after they have caused unwanted impacts on natural and human ecosystems. The difficulty of grasping timing among the bio-physical and social changes that underlie CC is especially notable in more *advanced* societies, with less vulnerable populations and with more resources to protect themselves or lessen the short-term reach of the more serious impacts. The indifference or inhibition with which CC has been treated in education systems reflect, among other eventualities, the shortcomings associated with this delay. As general considerations, they also apply to Spanish society.

The wording *climate emergency* makes it possible to go further than the connotations of the expression *climate change*. Firstly, it makes educational practice pay more attention to the political, social, and socioenvironmental dimensions. It also focusses attention on the temporal factor in the response. This does not in any way diminish scientific contributions and the knowledge they provide from academic perspectives for an action that brings about an eco-social transition that, as well as being technically viable, is also socially just and environmentally sustainable.

As the timeline shows (Figure 2), the European Parliament declared a climate emergency in November 2019. The Spanish government did the same in January 2020, identifying 30 priority measures in its declaration; among others, it would take on strengthening the incorporation of content associated with CC in the education system and approve a Plan de Acción de Educación Ambiental para la Sostenibilidad (PAEAS, Environmental Education for Sustainability Action Plan), which was launched in 2021. Its media impact would capture the echoes of COP25 held in Madrid in late 2019. Since then, and apart from the occasional isolated initiative, the Spanish education system and social education proposals have not offered signs that communicate to society the severity of the climate crisis, and even less the need to act urgently to mitigate, without delay, its causes and impacts from everyday reality. The climate crisis is far from occupying a leading position among the questions that concern educational policies in Spain.

The application of Organic Act 3/2020, of 29 December, amending Organic Education Act 2/2006, of 3 May, known as the LOMLOE might lead to some changes or many changes, as for the first time it incorporates the concept of *climate emergency* into Spanish education legislation. It does this in its preamble, linking it to following the UN's 2030 Agenda and materialising this in a two-part curriculum proposal: on the one hand, through *education for*

FIGURE 2. Timeline of educational and climate policies in Spain.



sustainable development (EDS) and global citizenship; and, on the other, what is known as *education for the ecological transition*. Its ideological and pedagogical turns are controversial (Meira, 2015), but it is surprising that the act does not include the concept *environmental education for sustainability* when this framework is used by the Ministry for Education and Professional Training, in collaboration with the Ministry for Ecological Transition and the Demographic Challenge, in preparing the PAEAS (2021-2025), the strategic priorities of which give a central role to the climate emergency.

It should be added that the concept *climate emergency* is also included in the decrees that govern the minimum content of Obligatory Secondary Education (ESO) and the Baccalaureate. In ESO, it features in the specific competences and basic knowledge of Civic and Ethical Values and Geography and History subjects. Its presence is important but it does carry the urgency of responses from the education system into the curriculum framework. So, beyond the LOMLOE's conceptual innovations, it is necessary to insist on the need to explore the bases of a climate emergency curriculum, positioning this crisis and its exceptional nature among the priorities that must be considered at all educational levels and at the level of social education initiatives,

with at least a triple purpose: (1) sending society a clear and forceful message about the risks we face, (2) connecting different agents from the education system and their communities of reference with the mitigation and adaptation policies, and (3) using the cultural and socialising tools from the education system and the field of social education to accelerate the changes that the socio-ecological transition demands (González et al., 2020)[4].

Analysis of the international educational panorama also does not reflect the importance of the climate challenge. A study by the International Bureau of Education on the presence of CC in the national curriculum frameworks of 78 countries found that only 35% of the total included the topic of CC in the text (IBE-UNESCO, 2016). A repeat of this study (UNESCO, 2019) shows that the panorama has barely evolved. These studies and others (Colliver, 2017; MacIntyre, et al., 2018; Monroe, *et al*., 2019; Eliam, 2022; Dawson et al., 2022) underline that treatment of the climate crisis when it is incorporated into educational practice tends to be reductive, linked to bio-physical science content, and paying little attention to its human, ethical, and social dimensions.

Furthermore, the limited action orientation of the dual mitigation and adaptation perspective should be noted. The cultural challenges of the socio-ecological transition and descarbonisation are usually absent from official curricula and have a marginal presence in extracurricular educational processes. The limited application of the PAEAS reflects the marginality of educational policies to tackle the climate emergency, hindered by the lack of consistent funding mechanisms and by inaction at other levels of the Administration, above all at the local and autonomous-region level. In view of the precariousness of the educational responses, Whitehouse (2017) argues that it is necessary to move CC "towards the centre of curriculum practice" (p. 64). Heras (2014), for his part, had already indicated that we not only need to put CC at the centre of the curriculum. In his opinion, educational resources that do not belong to the school system must also be strengthened, activating processes of social learning through the creation of peer knowledge networks, without ignoring the weight of the gender variable (García-Vinuesa et al., 2020), to involve all of society in action against CC, as suggested in the Action for Climate Empowerment (ACE) strategy promoted by the United Nations (UNESCO & UNFCCC, 2016; UNFCCC, 2018).

The LOMLOE is taking the first steps in this direction. However, the pace is still too slow. It might help promote a climate emergency curriculum in the short term, but it is necessary to identify what exceptional pedagogical focuses can be adopted, given the demand of the urgency of responding to the climate crisis. The lessons deriving from the recent health emergency caused by the covid-19 pandemic suggest that the education system can react and change significantly in a very short time period. The challenge is in how to turn the climate emergency into a problem that is relevant and meaningful for the different agents in the education system (political leaders, teachers, students, educational communities) and in the population as a whole. In other words, to ensure that it is no longer just another problem among the ones to which school and social educational practice must respond, and to make it a priority in the short and medium terms.

Curriculum theory has sufficiently demonstrated that one of the keys to any transformational process that is coherent with priorities of reforming and improving the education system is the initial and continuous training of teachers so that they can integrate new thematic, ethical, or methodological demands into their practice, in the classroom and in projects and initiatives that can be undertaken in educational centres as well as in the relations established with the

[4] It should also be noted that this article's aim is not to assess exhaustively the changes that a specific law, the LOMLOE, and its regulatory implementation might make to the treatment of the climate emergency, but rather to draw attention to the slow pace with which educational systems, in general, are integrating transition policies aimed at mitigating and generating processes for adapting to the ongoing climate crisis. Despite its potential (which is still only performative), the LOMLOE arrives almost a decade after the Paris Agreement and at the moment in which everything indicates that the aims of limiting the increase in temperature by the end of the 21st century that were set in this agreement are already unattainable and so the delay will have more serious practical consequences.

communities in their surroundings. Integrating the climate emergency into everyday curricular practice is no exception[5].

Beyond the regulatory framework that governs education, it should be noted that section 35 of Spain's Climate Change and Energy Transition Act 7/2021, of 20 May, states that

> the Spanish education system shall promote the engagement of Spanish society in responses to CC, strengthening knowledge of CC and its implications, training for a technical and professional activity that is low in carbon and is resilient in the face of climate change and the acquisition of the necessary personal and social responsibility.

It assigns to the government the duties to review "the treatment of CC and sustainability in the basic curriculum of the teachings that form part of the education system" and to encourage "actions that guarantee adequate training in this subject for teachers".

8. Conclusions

Systematic reviews of scientific and informative literature about the climate crisis display significant shortcomings, limitations, and biases in the agendas being adopted in both educational and environmental policies. In so doing, they significantly compromise many of the commitments that have been made nationally and internationally, both in regards to the objectives that have been agreed for sustainable development and for adapting to, mitigating, and reversing climate change. In this context, it is on longer hidden that climate change and destabilisation and destruction of ecosystems greatly exceed the planet's limits in terms of production, consumption, and waste of materials, affecting education directly or indirectly, as stated in the report delivered to UNESCO by the International Commission on the Futures of Education (2022), which states that "our strategies should draw on existing knowledge about how to foster deeper learning and the development of civic competency, and on recent research on the development of skills for life and work" (p. 35).

With this aim, we have positioned a good part of our contributions in a critical, historical, and forwards-facing reading of the treatment given to various topics, interests, and priorities in contemporary educational research, with a double perspective: on the one hand, promoting educational and environmental policies in the configuration of agendas aimed at confronting the climate emergency; on the other, emphasizing the presence that in its proposals and lines of action has time as a variable, dimension, or vector coterminous with any process of development that aspires to be sustainable ecologically and socially. An undertaking that poses multiple questions that are still seeking the best answers. Although interest and a progressive increase in empirical output can be observed, the temporal vector of the climate crisis is absent, requiring more effort and attention. Works of a historical-phenomenological nature with emphasis on linguistic aspects will, in this sense, be able to open an innovative window on the reinterpretation of climate narratives on educational and environmental policies.

In any case, it is clear that the expression *climate emergency* makes it possible to go further, from a temporal perspective, than with what is more usually identified as *climate change*. In this sense, as there is no indication that education systems are meeting the challenges that such an emergency presents, accelerating the educational responses will be necessary, informing society of and educating it about the true nature and reach of the crises. This requires active participation of all sectors of society and joint responsibility and commitment from different scientific disciplines, with an interdisciplinary and transdisciplinary outlook being demanded

[5] Beach (2023) reviews the theory of and research into the preparation of pre-service teachers to address the climate crisis, identifying seven principal challenges: (1) accepting variation in state standards relating to climate change teaching in schools, (2) providing valid knowledge about climate change, (3) acquiring positive attitudes and a sense of self-efficacy about climate education, (4) providing training for a transdisciplinary curriculum focus, (5) integrating environmental justice topics, (6) adopting a systemic focus, and (7) using case study methods to organise learning processes around local experiences of climate change.

ever more by the exceptionality, uncertainty, and risks that this crisis entails at a local and a global level. Environmental education and the construction of a culture of sustainability, in conjunction with the programmes and initiatives adopted regarding education for climate change, must contribute to this by exploring new methodologies for reflection, inquiry, knowledge, and action, contextualised territorially and socially.

Consequently, our proposed education research agenda seeks to explore what these focuses might be and how they can be promoted and *accelerated* from evidence proven by basic and applied scientific inquiry. From this outlook, the climate emergency presents an unprecedented challenge for the field of education, largely because of the temporal dimension that its genesis as a socio-environmental problem entails. Also because of the required speed of social responses, in a broad sense, to mitigate or limit risks to the human species. The drive for research in conjunction with the educational policies that are promoted must make it possible to introduce meaningful curricular, cultural, and social practices that connect the school and community experience with the climate emergency, as well as to design alternative and innovative resources and educational-social strategies to speed up the socio-ecological transition by acting on the lifestyles and developmental dynamics that foster these resources and strategies.

Authors' contributions

José-Antonio Caride: Conceptualization; Project administration; Resources; Visualization; Writing (original draft); Writing (review and editing).

José Gutiérrez-Pérez: Conceptualization; Resources; Writing (original draft); Writing (review and editing).

Pablo-Ángel Meira-Cartea: Conceptualization; Resources; Writing (original draft); Writing (review and editing).

Artificial Intelligence (AI) Policy

The authors do not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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Analysis of initiatives to promote education for sustainability and climate action in schools in Madrid and proposals for improvement

Análisis de iniciativas para fomentar la educación escolar para la sostenibilidad y la acción climática en Madrid y propuestas de mejora

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Abstract:

As a powerful tool for social change, education is one of the key transversal areas for promoting sustainability and addressing the climate emergency. This is reflected in international guidelines, such as the 2030 Agenda and the European GreenComp framework, and national guidelines, such as the current Spanish education law (LOMLOE). As a result, Spanish formal education has an opportunity to strengthen schools as strategic nodes for social change. However, there are several barriers that inhibit its true incorporation into the curriculum, such as teacher training and the lack of whole-school projects that address the topic, with many initiatives still being run on an occasional basis in isolation from the wider curriculum. To understand the external support available to schools for the integral incorporation of this approach, this study comprises a documentary analysis of the educational programs for sustainability and climate action offered by private, social, and public organisations in the city of Madrid. This analysis is complemented by a discussion group with relevant stakeholders from the ecosystem to assess the challenges and opportunities involved in promoting this approach. The results indicate that external organisations must adapt their offers to the new LOMLOE framework and support schools with training for teachers and management teams. They must also help schools implement programmes with a curricular and whole-school approach that is collaborative and contextualized. The entire educational community should be involved and the integration of these initiatives in public policies fostered.

Keywords: education for sustainability, education for climate change, climate action, educational initiatives, LOMLOE, whole school approach, teacher training.

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Resumen:

Como herramienta poderosa de cambio social, la educación representa uno de los ámbitos fundamentales y transversales para promover la sostenibilidad y abordar la emergencia climática. Ello queda reflejado en lineamientos internacionales, como la Agenda 2030 y el marco europeo GreenComp, y nacionales, como la actual ley de educación española (LOMLOE). La educación formal española cuenta, por tanto, con la oportunidad de fortalecer los centros educativos como nodos estratégicos para la transformación social. Sin embargo, varias barreras dificultan la verdadera incorporación en el currículo, como la formación del profesorado y la falta de proyectos integrales de centro que aborden la temática, por lo que predomina el carácter puntual y aislado de muchas iniciativas. A fin de conocer los apoyos externos con los que cuentan los centros educativos para incorporar este enfoque de forma integral, este estudio realiza un análisis documental de la oferta de programas educativos para la sostenibilidad y la acción climática con presencia en la ciudad de Madrid, desde el ámbito de organizaciones sociales y privadas y de organismos públicos. El análisis se complementa con un grupo de discusión con actores relevantes del ecosistema que valoran los retos y las oportunidades para favorecer este enfoque. Los resultados señalan que las organizaciones externas deben adaptar sus ofertas al nuevo marco de la LOMLOE, apoyar a los centros escolares con formación al profesorado y al equipo directivo, y promover la implementación de programas con un enfoque curricular e integral, colaborativo y contextualizado que involucre a toda la comunidad educativa y fomente la integración de estas iniciativas en las políticas públicas.

Palabras clave: educación para la sostenibilidad, educación para el cambio climático, acción climática, iniciativas educativas, LOMLOE, enfoque escolar integral, formación docente.

1. The importance of a curricular and whole school approach in consolidating education for sustainability and climate action (EfS&CA)

The approach to sustainability and climate change (CC) is being addressed globally through various frameworks, most notably the 17 sustainable development goals (SDGs) of the United Nations' Agenda 2030 (United Nations, 2015). Education has an essential role in this agenda, specifically in goal 4, which calls for quality education, and in target 4.7, which promotes learning that is relevant to global citizenship and sustainable development.

UNESCO, as the United Nations body for education and culture, and other international organisations and States have drawn up directives to incorporate education for sustainable development (ESD) and climate action at a local level (Organización de las Naciones Unidas para la Educación la Ciencia y la Cultura [UNESCO], 2021; Education International, 2021). These directives identify the need to prioritise ESD in policies, in curricula, and in teacher training, as well as to transform schools and learning environments, and to use a science-based approach with a holistic focus. These tendencies are also found at a European level, where the Green Deal (European Commission, 2019) and the European Sustainability Competence Framework (GreenComp) (Bianchi et al., 2022) stress the importance of education to facilitate the transition towards a sustainable future, promoting competences such as critical and systems thinking, futures literacy, promoting nature, and individual, collective, and political action.

In the case of Spain, Organic Law 3/2020 Amending the Organic Education Law 2/2006 (LOMLOE, 2020) and the Action Plan for Environmental Education for Sustainability (PAEAS) 2021-2025 (MITECO et al., 2021) emphasise the integration of sustainability in the education system, promoting education that drives critical participation and the ecological transition.

This support should solve the issues identified by Benayas and Marcén (2019), who observed that in schools, one-off actions relating to environmental celebrations or activities in which a particular group participates are still more common than collective projects.

On these lines, Navarro-Díaz et al. (2020) note that the curricular approach is fundamental for fostering citizen involvement in CC topics. Incorporating the topic into the curriculum highlights its priority and legitimises it as knowledge for students and their families. The LOMLOE (2020) also underscores the need to promote capacities, values, and attitudes aligned with this approach, rather than merely focusing on knowledge, to pursue a fulfilling life and play an active role in resolving problems shared by people all over the world.

Although a major step has been taken in Spain's regulatory framework to consolidate EfS&CA, the challenge of incorporating it effectively in classrooms remains, for which various factors are relevant. Firstly, teacher training is one of the principal levers of change to incorporate these topics truly (Mulà & Tilbury, 2023). This training faces the challenge of overcoming certain barriers, as Oranga et al. (2023) note, specifically for the topic of CC: low levels of eco-literacy and scepticism of scientific evidence (relating to the abundance of erroneous information and disinformation about CC) and of the actions required from citizens.

In relation to eco-literacy, Gómez and Fontao (2022) note that pre-service secondary school teachers display differences in level of knowledge, training, experience, and positive perceptions of the SDGs depending on their specialities, and so fostering training and motivation in these topics in current and future educators is vital to make improvements in transdisciplinary socio-environmental education. Sáenz-Rico de Santiago et al. (2023) also identify the need for training for practising secondary school teachers. In view of this, various studies are being carried out and proposals are being made to improve initial teacher education and continuing training (Marcén et al., 2024; Mulà & Tilbury, 2023; Sáenz-Rico de Santiago et al., 2023).

The scepticism relates to the politicisation of the topic and the moral and behavioural challenges that are proposed as adaptation and mitigation measures. Orenga et al. (2023) note that disinformation makes a major contribution to public polarisation relating to the climate crisis and helps shape public attitudes towards climate science, something that hinders public participation in mitigation policies. In the case of pre-service teachers, Morote and Moreno (2022) also identify the problem of interpreting and critically evaluating information on social networks, which according to these authors is the principal medium of information from which pre-service teachers receive information about CC, and which can contain errors that must be detected.

Another relevant factor is the availability of textbooks with science-based content that address EfS&CA from a broad and global perspective as a complex system. As Serantes-Pazos and Meira-Cartea (2016) observe, the content of these books is the most used resource by teachers in classrooms in Spain and they have a significant influence on students' construction of social representations because they are regarded as objective and scientific. Nonetheless, these authors note the need to take into account the fact that as textbooks are mediators of the accepted scientific culture through official curricula, they are vulnerable to the processes of social representation of the culture in question.

Some studies prior to the LOMLOE that analyse the treatment of CC in textbooks, note that its presence has been increasing (Navarro-Díaz et al., 2020), although they encounter that some aspects are absent or subject to reductionist focuses. In the case of secondary education, Navarro-Díaz et al. (2020, p. 957) find "deficiencies and absences [of] certain relevant causes, social and economic consequences, adaptation strategies, and strategies focussed on alternate socioeconomic models. These limitations are unhelpful for students' understanding of the climate crisis and their related actions". Future studies will consider in greater depth whether the new texts created since the LOMLOE have incorporated these topics in a more transdisciplinary way.

A whole-school focus to tackle EfS&CA is another of the relevant factors identified. Various studies have adopted the concept of a whole-school approach to sustainability (Hargis et al.,

2021; Tilbury & Galvin, 2022) or to climate change (Organización de las Naciones Unidas para la Educación la Ciencia y la Cultura [UNESCO], 2017) to refer to the involvement of the educational institution to incorporate sustainability and CC reduction measures into every aspect of school life, including school governance, teaching content and methodology, facilities management and functioning, and community partnerships. Section 121.1 of the LOMLOE echoes this and includes transversal coverage of sustainability in institutional educational projects.

To achieve this focus, it is fundamental that management teams assume active leadership in favour of sustainability, facilitating the transition to more humanistic educational models, sharing a clear vision of a sustainable future, and fostering innovative processes that promote sustainability in curricula (Sáenz-Rico de Santiago et al., 2023; López & Sánchez, 2023). This enables teachers to have a greater degree of knowledge of Agenda 2030 and better consciousness and awareness to promote sustainable development in the classroom.

As stated above, one aspect of the whole-school approach that transcends the curriculum is relations with the school's surroundings. This is another of the relevant factors for incorporating ESD into the curriculum, as stated in section 110 of the LOMLOE and in other studies (Sáenz-Rico de Santiago et al. 2023; López & Sánchez, 2023; Hargis et al., 2021; Tilbury & Galvin, 2022). Although teachers have to be trained in how to accompany students, and require science-based knowledge of the topic, the whole educational community must be conscious of the importance of ESD to achieve the multiplying effect of education (López & Sánchez, 2023) and transcend the classroom. This focus goes beyond knowledge transfer and promotes behavioural changes. As Allen and Crowley (2017) observe, behavioural changes are created when collective efficacy is fostered, in other words, the sense that one's own actions can have an impact when combined with those of one's community. This can be achieved by incorporating into students' learning experiences participation in activities from their surroundings, in relevant topics to each student, and interconnecting learnings across different subjects.

Relations with the surroundings can happen in the context of the school itself, through an exemplary infrastructure regarding measures relating to CC (Organización de las Naciones Unidas para la Educación la Ciencia y la Cultura [UNESCO], 2017), and through participation in the school's environmental management. The school, according to Benayas and Marcén (2019), should be a setting for ESD as long as the work is consistent with the methodology, the content, and the school's surroundings. Interactions can also take place within the community around the school and in a broader sense, as well as with other schools and networks of teachers (López & Sánchez, 2023). As for methodologies, relations with the surroundings can be favoured through techniques such as project-based learning and service learning (Marcén et al., 2024).

In view of the above, this study focusses on the city of Madrid and tries to answer the following research question "What aspects can enrich the different educational offers that promote EfS&CA at a curricular level throughout the different school levels?".

To answer this question, two research aims were proposed: (1) to describe and analyse the current offer of educational initiatives for fostering EfS&CA in the city of Madrid and (2) to identify the perception of the key stakeholders involved in EfS&CA initiatives about the current offer and its challenges and opportunities.

2. Methodology

2.1. Design

This study's methodology is framed within an interpretative paradigm, employing a qualitative approach. Specifically, a case study was selected to gain an in-depth understanding of the current offer of external initiatives to promote EfS&CA in schools in the city of Madrid, and to explore the perspectives on challenges and opportunities expressed by key stakeholders involved in these initiatives.

The geographical context is determined by the scope of the project in which the research is framed, defined with the funding body. Madrid is considered to be a demonstrator city for various innovative processes of urban change towards climate neutrality (Alméstar et al., 2022), and the body funds studies and actions to make these transitions fair. In this sense, improving EfS&CA could contribute to this mission.

The study has a sequential two-phase design. The first used documentary analysis to characterise the curriculum-based initiatives offered by external organisations to schools in Madrid. In the second, a discussion group contrasted the findings of the characterisation and debated about the related challenges and opportunities to advance an EfS&CA. The results of the first and second phases enabled the research team to identify and consolidate elements for enriching this offer.

2.2. Sample

In the first phase, characterising the offer, an initial process of exploration of initiatives was performed to establish a series of inclusion and exclusion criteria to shape the sample (Table 1). The fundamental criterion established on the basis of the bibliographic review was the curricular component. This focussed the sampling solely on programmes, resources, and initiatives, offered to schools in the city of Madrid, that are intended to work in line with the curriculum and connected to the study plans. Only initiatives from external organisations were selected owing to their scalability and the greater ease of access to information about their design.

Table 1. Inclusion criteria for characterising initiatives.

Criteria	Inclusion
Geographical scope	Presence in the city of Madrid
Connection to the curriculum	Initiatives with a link to the curriculum
Educational stage	Pre-university education
Promoter	Public, private, or social bodies external to the schools
Current availability	Active at the moment of the research
Source	Published online

Non-probability chain or network sampling was used (Hernández-Sampieri et al., 2014), as the initiatives were identified using the snowballing system starting from key actors already known to the researchers. Among the offer, 92 initiatives were identified of which 41 met the criteria for being systematised in accordance with Table 1.

The main ground for exclusion was that initiatives lacked a clear link with or intention to influence or be integrated in some way with the schools´ study plans and curricula, despite being thematically related to sustainability or climate action. This would be the case of a programme that is dedicated to fostering more sustainable practices in the school dining room or that proposes renaturing the school's grounds but does not present a proposal to address this in the classroom as well. As a result, a varied sample of bodies and initiatives was obtained, which supports the relevance of the results and the representativity of the phenomenon studied. In the second phase, a discussion group was held using convenience sampling. To

provide different perspectives, 19 social organisations and from the public sector, identified as relevant actors in the ecosystem, were invited. Of the 19 organisations invited, 10 took part with a total of 11 people, as well as representatives of the research team of the "Clim-Action: Educational Alliance for Climate Action (Clim-Acción)" project, of which this study forms part. The participants comprised six women and five men, representing three public organisations (council, autonomous region, and university), three foundations from the educational sector with extensive experience in the subject, one representative of an Erasmus+ European educational project, and three organisations that represent social networks or laboratories relating to climate action. The different profiles present a diversity of perspectives, increasing the credibility of the study.

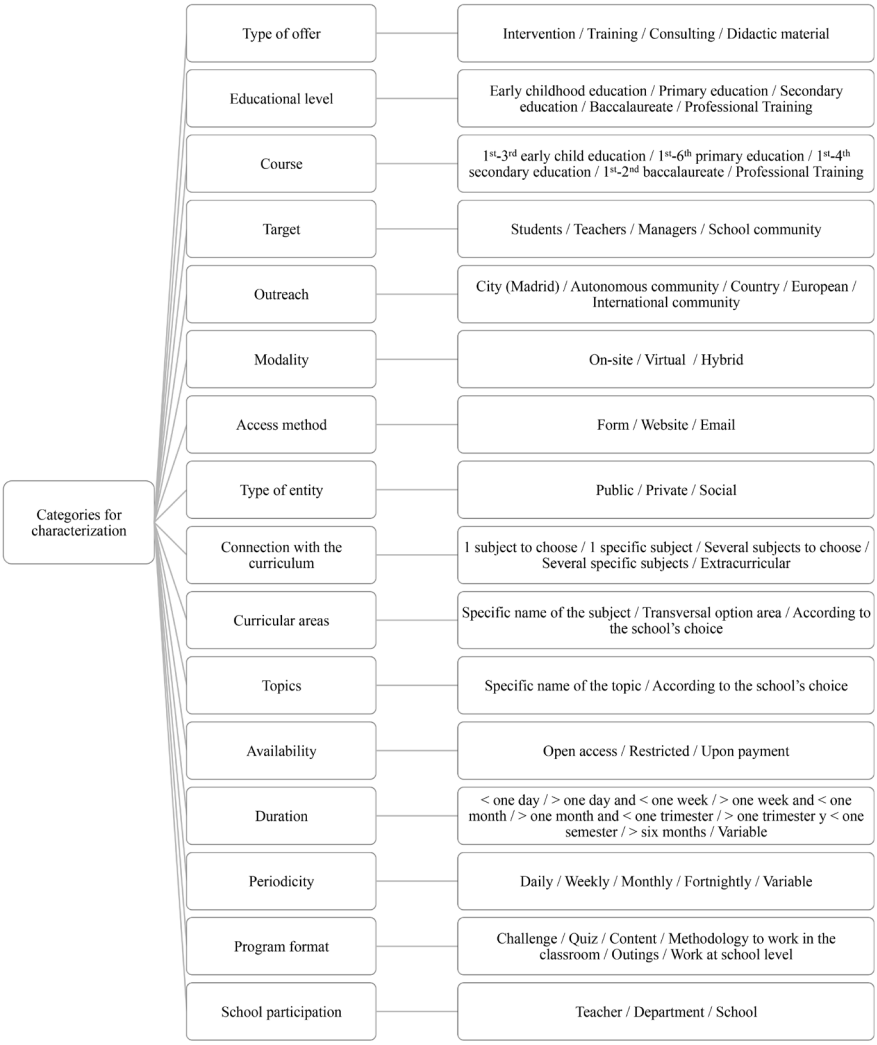
2.3. Instruments

A content analysis sheet was designed through an inductive process to characterise each initiative. The initial focus of the research was to identify the offers labelled as intervention programmes, but the sampling process identified the need to recognise the existence of a range of offers and to expand the categorisation of the offer. Therefore, a principal category relating to the type of educational offer was defined (Table 2). This was subsequently supplemented with other categories and subcategories to complete the coding (Figure 1).

TABLE 2. Principal category for characterisation of initiatives.

Tipo de oferta	Descripción
Didactic materials	Didactic guides and resources (learning situations, content, methodologies, etc.) created for the specific purpose of supporting the incorporation of sustainability and climate action into teaching and learning in the classroom. Given the profusion of materials, the organisations or programmes that offer this type of resources are categorised, many of which offer collections of materials, and not each separate material.
Intervention programmes	These involve implementing activities to cover content, methodologies, or educational actions with a specific objective. They can be provided directly (implemented by the offering organisation) or tutored (facilitating implementation by the school stakeholders themselves, e.g. teachers). These can include training activities and have supporting didactic materials.
Training	Training programmes solely for school management and teachers on how to incorporate sustainability in the classroom. Generic training about sustainability or CC that does not display a clear link with teaching or the educational context was not included.
Guidance	Personalised orientation based on an integral analysis of the situation of the school, including the curricular area.

FIGURE 1. Content analysis sheet with categories and subcategories for characterising initiatives.



As for the discussion group, this was structured using a four-stage script:

1. Introduction of the project framework and participants.
2. Presentation of the repository of characterised initiatives and its results.
3. Individual work and work in two groups to discuss the guiding question, designed in accordance with the research question: "Considering your experience and the results shown in the repository, what opportunities, possible synergies, challenges and needs do we identify for education aimed at climate action and sustainability?". The two groups were formed to give the maximum possible heterogeneity and the moderators previously agreed on the procedures of the dynamic and data collection to be homogeneous and avoid biases.
4. Plenary.

2.4. Procedure

2.4.1. Data collection

In the first phase, the following data collection stages were established:

1. Defining initial inclusion and exclusion criteria, in accordance with the theoretical framework and the research question.
2. Exploratory and inductive process of initial review of key initiatives in the city of Madrid in order to define a code book with the principal category (type of offer) and secondary categories (rest of Figure 1) and subcategories. This was done by two researchers and was subsequently reviewed by another researcher from the team to validate the categories and their descriptions and discuss possible biases.
3. Coding by means of documentary analysis of the websites of the programmes and analysis to categorise them. This process was carried out by two researchers and then meetings were held with the whole research team to validate the results.
4. External verification of the characterisation of each initiative. We asked the promoter organisations of the 41 initiatives, either solely by post or by post and telephone, to review the content of the sheets. Responses were obtained from 27 of them, representing two thirds of the sample, with general agreement on the categorisation carried out on the type of offer and only some minor comments on other categories. This process made it possible to reinforce the credibility of the systematised data.
5. Expansion of the sample by snowballing.

After the repository had been published and its initial data had been consolidated, an in-person discussion group with the name "The state of the art of educational initiatives for the climate" was held on 25 October 2023. The aim was to analyse the results obtained in the documentary phase and answer the research question from the perspective of the organisations. In line with the script for the discussion group, the results of the repository were presented and the guiding question on challenges and opportunities was asked. The participants wrote their answers individually on sticky notes and then were divided into two groups, each moderated by two researchers. During the group debates, the research team also collected the group interventions on pieces of paper, at all times asking the group to confirm the fidelity of the ideas written. All of the written material was collected for analysis, along with notes and summaries done by the research team.

2.4.2. Data analysis

Once the sample of initiatives had been saturated by the snowballing procedure, a comprehensive analysis of the offer as a whole was performed, by calculating the frequencies of the categories and subcategories identified. Given the initial interest in intervention programmes owing to their practical component, a more detailed analysis of this type of offer was performed.

As for the discussion group, the summaries and written material were processed through manual content analysis by two experts who summarised the information on concept maps to extract the main conclusions. The experts subsequently reached agreement on these conclusions. To ensure impartiality in the analysis, all data were treated as equally relevant.

3. Results

3.1. Characterisation of educational initiatives for sustainability and climate action in the city of Madrid

The result of the sampling and characterisation of the offer of EfS&CA programmes was organised in a repository open to public consultation (Repositorio Clim-Acción, 2023). This

can be accessed in a database format, which allows the use of a search tool and filtration by categories, and a detailed sheet for each initiative can also be accessed.

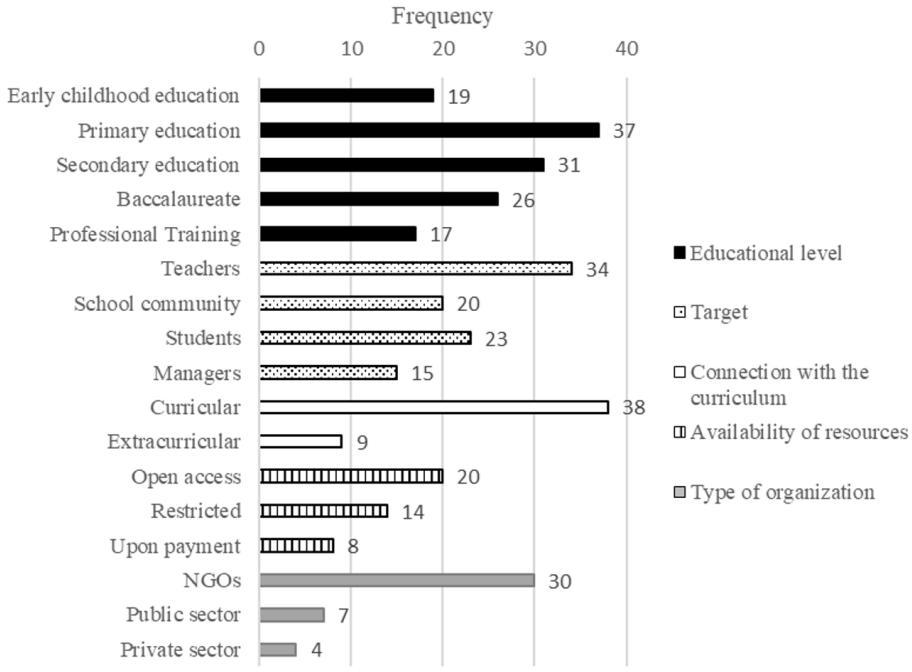
Figure 2 shows the results from several categories of analysis. As of 17 June 20241, the largest offer of the 41 initiatives systematised relates to didactic materials (44%). However, as has been mentioned, this represents the existence of far more didactic material, given that the project focussed on identifying organisations or programmes that offer these resources and not on systematising each of the existing contents. In fact, many initiatives provide a collection of didactic materials.

Intervention programmes are the second most offered category (31%), followed by training (20%), and guidance programmes (5%). Considering all the initiatives, most are offered by NGOs (73%). The public sector offers 17% of the initiatives and the private sector 10%.

Most of the resources (81%) are free to access, with 20% being open access, and 14% restricted (for example, they require signing up). Only 8 require payment. One organisation offers both paid resources and free access ones.

In relation to educational level, most offers are aimed at primary education, followed by secondary and baccalaureate. There are fewer offers for early childhood education and professional training. Some initiatives cover more than one level with the same programme or resource.

Figure 2. Characterisation of the offer of EfS&CA initiatives with a curricular approach in the city of Madrid by educational level, audience, connection to the curriculum, availability of resources, and type of organisation.



Note: some programmes cover more than one category, and so the data in each category will not always add up to the total number of programmes listed.

Most of the initiatives are aimed at teachers with fewer aimed at managers. And they present a proposal that is primarily for the obligatory curriculum rather than extracurricular activities.

The main topics offered include sustainable development, environmental protection, responsible consumption, sustainable development goals, food, and renaturing. These topics encompass other more specific ones, such as the climate, although this one does not particularly stand out, indicating the opportunity to address CC more directly.

The characteristics of the intervention programmes are different. Of the 13 initiatives mapped, 6 are offered by NGOs, 6 by the public administration, and 1 by the private sector. More than half (7) are specifically offered for the city of Madrid. The others comprise 1 international programme, 1 at the autonomous region level, and 4 nationwide programmes. Regarding form of access, most are free (85%) but with access restricted, given that they require participation by invitation, registration, or a specific agreement about the implementation of the programme.

In relation to educational level, most of the offers are also aimed at primary (12), followed by secondary (10). However, the trend then changes, as early years education is in third place (7), followed by baccalaureate (6) and professional training (5). Equally, some programmes cover more than one level with the same initiative. Most of the programmes offer a specific plan (85%), and two programmes permit some choice of topic.

Most of the initiatives are aimed at students (12), although some also involve or are aimed at teachers (10). Slightly less than half (6) involve the management team and the school community (5). The fact that students are the principal target audience, and that not all of these programmes explicitly involve teachers indicates that some of these programmes directly implement the initiatives with an external team, without actively implicating or training teachers. Furthermore, less than half (46%) involve the management team.

Regarding their continuity, it was also observed that these programmes are constrained by funding, which is often sporadic or short-term. To cope with intermittent funding, many organisations systematise their intervention programmes on websites or in didactic guides to inspire and support schools' ability to implement the programmes independently, thus turning the intervention programme into a didactic resource.

Finally, it has not been possible to identify the extent to which different initiatives are evaluated in relation to their results and their transformational potential. The sampling of educational initiatives and contact with the respective organisations suggest limited or non-existent follow-up and evaluation.

3.2. Key stakeholders' perception of the current educational offer and its challenges and opportunities

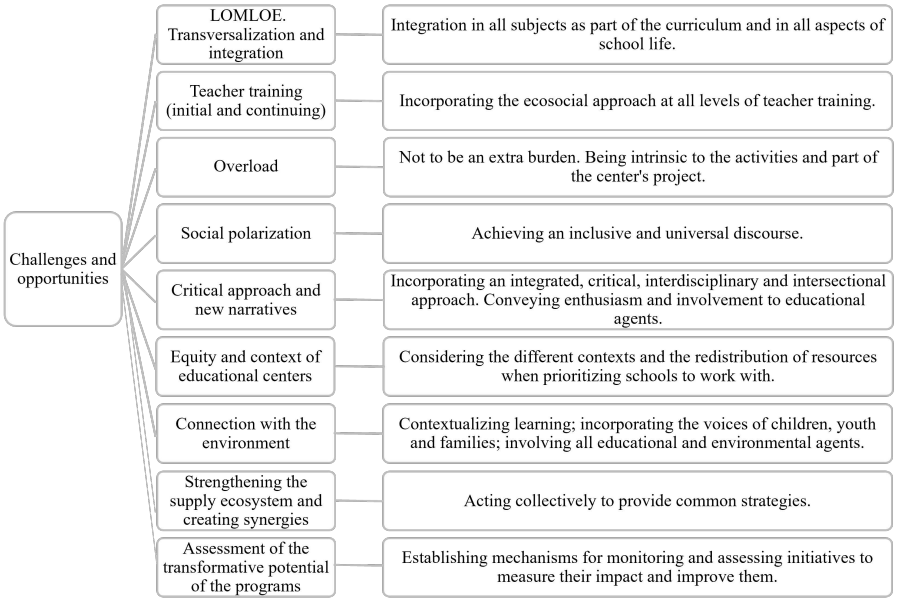
In relation to the results presented on the characterisation of educational initiatives for sustainability and climate action in the city of Madrid, the discussion group (DG) stated that "what has been said represents educational reality well" and expressed surprise about the "multitude of initiatives". There was consensus on the value of this resource because of "all of the information it contains" and recognition of "the wide repertory contained in the repository, its classification and systematisation".

Thereafter, the group identified challenges and opportunities for strengthening EfS&CA in schools. Figure 3 summarises the principal topics covered and agreed in the workshop and descriptions of them.

The DG recognised the LOMLOE as one of the principal current opportunities for EfS&CA in the Spanish context, and as well as being an opportunity it is a mandate, which as such requires "adaptation to regulations", as various participants noted. Similarly, the whole group recognised that to ensure appropriate compliance with the LOMLOE, suitable training and accompaniment must be provided for teaching and management teams. On this line, they identified a need to promote «methodological integration that cross-cuts the content and does not make teachers feel it is an additional burden». They observed that the above is fundamental

both “to make [EfS&CA] reach students as a topic that they will frequently encounter in daily life”, and so that “teachers do not feel burdened in the application of programmes”. This is even more relevant given the acknowledged current situation of «increasing saturation (bureaucracy and emotional instability)» of teachers, which the DG identified as a significant problem that must be considered when proposing new programmes.

Figure 3. Challenges and opportunities of EfS&CA detected in the discussion group.



As well as support for making EfS&CA transversal, the DG identified other challenges to address through training and other types of educational offer. Firstly, they shared the perception that teachers usually have “less knowledge than they believe”. Secondly, it was noted that the current discourse on sustainability is presented in a worn-out and politicised way and has become “boring” for students. Social polarisation is already apparent in classrooms and represents a further challenge for teachers, including for their emotional state.

However, some members of the DG suggested that the context of the climate emergency, with increasingly palpable evidence recognised by society, is an opportunity for EfS&CA to have greater acceptance among different ideological strands. Consequently, the topic can generate ever more receptivity and at the same time be more attractive than the notion of sustainability itself.

Therefore, all the participants underlined the need for EfS&CA training to be addressed from an interdisciplinary perspective and to be capable of prompting empowerment and action, of “inspiring enthusiasm or engagement” among educational stakeholders through new narratives that are more positive, inclusive, and universal. Some stakeholders placed more emphasis on the need to evade superficialities and reductionism and promote more intersectional and critical reflection on the structural causes of and interrelation between environmental and socio-economic problems, transcending individual responsibility.

With regards to how to enrich the programmes and materials, the discussion group emphasised two aspects. On the one hand, a need for organisations to consider “different educational contexts (socio-economic, ethnic-racial segregation)” and for the redistribution of resources when prioritising which schools to work with. And on the other, a need to contextualise learning and to connect it with the surroundings. To do so, the importance of

"mapping, incorporating, and informing any strategy from the voices of learners (children, adolescents, young people, and families)" and involving all educational stakeholders and the ones from the surrounding community was identified. Programmes would also be strengthened if they promoted relationships and exchange among schools by "involving most of the educational community, so that the neighbourhood community knows about the school's climate action initiatives" and promoting the "collective of schools working towards shared objectives".

Interchange between organisations that offer educational initiatives was also identified as an opportunity to reinforce the ecosystem of stakeholders, acting "collectively to increase shared strategic topics" and achieving greater connection and creation of synergies. The group therefore affirmed the importance of "meetings like this one" and recognised that "there are nodes of will and interest (multiple initiatives) that have already been created" and that it is necessary to "take advantage of them".

Finally, the discussion group confirmed what the research team had identified regarding the absence of adequate follow-up and evaluation mechanisms by the programmes.

4. Discussion

The process of developing the repository and cross-checking the results with stakeholders has facilitated the organisation of the offer and provided an overview of educational initiatives and resources, currently offered in Madrid by external organisations, to support schools in their task of educating for climate action and sustainability (research aim 1).

These results, combined with the different perspectives provided by stakeholders from the EfS&CA ecosystem in the city (research aim 2), has made it possible to identify the main challenges and opportunities for educating in favour of EfS&CA in curricular contexts. Particularly to indicate which aspects can enrich the different educational offers at a curriculum level from these external stakeholders to promote EfS&CA throughout the different levels of education, responding to the central question of this research.

Firstly, in relation to the type of educational offer and how it is accessed, it has been found that didactic materials that are free to access are the most available resource type. These can contribute to teachers' eco-literacy and support the available text books. In this sense, by consolidating the sources of these materials into a standardised and accessible tool, the repository seeks to meet one of the challenges that faces teachers, which is the spread of this type of material.

However, in isolation these resources are not usually sufficient to produce a change of attitude. While a variety of curriculum resources are available, they require interest and prior training or support to enable generic materials to be turned into ones that are more contextualised and relevant for teachers and students, thus increasing collective efficacy, according to Allen and Crowley (2017).

Intervention programmes seek to fill this gap through their practical component. This is especially true if they are tutored, facilitating implementation of the programme by the educational stakeholders themselves, especially teachers. However, it has previously been identified that not all of these initiatives do so and that less than half involve school management teams.

This prevents teachers and management teams from being key players in the initiative, hindering their ability to integrate and to give continuity to the programme. This is an especially relevant point because the sampling has identified that one of the greatest challenges of the intervention programmes relates to their continuity and their potential to be integrated as a whole-school project (and not as a one-off activity or an activity of one particular teacher).

Another challenge relates to openness to co-creation and adaptation. Many proposals feature closed projects, but it has been found that it is crucial to prioritise programmes that can adapt to the specific context of the institution and actively involve educational stakeholders.

Giving school stakeholders a central role is fundamental for permanently incorporating context-based classroom activities that drive behavioural change among students. Behavioural change is closely tied to the emotional impact of the topic and the methods used to address it, as noted by González-Muñoz et al. (2024). Intervention programmes should provide teachers with training and practical demonstrations of strategies that foster deep learning, such as cognitive conflicts, critical analyses of controversial situations, or creative processes (Bengsston et al., 2024; Pérez-Bueno et al., 2024).

Another limitation of the current offerings lies in the lack of oversight regarding their use and the evaluation of their quality. The repository does not include an evaluation of the content of the resources provided and there is no evidence of external evaluations or reviews conducted by the offering organisations themselves on their materials and initiatives. Establishing monitoring and evaluation mechanisms is essential for promoting continuous improvement and creating truly impactful and transformative initiatives. Adequate evaluation would also support educational stakeholders in selecting the most suitable existing initiatives.

The lack of evaluation becomes particularly significant given that other studies highlight absences and reductionist approaches in the treatment of climate change within textbooks, which hinders understanding and action regarding the climate crisis (Navarro-Díaz et al., 2020). This point, which was also emphasised by the discussion group, underlines the need for these resources to avoid superficiality and instead be approached from an integral, interdisciplinary, intersectional, and critical perspective. They should aim to inspire empowerment and action. These impressions of the stakeholders align with the findings of Mulà et al. (2022).

Given that teacher training in these fields remains insufficient (Gómez & Fontao, 2022; Sáenz-Rico de Santiago et al., 2023), this hinders interest, appropriate selection, and effective use of such resources. This again reinforces the imperative for greater efforts for quality initial education and continuing training relating to EfS&CA (Mulà & Tilbury, 2023). Therefore, it is recommended that the key aspects of CC and sustainability be integrated into teacher training all over the world alongside policies aimed at addressing scepticism and misinformation about climate change facts (Oranga et al., 2023). Those in charge of designing training at different levels could benefit from the accumulated knowledge of organisations specializing in this field. Similarly, there is also an opportunity for organisations to strengthen the educational component of their offerings, such as intervention programs. This opportunity is boosted by the context of Spain's new education law, which offers a legislative framework that facilitates and promotes EfS&CA, as Gavari-Starkie et al. (2021) note, while at the same time generating a need for training and backing for teachers and managers to comply with it (Marcén et al., 2024).

The need to consider training, programs, educational actions and materials with new, more critical, in-depth and attractive approaches and narratives is also reinforced. The discussion group underlined the need to move beyond individual responsibility and foster a more critical reflection on the structural causes and interconnectedness of environmental and socioeconomic issues. These topics should be approached critically and scientifically (Education International, 2021), but without resorting to catastrophic narratives. It is necessary to confront polarisation by creating an inclusive discourse that avoids associating sustainability and climate action with specific ideologies or political parties, focusing instead on their universal nature. At the same time, it is necessary to inspire imagination and collective construction of more desirable futures, capable of generating enthusiasm and commitment among educational stakeholders. This perspective is also highlighted by the European Commission (Bianchi et al., 2022).

Among the new approaches to EfS&CA, the emphasis on experiential and everyday learning stands out. In this sense, connecting the classroom with its broader school environment and community is essential (Sáenz-Rico de Santiago et al. 2023; López & Sánchez, 2023; Hargis et al., 2021; Tilbury & Galvin, 2022) as it makes learning meaningful and encourages students to become active change agents.

The importance of working in a way that is consistent with the methodology, content, and school environment (Benayas & Marcén, 2019) was previously identified, and also underlined

by the discussion group. This connection is strengthened when the initiatives incorporate the voices of the educational community and when the EfS&CA actions promoted by the school are also linked to a broader, real-world context. For example, these actions can connect to other schools, or the climate agenda and the public policies of cities or regions. In addition to representing a pedagogical improvement, this enables the school to contribute to a broader transformation by strengthening the social fabric and acting as a node for transformation of its surrounding environment.

All of the above is only possible if management and teaching teams assume an active leadership role in favour of more humanistic and innovative educational models, sharing a clear vision of a sustainable future (Sáenz-Rico de Santiago et al. 2023; López & Sánchez, 2023). In this sense, guidance, although it is the least commonly offered type of support (5%), can add significant value, as they aim to engage school management team and adapt more closely to the realities of the schools.

5. Conclusions

Given the opportunity and challenges that Spain's new education law provides to consolidate EfS&CA at a curricular level, this study focussed on two aims. First, to analyse the educational offer with a curricular focus from external organisations that support schools. And secondly, to analyse challenges and opportunities from this offer, jointly with organisations from this ecosystem, to identify elements for improving the offer. The curricular focus is considered essential for fostering citizen engagement, making visible and legitimising the precedence given to sustainability and climate action, and achieving a whole-school approach. Recommendations for organisations that want to enrich their actions and resources to support schools on their journey towards EfS&CA are given below.

To start, some of the programmes offered were not designed within the framework of the new education law. Accordingly, one challenge and opportunity for organisations is to be able to contribute to schools, both through new resources that help with adaptation to the new law and by modifying pre-existing programmes and resources to the new context. This would facilitate the work of teachers and management teams and increase the appeal of these materials, initiatives, and services.

Moreover, there is a clear need for training for teachers and management teams as this is one of the principal levers of change to truly make this focus permeate schools. Therefore, training organisations and institutions can and must assume an active role to facilitate ownership of new approaches, methodologies, and contents. It is recommended that any action that seeks to promote EfS&CA presents a clear contribution to the curriculum and to classroom work through learning situations and schools' pedagogical projects. Also, work with tangible elements and demonstrative and applied experiences should be fostered whenever possible. Furthermore, initiatives and training should also support a more integrated collective vision of school life, avoiding individual-teacher focuses and supporting EfS&CA reaching the whole educational community, connecting schools with their neighbourhood, territory, or city, and acting as nodes for change in their surroundings. In this sense, designing actions and strategies to support and involve management teams is essential and offers of guidance can be a good complement to the other types of offer, owing to their more personalised and contextualised character, but also the processes of listening to the voices and perspectives of learners, educational stakeholders, families, and the community, to incorporate them into whole-school projects.

Another challenge for organisations, as has been observed, is the incorporation of systems for evaluating programmes and assessing whether they reach schools in a contextualised and equitable way. This is also a relevant point for the organisations that fund the programmes. Their role is essential for promoting innovation and generating model experiences, but they often centre on occasional investments that do not make it possible to generate experiences at a sufficient scale, nor do they allow adequate evaluation of impacts, which require longer time

frames. Among the impacts of the transformational capacity of these initiatives, the potential to integrate initiatives in schools and in public policies must be considered.

In addition, the overview that the repository permits can facilitate cross learning between organisations, which can take other actions into account as an input to improve programmes and even strengthen collaborative work and work in partnership. Work on EfS&CA in Madrid is already well established, so there are consolidated programmes and expert and experienced knowledge that can be used to boost the current offer and have an impact on public policies. Similarly, in line with the proposals of Oranga et al. (2023), broad coordination of the efforts of stakeholders is recommended (private sector, government, universities and training and research centres, members of the community, families and civil society) to promote EfS&CA, as well as the adoption of a transformational learning that results in a change of perspective and behaviour.

The study has some limitations, which at the same time suggest future lines of research. Firstly, organisations' dependence on funding to keep their initiatives active means that their stability over time varies, and so the repository is a living concept and constantly under construction. As a result, we have not taken into account the historical path and antecedents of the initiatives, but instead only their availability at the moment of the study.

Moreover, the scope of these initiatives with regards to the number of beneficiaries, the type of schools involved, and the short, medium, and long-term impact of each type of action was not evaluated. This information, along with a quantitative focus, would complete the analysis and show relations between variables that enable improved decision making about how to reinforce initiatives, which ones are most suitable for promoting EfS&CA, and even establishing inferences with independent variables such as the type of initiative (public, private, social) or the degree of dependence or autonomy of the teachers when implementing the educational interventions.

Finally, although the discussion group featured a variety of perspectives, it did not contemplate all of the diversity in relation to the initiatives offered, as private-sector voices were not included, and so the study could be complemented with more voices from other entities. Furthermore, this study's focus, centred on the perspective of organisations with initiatives, only represents a vision of the offer, which must be complemented by the perspectives of schools, teachers, and students, given that they face varied challenges and they also develop their own proposals and resources. Obtaining an overview of the initiatives that schools develop is a potent source of inspiration to other schools because they show initiatives tested by their peers.

There is an opportunity to foster communication and interchange between peers (teachers, management teams, and inter-school), an aspect that can be reinforced by public and private organisations. Indeed, the repository shows some pre-existing examples, such as the case of the *Tiempo de actuar [Time to act]* blog (FUHEM, n. d.). These networks, as Fernández and Gutiérrez (2014) and Sáenz-Rico de Santiago et al. (2023) observe, can foster the creation or strengthening of inter-school collaboration networks with a vocation to grow and project themselves towards state and international networks. In these spaces, schools could interact with external organisations to enrich the debate and progress in the incorporation of EfS&CA at a curricular level and with a whole-school approach, so as to increase its impact as a driver of social transformation.

The recommendations made in this study show some ways to enrich EfS&CA initiatives in the city of Madrid, but they can also be extrapolated to other contexts, given that the common national context put in place by Spain's new education law and the challenges identified in the bibliographic review are similar across different geographic areas.

Note

[1] The repository will continue to be updated until the end of the project if the team identifies new initiatives. Accordingly, the figures might be updated.

Authors' contributions

Susana Sastre-Merino: Conceptualization; Data curation; Formal analysis; Funding acquisition; Methodology, Writing (original draft); Writing (review and editing).

Cristine Zanarotti-Prestes-Rosa: Conceptualization; Research; Writing (original draft); Writing (review and editing).

Marvin-Josué Izaguirres-Betancourth: Data curation; Research; Writing (original draft).

Artificial Intelligence (AI) Policy

The authors do not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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Reconstructing the professional identity of compulsory secondary education teachers in curricular sustainability

Reconstrucción de la identidad del profesorado de Educación Secundaria Obligatoria en sostenibilidad curricular

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Abstract:

The current situation with its constant uncertainty regarding the new social and planetary challenges that societies face demands commitment and active participation by members of the public to achieve economic, social, and environmental transformations that favour a more sustainable planet. Establishing an alignment with sustainability in all its dimensions in secondary school curricula is necessary so that people can lead social changes in line with the sustainable development goals of the 2030 Agenda. This research seeks to establish whether the specialisation profile of compulsory secondary education teachers at national level interferes with the incorporation of the sustainability approach in the classroom. The sample comprised n = 208 participants identified through non-probabilistic sampling using the snowball technique. The results of a descriptive and inferential analysis showed that the participating teachers try to respond to the challenges of the 21st century (such as social inequalities, pollution and degradation of ecosystems, depletion and destruction of vital resources, etc.), but do not approach them from the necessary interdisciplinary and complex perspective, instead largely covering the environmental dimension. This makes it difficult for secondary school students to address global challenges holistically and explore ways of transformation from an approach centred on sustainability. It is therefore necessary for lifelong learning to aid teachers in the reconstruction of their teaching work, overcoming the current outlook, which is fragmented by disciplines or specialisations, in order to promote an interdisciplinary approach through cooperation and collaboration. In this way, true eco-social literacy would be consolidated in order to meet the new demands of the education system in terms of sustainability.

Keywords: global education, compulsory secondary education, curricular sustainability, teacher professionalisation, lifelong learning, environmental sustainability.

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Resumen:

La actual coyuntura contemporánea, en permanente incertidumbre ante los nuevos retos sociales y planetarios a los que se enfrenta la sociedad, demanda a la ciudadanía compromiso y participación activa para lograr transformaciones económicas, sociales y ambientales a favor de un planeta más sostenible. Alinear los planes de estudio de secundaria con la sostenibilidad en todas sus dimensiones resulta necesario para que la ciudadanía sea capaz de liderar cambios sociales alineados con los objetivos de desarrollo sostenible de la Agenda 2030. Esta investigación pretende conocer si el perfil de especialidad del profesorado que ejerce docencia en Educación Secundaria Obligatoria en el ámbito nacional interfiere en la incorporación del enfoque de sostenibilidad en el aula. La muestra, conformada por $n = 208$ participantes, responde a un muestreo no probabilístico mediante la técnica de bola de nieve. Se realizó un análisis descriptivo e inferencial y los resultados evidencian que el profesorado participante trata de dar respuesta a los retos del siglo XXI (por ejemplo: las desigualdades sociales, la contaminación y degradación de los ecosistemas, el agotamiento y la destrucción de recursos vitales, etc.), pero no desde la interdisciplinariedad y la complejidad que estos requieren, sino que desarrollan, en mayor medida, la dimensión ambiental de la sostenibilidad. Esto dificulta que el alumnado de secundaria aborde de forma holística los retos planetarios y explore vías de transformación desde un enfoque sostenible. Por tanto, es necesario que la formación permanente acompañe al profesorado en la reconstrucción de su quehacer docente y supere la actual visión fragmentada por disciplinas o especialidades en aras de promover un abordaje interdisciplinar, mediante la cooperación y colaboración. De esta forma, se consolidaría una verdadera alfabetización ecosocial para dar respuesta a las nuevas demandas del sistema educativo en materia de sostenibilidad.

Palabras clave: educación global, enseñanza secundaria obligatoria, sostenibilidad curricular, profesionalización docente, formación continua, desarrollo sostenible.

1. Introduction

The current situation, with its constant uncertainty regarding the new social and planetary challenges that societies face, demands commitment and active participation by members of the public to achieve economic, social, and green transition changes (European Commission, 2024). Establishing an alignment with sustainability in all its dimensions in secondary school curricula is necessary for citizens to be able to drive social changes that are coherent with the sustainable development goals (SDGs) of the 2030 Agenda. This focus is crucial for educating people to be committed to environmental, social, and economic sustainability.

The evolution of Spain's education system, marked by the passing of a succession of often conflicting pieces of legislation, has created instability that seems to hinder the improvement and consolidation of educational quality (Novella & Cloquell, 2022). Integrating the focus on sustainability into the official curriculum makes it possible to prepare students to face the challenges of the future holistically (Patta & Murga-Menoyo, 2020). In this framework, the Organic Law 2/2006, of 3 May, on Education established as one of its principles and goals the promotion of education for ecological transition with social justice criteria, underlining its contribution to the dimensions of sustainability. In particular, the organisation of the fourth year of compulsory secondary education included the need to foster education for sustainability transversally, which entailed integrating it into all areas of the curriculum. However, these early advances were undone by the Organic Law 8/2013, of 9 December, for improving the quality of education, which focussed more on aspects relating to quality, competitiveness, and improving academic performance, sidelining curriculum sustainability.

The passing of Organic Act 3/2020, of 29 December, Modifying the Organic Education Act 2/2006, of 3 May (LOMLOE in its Spanish acronym), emphasises what humankind must confront, with the urgency of promoting lifestyles that are sustainable and responsible to

our planet (Coll & Martín, 2021; Moya & Luengo, 2021). Consequently, it advocates for the inclusion of education for sustainable development in curricula and educational programmes, developing key competences in the focus on sustainability (critical thinking, systems thinking, collaborative decision making, and responsibility to present and future generations) to contribute with active responsibility and commitment to consolidating sustainable societies (Murga-Menoyo, 2015; Pellín et al., 2021). However, what possibilities does the LOMLOE offer to try to address sustainability in the compulsory secondary education curriculum?

On the one hand, it states that by 2025 practising teachers must be trained in the goals set by Agenda 2030 and will need to have acquired sustainability competences, which should also, in our view, be introduced into training to access the teaching profession. On the other, it makes education in civic and ethical values an obligatory subject that pays special attention to ethical reflection and features content referring to education for sustainable development and global citizenship, among other aspects, so that secondary-school students discover what consequences the actions of humankind have for the planet.

Royal Decree 217/2022, of 29 March, Establishing the Organisation and Minimum Teaching Requirements of Obligatory Secondary Education states that this subject (sustainable development and environmental ethics block) enables students to address essential ethical questions and develop behaviours that reflect the interconnected and eco-dependent character of the environment through meaningful learning situations. These must form part of their reality, inviting them to reflect and cooperate in order to promote a planetary citizenship committed to the challenges of the 21st century, which include social inequalities, pollution and degradation of ecosystems, exhaustion and destruction of vital resources, etc. (Calero et al., 2019; Castro-Zubizarreta et al., 2022; De la Rosa et al., 2022).

The most recent *United Nations sustainable development goals report* [Organización de las Naciones Unidas (ONU), 2023] notes that teachers are aware of the importance of addressing the seriousness of climate change in depth in their classrooms in an attempt to develop holistic strategies that contribute to mitigating these challenges, but it appears that not all of them manage to do so. Students report needing more information and education to understand its complexity, calling for interdisciplinary and action-oriented education. The LOMLOE invites teachers from a variety of obligatory subjects (Physics and Chemistry; Geography and History; Spanish Language and Literature, etc.) and optional subjects to develop basic knowledge that favours the connection between the different branches of knowledge to contextualise learnings and connect them in response to the global challenges of the 21st century. However, what are teaching practices like and how do they interfere in the secondary-school curriculum for the sustainability focus?

1.1. Teaching practices and the curriculum

The holistic focus in sustainability involves addressing the complexity of relations between social, environmental, and economic systems (Collazo & Geli, 2022; Moya & Luengo, 2021). This requires connecting current problems in society, which are still seemingly approached through individual disciplines with a focus on specific questions such as, for example, environmental ones (Solís-Espallargas & Valderrama-Hernández, 2015), sometimes reduced to warning of climate change, recycling, and caring for natural spaces (Madorrán & Almanzán, 2022). In this regard, and with the objective of educating citizens who are committed to the planet, the secondary curriculum cannot be treated as a set of independent and unconnected subjects (Risco & Cebrián, 2018), an approach that seems to be part of the dominant culture, as Morín (1999) already mentioned the need to stop dividing and compartmentalising our knowledge so that we can face complex and global challenges.

If we start from the position that curriculum sustainability does not involve covering content independently in the topics of different subjects, but rather driving global changes in the conception of the educational process (Collazo, 2018), it is important to understand that interdisciplinarity is necessary to confront complex challenges that are closely connected and must be resolved jointly (Vilches & Gil, 2021), generating a culture of sustainability in educational centres.

On this line, the LOMLOE states that educational institutions can teach subjects together that are related to one another, going further to respond to the new culture, deriving from the need to create sustainable ways of life (Moya & Luengo, 2021). There is a need to connect areas, subjects, and fields that make it possible to integrate sustainability competences from different disciplines into the curriculum: critical analysis, systemic reflection, decision making, and sense of responsibility towards present and future generations (UNESCO, 2017).

Completing the basic education stage requires knowing how to use the content acquired to resolve needs that are present in reality. Therefore, as LOMLOE indicates, more than understanding the challenges of the 21st century and believing that this is sufficient to produce changes in the behaviour of students and consequently the public, educational action must promote education for sustainability, establish commitments to action in all of the spheres that comprise society, put them in progress, and monitor the results achieved. This will give a holistic perception of the reality of the world (Vilches & Gil, 2021), reinforcing global citizenship.

On these lines, educational institutions attempt to deal with transformations in an effort to react to the challenges people face. To do so, they have to take teachers into account as key agents in the transformation of the public (UNESCO, 2022) and as facilitators of the learning process to contribute to the new demands of current society (Dubet, 2006; Patta & Murga-Menoyo, 2020).

Along with reciprocal collaboration with their peers and the support of educational institutions in a community oriented towards sustainability, teachers will be able to act as enhancers of new educational ecosystems from a systematic perspective in increasingly complex settings and will be able to set up learning networks (UNESCO, 2022), taking into account the fact that teaching practices tend to follow a single-discipline path and must be reconceptualised to move towards the sustainability focus.

1.2. Reconceptualising the profession

Teachers should play an essential role in the current challenges facing education in the context of a world that is interrelated and constantly changing (Van der Wal et al., 2018), and so they should have a holistic and dynamic vision that enables them to confront the challenges that are present in society (Misad et al., 2022) and integrate them into their professional practice.

Their teaching work results in students, as members of this society (Montané, 2020), being conscious of the impact of human activity on the planet so that they can take conscious decisions to build a sustainable present and future (UNESCO, 2017). With this aim, teachers must analyse and reflect on their teaching performance from a critical outlook to identify areas for improvement and propose actions that make it possible to improve their pedagogical practice in order to meet the needs of the social context (Domínguez & Rojas, 2018; Esquerre & Pérez, 2021; Reis et al., 2020).

Authors such as Rodríguez and Hernández (2018) and Ruíz and Santos (2020) note that teachers who participate in upgrading and lifelong training programmes acquire competences to perform their duties effectively in the classroom, fulfilling their role as educators. This training must favour an attitude that embraces change (Chocarro, 2007) and help them understand the current situation of an emergency of anthropogenic origin that the planet faces (Tomas et al., 2015; Vilches & Gil, 2021) in which the impact of human activities has disrupted the sustenance of life.

Nonetheless, many secondary teachers are currently still anchored to their subject and to their classroom, which can result in students having a partial understanding of the challenges we face in the 21st century and so their response to them is insufficient. The Bonn Declaration, from Germany (UNESCO, 2009), called for teacher training programmes to be redirected. Teachers must respond to the call to action regarding education for sustainable development and recognise their responsibility in the construction of a sustainable future (Brandt et al., 2022; Shepard, 2008).

The fact is that, as agents of change, it appears that they do not tend to make their teaching practice and thinking sustainable, either because they do not consider it to be relevant or because they think it is not related to the subject they teach (Vilches & Gil, 2012). This might be explained by the crisis of professional identity that has hit the profession owing to the decomposition of the transmissive model of teaching (Bolívar et al., 2014; Chocarro, 2007; García-Pérez & Mendia, 2015; Rufinelli, 2021), as the student is now at the centre of learning and

is the figure who must develop competences in sustainability to adapt to demands, changing surroundings, and new realities (Misad et al., 2022; Van der Wal et al., 2018).

What is needed to reconceptualise teaching as a profession in response to this new form of educating and for this to permeate students and so have a positive impact on the challenges society faces? Firstly, bearing in mind that education is at a critical moment (Misad et al., 2022), teachers need to be trained in sustainability as a lack of training about social challenges is an obstacle that has not been overcome. There is also a need for joint coordinated actions between all parties in the educational institution that make it possible to reconceptualise teaching as a profession and strengthen the identity of teachers so that they can manage their own learning and that of the students (Montané, 2020; Risco & Cebrián, 2018), contextualising their teaching in current problems and from there constructing knowledge, helping them to build global citizens through their own know-how and being (Cebrián & Junyent, 2015).

Secondly, teachers at secondary-school level must understand that whichever subject or specialisation they have can contribute to confronting the different problems that affect humankind, generating responsible attitudes and behaviours that lead to taking well-informed decisions (Vilches & Gil, 2011). To do so, it is beneficial to promote interdisciplinary experiences that can interrelate knowledge from a holistic perspective (Imbernón, 2001). So, teachers will be able to comprehend the paradigm of complexity, which, in the words of Collazo (2018), enables "the construction of explanatory models, of an anthropocentric worldview, and strengthens transformative action" (p. 29, own translation), as the transition to sustainability consists of a plurality of essential transitions (towards responsible consumption, economic, energy, demographic, urban, from anthropocentrism to biocentrism, etc.) that are closely connected to one another, as happens with environmental, economic, and social problems. And the fact that teachers and students among other agents involved lack a global vision is an obstacle to being able to adopt effective measures and actions (Vilches & Gil, 2021).

On this line, Imbernón (2022) considers knowledge of the context to be necessary to carry out the role of teacher correctly, with a need for teachers to question their professional and practical knowledge and also to regard teaching as knowledge in construction where collaboration between people for their own personal development is essential.

In light of the above, the research presented leads us to ask the following questions: Do secondary teachers cover concepts from Agenda 2030 in their teaching practice to develop the sustainability focus in class through their subject? And, if so, is the approach to the focus on sustainability holistic? And does it respond to its three dimensions (environmental, social, and economic)?

This purpose of this study is to establish whether the specialism of teachers who teach in compulsory secondary education interferes in the incorporation of the sustainability focus in the classroom, and if so, the extent to which it does so.

2. Hypotheses

This research, which is of a quantitative, transversal, and multicentre nature, was done at a nationwide level and proposes the following hypotheses:

- H1: secondary teachers only cover concepts in their teaching practice that are related to their speciality, contrasting with the holistic sustainability focus.
- H2: the sustainable development concepts that secondary teachers incorporate into their pedagogical practice are worked on through the key competences of the curriculum for this educational stage.

3. Method

3.1. Participants

This research uses purposive non-probability sampling with the snowball chain-referral technique to access a specialist population consisting of secondary teachers and to ensure

representation of the greatest possible number of autonomous communities. The sample comprises a total of 208 participants, distributed among male teachers (*n* = 82, 39.4%) and female teachers (*n* = 124, 59.6%) in compulsory secondary education. The participating teachers are in the following age bands: 20 to 30 years (*n* = 16, 8%), 30 to 40 years (*n* = 50, 24%), 40 to 50 years (*n* = 72, 35%), 50 to 60 years (*n* = 65, 31%), and over 60 years (*n* = 5, 2%). They have been teaching for less than 5 years (*n* = 55, 26%), between 5 and 10 years (*n* = 24, 12%), between 10 and 15 years (*n* = 24, 12%), between 15 and 20 years (*n* = 32, 15%), between 20 and 25 years (*n* = 32, 15%), and more than 25 years (*n* = 40, 19%) in various educational centres in Spain that are publicly owned (*n* = 201, 96.6%), state-funded independent (*n* = 6, 2.9%), and private (*n* = 1, 0.5%), predominantly located in the Valencian Community (*n* = 40, 19.2%), the Community of Madrid (*n* = 36, 17.3%), the Principality of Asturias (*n* = 21, 10.1%), and Galicia (*n* = 15, 7.2%).

Teachers are distributed by speciality as follows: Plastic and Visual Arts (*n* = 12, 5.8%); Biology and Geology (*n* = 43, 20.7%); Economics and Business Administration (*n* = 25; 12%); Physical Education (*n* = 8, 3.8%); Philosophy (*n* = 13, 6.3%), Physics and Chemistry (*n* = 12, 5.8%); Geography and History (*n* = 35, 16.8%); Information and Technology (*n* = 16, 7.7%); Spanish Language and Literature (*n* = 16, 7.7%); English (*n* = 10, 4.8%); French (*n* = 8, 3.8%); Mathematics (*n* = 8, 3.8%); Music (*n* = 2, 1%).

3.2. Variables and instrument

The following variables were studied: relevant concepts for working on sustainability in the classroom, which, owing to their relevance, were taken from *Voces para una alfabetización ecosocial (Voices for eco-social literacy)* by Murga-Menoyo and Bautista-Cerro (2022); curriculum competences; and teaching specialism, with this last one being the dependent variable.

A questionnaire was designed, comprising 17 items with different answer options (single, multiple, or 5-point Likert scale, where 1 corresponded with "I do not know this" and 5 with "I know this well"), to explore the ecosocial literacy of secondary teachers. This was administered anonymously using the Google Forms platform (Table 1). To identify the relationship between the proposed statements and the research objectives, as well as to guarantee comprehension of the questions asked, the questionnaire was validated by ten experts from different fields: two from sustainable development, two secondary teachers, two from the Conferencia de Rectores de las Universidades Españolas (Association of Rectors of Spanish Universities, CRUE), one university expert, two experts in questionnaires, and one from the civil population. Good reliability (Ω = .89) was found for the whole of the instrument.

Table 1. Types of response to the items on the questionnaire.

Questionnaire items	Types of response
A. Gender	Single
B. Age	Single
C. Years of teaching practice	Single
D. Ownership of school	Single
E. Autonomous community where the school is located	Single
1. What is your level of knowledge of the SDGs?	Likert scale
2. How did you find out about the SDGs?	Single

3. What is your level of knowledge of Agenda 2030?	Likert scale
4. Basic sustainability concepts (environmental, social, and economic) that must form part of the OSE curriculum	Single
5. Developing projects and activities in the centre on the importance of SDGs	Single
6. Number of projects implemented in the centre	Single
7. Selection of concepts from Agenda 2030 for working on sustainability in class	Multiple
8. Would you incorporate other concepts?	Open
9. In what subjects do you incorporate the concepts identified?	Multiple
10. If you incorporate the concepts into your teaching, in what curriculum competences do you work on them?	Multiple
11. You develop the selected concepts through...	Multiple
12. Methodologies used for working on sustainability in class	Multiple
13. Didactic experience with regards to sustainability	Open
14. Difficulties implementing the SDGs and Agenda 2030 in class	Single

3.3. Procedure

The first phase of the study involved identifying secondary education centres in Spain's autonomous communities and the potential participants, which would be the heads of these educational centres. In the second phase, we sent an email to them to inform them of the aim of the study and the inclusion criteria for participants, as well as a link to the instrument which we asked them to distribute among their networks of secondary teachers. Finally, the teachers had a period of approximately 3 months to complete the questionnaire voluntarily and anonymously.

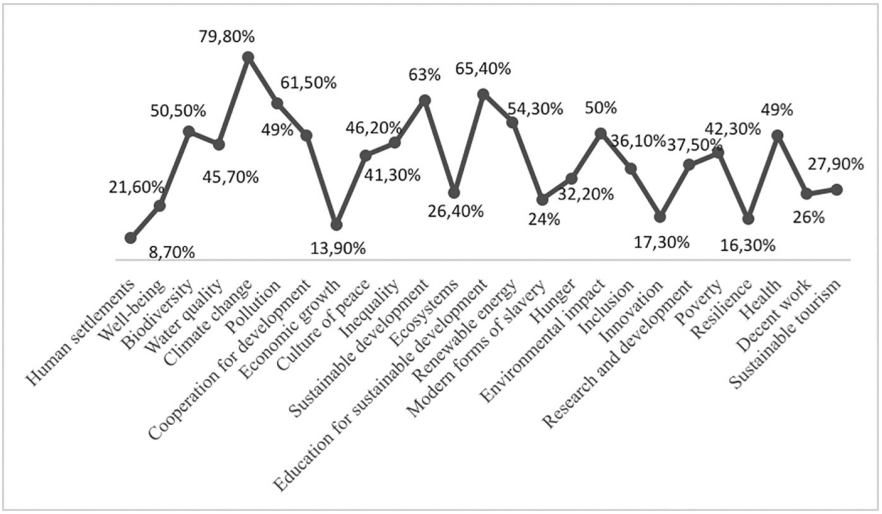
3.4. Data analysis

A descriptive and inferential analysis was performed using Pearson's chi-squared test (p <.05) and Fisher's exact test (p <.05) to identify the relationship between the variables, using the IBM Statistical Package for Social Sciences (SPSS) version 27 software.

4. Results

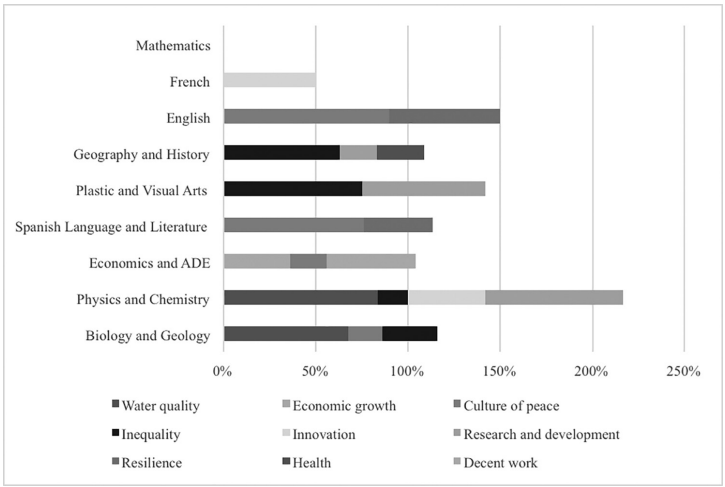
Of the secondary teachers, 97.1% (n = 202) consider that the concepts from Agenda 2030, contemplated in their three dimensions (social, environmental, and economic), must form part of the secondary curriculum. However, in their teaching practice, they tend to cover to a greater extent the ones that are most closely linked to the environmental dimension (Figure 1): climate change (n = 166, 79.8%), pollution (n = 128, 61.5%), renewable energy (n = 113, 54.3%), environmental impact (n = 104, 50%), and biodiversity (n = 105, 50.5%).

FIGURE 1. Distribution of the concepts covered by secondary teachers in their teaching practice.



These results agree with H1, as teachers tend to use sustainable development concepts that are related to the disciplinary content of their specialism. In this sense, a higher response rate is detected from teachers specialising in Biology and Geology (n = 43, 20.7%) and Geography and History (n = 35, 16.8%). Furthermore, Fisher's exact test (F) shows that there is significance (p <.05) between certain teaching specialisms and some concepts which are considered relevant for working on sustainability in the classroom: water quality (p = .00), economic growth (p = .01), culture of peace (p = .00), inequality (p = .00), innovation (p = .00), research and development (p = .00), resilience (p = .01), health (p = .03), and decent work (p = .02). These results lead us to confirm that the concepts on which secondary teachers work in their teaching practice are largely related to their teaching specialism (Figure 2).

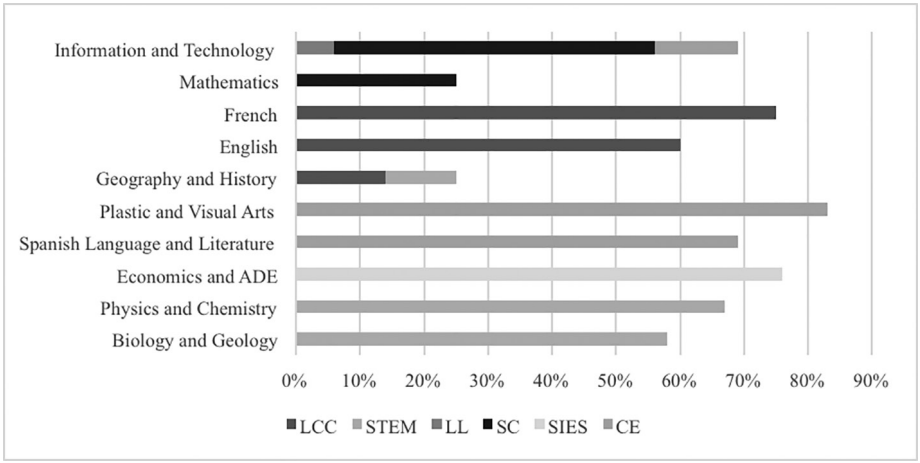
FIGURE 2. Relationship between teaching specialisms and concepts from Agenda 2030 covered by teachers in compulsory secondary education.



Note: BAM = Business Administration and Management.

With regards to H2, it is confirmed that there is a significant relationship between the teaching specialism of secondary teachers and the incorporation of concepts in their teaching practice through the key competences of the secondary curriculum (p <.05), specifically the following ones: linguistic communication competence (p = .00), competence in mathematics and basic science and technology competence (p = .00), learning to learn competence (p = .04), social and civic competence (p =.00), sense of initiative and entrepreneurial spirit competence (p = .01), and competences in cultural conscience and expressions (p = .00) (Figure 3).

FIGURE 3. Relationship between key competences from the secondary curriculum and teaching specialisms of compulsory secondary education teachers.



Note: BAM = Business Administration and Management; LCC = linguistic communicative competence; STEM = mathematical competence and competences in science, technology, and engineering; LL = learning to learn; SC = social and civic; SIES = sense of initiative and entrepreneurial spirit; CE = conscience and expressions.

Finally, it should be noted that the results obtained show that, in their teaching practice, the participating teachers tend to respond to the challenges facing society from the conceptual heart of their discipline, which does not favour a holistic understanding of the problems and realities that secondary students face. For example, participating teachers from Biology and Geology as well as Physics and Chemistry seem to develop concepts (water quality, inequality, etc.) relating to sustainability through STEM competences. Their aim is to explain and make students understand the problems from the natural and social setting by transmitting them a body of knowledge and methodologies that enable them to act and transform such problems. Participating teachers from Economics and Business Administration tend to approach concepts linked to their specialism (such as economic growth or decent work) through the sense of initiative and entrepreneurial spirit competence, providing strategies that make it possible to detect needs and opportunities with the aim of generating results that are of value for other people. In this respect, it appears that secondary teachers seek to respond to problems that are interconnected, but that they approach independently.

5. Discussion

The data found in this research confirm our first hypothesis. Compulsory secondary education teachers incorporate the sustainability focus in class according to the specificity of their teaching specialism, largely focussing on the environmental dimension, which agrees with what Solís-Espallargas y Valderrama-Hernández (2015) found. This way of implementing

sustainability in the classroom prevents the complexity of the planet from being understood and examined through the three systems that comprise sustainability in accordance with the recommendations of authors such as Collazo and Geli (2022), and it prevents students from exploring contextualised pathways for transformation towards sustainability. In this sense, the research presented here proposes a number of key elements that can contribute to moving the teaching culture towards dialogic models in the understanding of the teaching–learning process (Venegas, 2013). It is necessary to offer a global response to the challenges of the 21st century, constructing the professional identity of the teachers by incorporating the sustainability focus.

Teachers regulate, plan, coordinate, and select the content students should learn and how they should do so; as such, the initial and lifelong training processes in which they participate are both fundamental in teachers' professional continuous training. In initial training, university teachers can act as a reference point for future teachers (Jarauta & Pérez, 2017), and so their teaching practice can affect the training of future generations of education professionals (Jiménez et al., 2018; Martínez & Carreño, 2020), replicating a model that is far from current society's needs and demands with regards to education. Therefore, the sustainability focus must be incorporated into the curricula of the Master's programmes in Obligatory Secondary Education and Baccalaureate Teacher Training, Professional Training, and Language Teaching, because these lead to a professional qualification. This incorporation must not only be in each of the subjects that comprise the curriculum but by strengthening new ways of working that require an interdisciplinary approach to create meeting points in the curriculum between the modules for the different specialisms of the master's programmes mentioned above. This is in line with what Risco and Cebrián (2018) point out regarding the incorporation of methodologies such as, for example, learning based on projects, case studies, problem solving (UNESCO, 2017) as generic competences.

The current approach is divided into subjects and develops capacities linked to the key competences, which take as their reference the Recommendation of the European Parliament and of the Council, of 18 December 2006, on key competences for lifelong learning, which does not incorporate any reference to competences in sustainability. This, along with the data obtained in the study, clearly supports the claim made in the second hypothesis of the present study, which leads us to affirm that we are still far from true curriculum sustainability in this educational stage.

Any process of reconstruction of teachers' identities will require refresher training for teachers, also known as continuous professional development, through dynamics of lifelong training. Authors such as Alonso and Vera (2022) identify this as "a process of learning that is developed through the whole of the life of the teacher" (p. 167, own translation) in response to the training needs and issues that teachers display in their teaching practice. The situation of contemporary societies, which are heading towards a need for planetary citizenship, will require a change in processes for continuous training for teachers to make the sustainability focus a reality in classroom teaching practices (García-Ruiz & Castro, 2012; Imbernón, 2007, 2022a), with activities that range from reflective practices shared among teaching staff to student participation in their own process of learning through experimentation, experience, sharing, dialogue, and extrapolation of knowledge (Imbernón, 2022b) from a contextualised didactics. Consequently, as Imbernón (2017) suggests, a new professional culture is needed as is a new style of lifelong training with a holistic and interdisciplinary approach so that it contributes to improving the teaching profession. Lifelong and initial teacher training is, as we believe, the key point from which to react to the gaps relating to sustainability identified in teaching practice throughout our research in order to achieve sustainability in the compulsory secondary education curriculum, as required by the current education act (LOMLOE).

OSE teachers have to be trained to position their teaching actions in a shared framework (Cantón, 2019) that allows them to understand and comprehend the situation of global emergency we face, which, in the words of Vilches and Gil (2021), is characterised by "a set of grave socio-environmental problems of entropic origin that have led to the current stage in the evolution of the planet being called the Anthropocene" (p. 55, own translation), abandoning the idea that teacher professionalism involves undertaking their practice individually (Zabalza, 2022). Therefore, lifelong training must accompany teachers in the reconstruction of their teaching practice, overcoming the fragmented disciplinary perspective and promoting an

interdisciplinary approach to the challenges of the 21st century through cooperation and collaboration between teachers from different specialities so that they can expand it to their classrooms. In this way, through curriculum innovation with the use of active and participatory methodologies that make it possible to approach education from an intersectional outlook on planetary challenges (Collazo & Geli, 2017; Lozano & Figueredo, 2021), the culture of sustainability would be able to contribute to education for global and local development (Opertti, 2023) from the eco-social perspective (Bolarín et al., 2015; González et al., 2021).

6. Conclusions

The aim of this study is to establish whether secondary teachers' specialisms interfere in the incorporation of the sustainability focus in the classroom, which is confirmed. On the one hand, teachers tend to work on concepts that are aligned with their specialism, focussing on ones that are related to the environmental dimension, which prevents a holistic response to the social and planetary challenges facing society. Teacher training curricula should incorporate the focus on sustainability, so that graduating teachers can understand and comprehend societies as a whole, as well as leading their transformation. On the other hand, teachers incorporate the concepts through the key competences of the curriculum, thus responding in their professional practice to the curriculum structure proposed in the LOMLOE. However, the holistic character that the sustainability focus requires appears not to be facilitated. This underlines the need to go beyond the fragmented outlook in secondary teachers' initial and lifelong training, something that would lead to the promotion of a more cohesive education.

6.1. Limitations

Although this study meets its proposed aim, it could be limited by certain data not being collected, such as the participants' origin, precise age, and years of teaching experience.

Authors' contributions

María-Rosario Mendoza-Carretero: Conceptualisation; Data curation; Methodology; Writing (original draft).

Belén Sáenz-Rico-de-Santiago: Conceptualisation; Data curation; Methodology; Supervision; Writing (review and editing).

Artificial Intelligence (AI) Policy

The authors do not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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Nature deficit and technology overuse in childhood. A correlational study by gender of its influence on sustainable identity construction in childhood

Déficit de naturaleza y sobreuso de tecnología en la infancia. Un estudio correlacional por género sobre la influencia en la construcción identitaria sostenible de la infancia

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Abstract

This article addresses important aspects of the fragmented bidirectionality between children and nature that currently exists in childhood. The combination of factors to consider as a result of constant socio-environmental crises makes addressing two important points relevant: where children prefer spending their free time and the differences they perceive according to whether the options are more or less artificial/natural; and, on similar lines, whether these decisions and preferences shape other key pieces of their identity, such as their sense of freedom, autonomy, and responsibility. The main aim is to identify their preferences and, based on their perceptions, analyse whether there are differences by gender in how they approach free time: whether they use technology or not, whether they prioritise the street and natural spaces, and whether effects are observed in their identity construction. An anonymous, self-administered quantitative survey using a structured questionnaire was performed. The target population comprised students enrolled in years 5 and 6 of primary school, with a sample of 2586 respondents at a national level. The statistical analysis involved calculating descriptive measures such as means, standard deviations, medians, and interquartile ranges (IR). The Mann-Whitney Utest was also applied and Spearman's correlation coefficient was

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calculated. The results, based on a series of correlational analyses, suggest that there are significant differences by gender in preference for use and spaces, as well as differences in the effects of these preferences on their identity. The possibility of new pedagogical demands and responsibilities for social justice in environmental matters emerging remains open.

Keywords: nature deficit, technology surplus, childhood, identity, autonomy, freedom, responsibility.

Resumen

Este artículo aborda aspectos importantes sobre la bidireccionalidad fragmentada que existe hoy por hoy en la infancia entre el/la niño/a y la naturaleza. Así, la convergencia de factores que considerar como consecuencia de las constantes crisis socioambientales hizo pertinente abordar dos puntos importantes, que son: dónde prefieren pasar los niños y las niñas su tiempo libre y qué diferencias perciben según si las opciones son más o menos artificiales/naturales; y, en esta misma línea, si esas decisiones y preferencias moldean otras piezas clave de su identidad, como el sentimiento de libertad, la autonomía y la responsabilidad. El objetivo fundamental es comprobar sus preferencias y analizar, a partir de sus percepciones, si existen diferencias de género a la hora de afrontar su tiempo libre: si emplean o no tecnología, si priorizan la calle y el espacio natural, y si se observan efectos en su construcción identitaria. La técnica utilizada fue la encuesta cuantitativa anónima y autoadministrada a partir de un cuestionario estructurado. La población objetivo comprendía estudiantes inscritos en los cursos 5.º y 6.º de primaria, con una muestra de 2586 cuestionarios a nivel estatal. El análisis estadístico comprendió el cálculo de medidas descriptivas como medias, desviaciones estándar, medianas y rangos intercuartílicos (RI). Además, se aplicó la prueba U de Mann-Whitney y se llevó a cabo el cálculo del coeficiente de correlación de Spearman. Los resultados, a partir de una serie de análisis correlacionales, apuntan a que existen diferencias significativas por género en cuanto a preferencias de uso y espacios, así como diferencias en la repercusión de esas preferencias en su identidad. Queda entreabierta la posible efervescencia de nuevas exigencias y responsabilidades pedagógicas de justicia social en materia ambiental.

Palabras clave: déficit de naturaleza, superávit de tecnología, infancia, identidad, autonomía, libertad, responsabilidad.

1. Introduction

Human development processes have, for some time, been happening in combination with processes of growth and consumption of resources in a way that no other species has done (Tafalla, 2022). People have accepted that we are rightfully entitled to do this, establishing these processes as legitimate and, more strikingly, desirable. The idea of indefinite growth hovers over the development of humankind and, in contrast, over the increasingly limited world (Stratford, 2019). The environmental, climate, and even civilisational crises that these factors entail hampers sustainable human development. The way we observe the world and the mechanisms through which we coexist and relate to one another has been established under an anthropocentric perspective that leads to a need for a change of perspective (Paulsen et al., 2022). The deterioration of how we live alongside one another requires us to set aside the anthropocentric logic and the anthropocene era and face the social and ecological crisis into which we have drifted from different angles (Martínez, 2023).

One of the angles from which we can observe, understand, interpret, and take action is education. There is no viable option that does not go hand in hand with the educational as a necessary step (Díaz-Romanillos, 2024). There is no other possible plan. It is crucial to understand that education and the educational cannot be understood or develop in isolation from the living world, but instead must start to be understood from the vital junctures and structures where their path is found. We must continue aspiring to envisage and make an education that goes beyond our material ways of coexisting and offers answers to the eco-social crisis surrounding us, which we must see as both a social challenge and a need, as pertinence and as an educational opportunity (Misiaszek, 2023). As such, we understand the educational to be a situated action from a dialectic triangle between I, you, and the other. The situation, the social space–time in which the educational occurs, forms part of this triangulation that we see as a *tri-a-logue*, a three-way critical dialogue in Derrida's words. And it is in the other, in the *alterum*, where the natural space-time and nature fully enter, in other words, visions, events, belongings, content, environments, landscapes, scenes, gestures, smells, mechanisms, textures, paths, places, etc.

In this sense, education for sustainable development has provided mechanisms, valid ways of thinking and doing education to trace the path on which to construct sustainable childhood development. Environmental and social degradation are interrelated at present, not just through matters such as poverty or economic inequalities, but also in phenomena such as nature deficit and technology surplus (Díaz-Romanillos, 2024). This is an environmental education understood from the paradigm of sustainability in the anthropocene era, in some cases resulting in so-called *pedagogies of stewardship* (Taylor, 2017), which bring together not only environmental interests but also ones relating to the well-being of humans. A model that is directed towards education to favour a sustainable future encouraging social schema that in turn pursue human well-being, understood not just in strictly human terms but also complemented by ethical interests that go beyond the human (Cortina, 2007).

This educational reading of lived reality places us in a phenomenon that does not at first seem to be very important but that, when studied in depth, turns out to be of great importance: nature deficit in childhood. A phenomenon that was named by Louv (2005) and in relation to which studies emphasise different aspects: on the one hand, it results from urban living conditions, from excess hyperconnectivity to screens, affecting aspects of children's development that include their ecological identity; on the other hand, its educational benefits and its importance for early childhood education are stressed and are associated with a multitude of physical, sensory, behavioural, and emotional benefits (Jarvis et al., 2022; Gutiérrez-Pérez et al., 2024). Children are starting to display limited levels of connection with the natural environment, even though science has traditionally shown the importance of everyday links to this setting (Todd, 2024) and its importance for human identity (Humphreys & Blenkinsop, 2018).

We do not seek to demonise technology in itself (García et al., 2021). We are aware that, even in childhood, albeit not excessively early, technology and the people who use it at an educational level display educational benefits (Pattier, 2021; Marcelo et al., 2022). What we wish to emphasise is a phenomenon that does exist and that is starting to have consequences in childhood development: the excess of screens to which children are exposed (L'Ecuyer et al., in-press). In some cases, it can even reach the level of addiction (Villar, 2023). Nonetheless, in this study we only discuss technology as a space that children now overuse, resulting in a social phenomenon we could call *technology surplus*, a social phenomenon that might correlate with nature deficit, a phenomenon or reality that this study centres. Speaking of technology surplus or overuse is nothing more than observing a phenomenon that has been demonstrated. On the basis of this realisation, it is worth studying its possible correlation with another phenomenon that was coined some years ago, namely nature deficit, without vilifying the use of technology per se at a social and cultural level.

This is one of the fundamental challenges we face from an educational perspective. Without contact and links with the natural world, we will find it hard to create a culture of sustainability (Squillacioti et al., 2022). To educate in the face of the climate emergency and environmental deterioration, we must first work towards a reconnection with the natural, and to do so we will need data that show us the current state of the aforementioned phenomenon.

In this work we attempt to find answers to a number of questions that inspire concern at a pedagogical level, on the one hand establishing whether children prefer spending their free time in natural spaces or surrounded by technology, without one option or the other inherently being more optimal for childhood development, and on the other hand analysing whether there are differences between children in how they perceive time in these different spaces, emphasising elements of children's identity that can be more affected, specifically the sense of freedom, autonomy, and responsibility.

2. Presenting the question, or *touching grass*

The visceral movement that children display towards nature during early childhood and adolescence warns that we overlook symbiotic irritations between us, human beings, and the natural or more-than-human world. Although it is assumed that our society communicates to and teaches children that we all form part of an integrated and holistic world-system made up of other living and non-living systems, children still exclude humans from their representations of nature (Wilson, 2019). These fragmentations are undoubtedly worth understanding from the subjective imbalance of the symptomatological and are worth addressing as though they were an intimate, individual, and personal problem. Abandonment of the *I* towards a system of life that is not dichotomising but rather ecologising. A series of anomalies that, as Louv (2005) would say, indicate a nature deficit.

Faced with a global dimension of this type, the pedagogical disorder that we said we would tackle is the existence of a certain tendency to avoid the natural in these early ages. That is to say, children prematurely understand how to cast off an identity with the Earth in order to choose other more modern alternatives. For this reason, we must continue to ask whether more artificial alternatives are more intelligent, such as technological ones (García et al., 2021; Martín & Muñoz, 2023). To provide more concrete examples, we will focus on the systematic review by Gutiérrez-Pérez *et al*. (2024), while part of the results will be based on other evidence that we know. Our confidence is because the aforementioned systematic review, which is based on the SALSA framework (search, appraisal, synthesis, and analysis), shares with the present monographic work an inspiration in the NATEC-ID and NATUR-TEC Kids LivingLab projects.

So, as noted above, nature positively influences emotional and social development in early childhood. And when this happens it also means that children's conventional expectations of themselves, where they live, and the time they spend in it can be said to be disrupted. The work of Chiumento *et al*. (2018), for example, shows that using social therapeutic horticulture (STH) when working with this age group gives satisfactory results regarding improved perception of nature. And contributions such as the one by Adams and Beauchamp (2021) show that natural spaces influence children's concept of time. In other words, there is a tendency for them to continue with periods of calm. Therefore, it is worth adding a fairly simple justification to this second detail: stopping, breathing, and slowing down. Or as Shahjahan (2015) would say, with a certain disruptive tone, leaving room for "being lazy" (p. 2) and decolonising the implicit productivity of the time of the educational per se, thus fostering the ability to re-wild the imagination (Kuchta, 2022) and encouraging children to surprise themselves with other ways of understanding life through the experiences of learning with nature. Something that with some intensity shows that slow pedagogies (Payne & Wattchow, 2008) apply themselves more thoroughly to these

aesthetic immersions that speak to us of colours, smells, learning through playing with mud (Mycock, 2019), and many other aspects.

Some notes on relaxation, well-being, and happiness that agree with the results of other literature reviews that centre on analysing creativity and outdoor education in the primary stage (Guerra et al., 2021). Furthermore, providing other common points, the study by Jarvis et al. (2022) found that *green* surfaces had a positive influence on the different dimensions of child development depending on the type and volume of natural cover, that is to say, whether they were wild areas, wooded areas, or grass-covered areas. And there are also the findings of González-Tapia et al. (2022) where feelings of belonging converge with nature and pro-environmental or pro-social behaviours. These results represent strong backing for the common interests that unite us as a community to argue for situations of ecological and social justice.

Two aims that combine in research in solid commitments to all voices, something reflected in equitable samples of participants when questions arise about the implications of the natural in these early stages (Adams & Beauchamp, 2021; Amoly et al., 2014; Askerlund & Almers, 2016; Chiumento et al., 2018; González-Tapia et al., 2022; Huynh et al., 2013; Jarvis et al., 2022; Luís et al., 2020; Pollin & Retzlaff-Fürst, 2021). However, these commitments are not limited to the formal aspect of the method, but nature shows that the spaces and conditions that sustain us are neutral and ideal for cathartic play in childhood without implicit social constructions (Änggård, 2016).

It should be said that as well as influencing the attributes that are at play in the construction of children's identity, nature also tips the balance towards the positive, providing touches of improvement in these stages that construct the subject. Albeit, of course, without setting aside its contribution to changed behaviour from an axiological dimension. Because in this latter case, nature strengthens the system of human values through an ethics centred on interests that go beyond us.

We focus then on how to address the technology surplus and lack of contact with nature in the early years of life, something that is an unresolved issue within pedagogy to try to redirect circumstances before it is too late. In this regard, it is sufficient to note that the technological expansion that has followed globalisation has made it increasingly uncommon to see children unhurriedly enjoying their right to play in spaces (we no longer say in the open air, which of course also concerns what we address, but in general) free from technological devices (Correa et al., 2023). Even so, disregard for the natural is not something that has appeared before us from one day to the next focussing exclusively on these early stages. Instead, problems in relating to nature are a concrete expression of the effects of a lack of empathy towards the social and the environmental. There have always been deficit crises from time immemorial. Today, in fact, we might be seeing the maximum expression of them, represented by the name given to our era: the anthropocene (Díaz-Romanillos, 2024; Figueras & Torrents, 2022), or as Haraway (2020) would say, the *cthulucene*. More or less proponents of these post-human denominations that emerge as we advance (Gaviria, 2024), the spirit that is expected is that time passes and over recent decades these issues of the lack of environmental conscience at early ages already seem to have gained a central position. Issues that have, of course, contributed to a variety of educational proposals to try to bring young children to the natural world (De Tapia & Salvado, 2022).

Now more than ever, education and the educational must become involved with each other given the potential impact of this phenomenon and the way in which we conceive our being and presence in society. In our view, environmental education should not just be branded as for sustainable development, as we agree with Díaz-Romanillos (2024) that this term is insufficient; instead, it should start from socio-bio-centric concepts, situated in the historical and social context of eco-social crisis which we inhabit. An education based on the *alterum* as the foundation of an ethical conception built on the common good, on the collective, and on ecological democracy, broadening the

concept of ethical community. An approach used more than half a century ago by Leopold (1948; 2017) in his ethics of the Earth and later Sosa (2000) and more recently Latour (2022) and Muñoz-Rodríguez (2022). Humankind's relationship with nature as a species is based on an expansion of traditional ethics, insisting that the natural and nature form an interdependent biotic community. Our understanding of the educational must transcend superficial conceptions that take measures to repair one-off problems or harms, moving to a deep, binding education on the line of the deep-ecology movement (Naes, 1986), inspired by Spinoza and Heidegger, that proposes a need for a new way to understand the world, society and human reality. Otherwise, we will be unable to overcome the nature deficit we speak of in childhood.

3. Methodology

An anonymous, self-administered survey was administered under supervision using a paper questionnaire. The target population comprised students from years 5 and 6 of primary education, with a sample of 2586 respondents. The sampling error was estimated to be ± 1.93% with a confidence interval of 95.5%. The questionnaire predominantly comprised closed questions along with some open ones and was validated by means of a pre-test with 15 interviews. Multi-stage sampling stratified by clusters was used, with proportionate random selection of primary sampling units and simple random selection of ultimate sampling units. Sex and age quotas were applied. The items were evaluated on an 11-point Likert scale (0–10) (Bisquerra & Pérez-Escoda, 2015).

Before final coding, a pilot study was performed with 15 participants within the target age range to modify the questionnaire. The questions were refined, eliminating redundancies and adding clarifying labels on the basis of the comments and experiences obtained. Sampling was done in two stages, using a stratified cluster method with Spain's autonomous regions divided into four zones: centre, north-east, east, and south. The sampling locations (primary schools) were selected taking into account variables such as *geographical area*, *socio-economic position*, and *ownership of the school* based on the networks of institutional contact of the research team. The final sample, after filtration, comprised 2586 units.

3.1. Statistical analysis

The statistical analysis involved calculating descriptive measures such as means, standard deviations, medians, and interquartile ranges (IR) to describe the data in detail. To assess differences between boys and girls, the Mann-Whitney U test was used owing to the skew of the data, using *p*-values to determine the significance of these differences in each context. The Spearman correlation coefficient was also calculated to analyse the association between two ordinal variables, providing a deeper comprehension of the relationship between these variables in both gender groups.

4. Results

The sample comprised 1244 girls (48.1%) and 1286 boys (49.7%) from years 5 (n = 1206, 46.6%) and 6 of primary education (n = 1373, 53.1%). Table 1 shows a descriptive analysis of the principal variables considered in the study broken down by gender (boys and girls) and with the overall value for all participants. A significant difference between girls and boys in the preference for natural sites is observed (p = 0.013), with girls enjoying these places more. Boys display a greater preference than girls for technology and the internet, a difference that is significant (p <0.001). Time spent using technology is significantly greater in boys than in girls, however, boys have a greater preference for going into the street compared to the girls, with a significant difference (p <0.001) (Table 1).

Table 1. Descriptive analysis of preferences and behaviours by gender.

	Total	**Girls**	**Boys**	
	Mean ± SD Median (IR)	Mean ± SD Median (IR)	Mean ± SD Median (IR))	*p*-value
Liking for going to places with nature (trees, grass, plants, gardens, woodland, mountains, rivers, beach, etc.) when they have time	8.22 ± 1.91 9 (7-10)	8.35 ± 1.79 9 (7-10)	8.12 ± 2.00 6 (5-8)	0.013
Perception of time (little–a lot) spent in sites with nature	6.19 ± 2.31 6 (5-8)	6.22 ± 2.24 6 (5-8)	6.17 ± 2.34 6 (5-8)	0.718
Liking for being with technology and the internet (mobile phones, tablets, consoles, social networks) when they have time,	6.94 ± 2.37 7 (5-9)	6.51 ± 2.33 7 (5-8)	7.35 ± 2.32 8 (6-9)	< 0.001
Perception of time (a little-a lot) spent using technology and the internet	6.94 ± 2.37 7 (5-9)	5.39 ± 2.27 5 (4-7)	6.00 ± 2.34 6 (5-8)	< 0.001
Ability to choose: going into the street vs staying at home surrounded by screens	2.14 ± 2.50 1 (0-4)	1.71 ± 2.12 1 (0-3)	2.52 ± 2.73 2 (0-5)	< 0.001

Note: SD = standard deviation; IR = interquartile range.

4.1. Analysis of the association between preferences and behaviours by gender

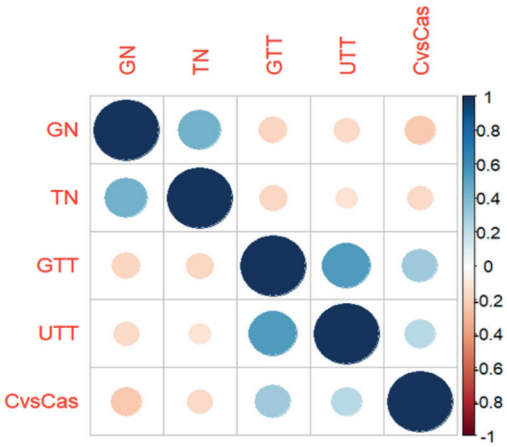
The results show a positive and significant correlation (r = 0.426**) between liking nature and time spent in natural settings, which suggests that people who enjoy nature more tend to spend more time in it. A negative and significant correlation was also found between enjoying nature and interest in technology and the internet (r = -0.187**), indicating that people who prefer nature tend to be less interested in technology. Likewise, a negative and significant correlation is observed between enjoying nature and time spent on technology and the internet (r = -0.147**), suggesting that people who enjoy nature the most tend to spend less time using technology. Finally, a negative and significant correlation was shown between the preference for nature and the inclination to stay at home surrounded by screens instead of going out into the street (r = -0.250**), indicating that people who prefer nature tend to stay at home with technology less.

The results show that for girls there is a positive and significant correlation between liking nature and time in natural settings (r = 0.421**). Furthermore, a negative and significant correlation is observed between liking nature and interest in technology (r = -0.180**), as well as between liking nature and time dedicated to technology (r = -0.140**). Finally, there is a negative and significant correlation between liking nature and preference for staying at home (r = -0.245**). For boys, a positive and significant correlation was also found between liking nature and time in natural settings (r = 0.431**), and a negative and significant correlation

between liking nature and interest in technology (r = -0.193**). Furthermore, there is a negative and significant correlation between liking nature and time dedicated to technology (r = -0.154**) and between liking nature and the preference for staying at home (r = -0.255**).

The figure presents the correlation between five variables that address both the preferences and the behaviours relating to nature and technology. The first variable, LN (liking nature), evaluates interest in being in natural settings, while NT (nature time) quantifies time dedicated to these settings. On the other hand, LT (liking technology) describes the affinity for technology and the internet, and UT (use of technology) indicates the amount of time dedicated to these devices. Finally, HvsSt (house screens vs street) reflects the preference for staying at home or going out into the street surrounded by screens. The analysis of correlations between these variables offers insights into how preferences and individual behaviours regarding nature and technology are related.

FIGURE 1. Correlation between variables of interest.



Note: LN = liking nature: preference for being in natural settings (trees, grass, mountains, beach, etc.); NT = nature time: time spent on activities in nature.; LT = liking technology: affinity for use of technology and the internet (mobile phones, tablets, social networks, etc.); UT = use of technology: amount of time spent on technology and the internet; HvsSt = house vs street screens - preference for staying at home surrounded by screens or going out into the street.

4.2. Association between preference for technology and connection with nature

The results show a significant negative correlation between a preference for staying at home surrounded by screens and time spent in natural settings (r = -0.184**). This relationship is significant both for girls (r = -0.164**) and boys (r = -0.196**), suggesting that people who have a greater inclination towards technology tend to spend less time enjoying nature. This implies a potential deficit in liking nature among individuals who prefer to spend more time in digital settings, which could affect their physical and emotional well-being. A certain nature deficit can be intuited among those who opt to stay at home with technology, which translates into a shortage of opportunities to enjoy and benefit from the potential of natural spaces.

Furthermore, a significant and positive relationship is observed between a preference for staying at home surrounded by screens and time spent using technology and the internet (r = 0.196**), which suggests that people who prefer digital settings tend to spend more time using electronic devices. This tendency is observed both in girls (r = 0.160**) and in boys (r = 0.208**), indicating that both genders display a greater dedication to the use of technology and the internet when they have a preference for staying at home.

These findings underline a possible relationship between a preference for digital settings and a weaker connection to nature, something that could have implications for health and well-being. A disconnection from nature could be regarded as a deficit, as individuals do not take advantage of the resources and benefits offered by contact with the natural world. Consequently, these results could be used to identify a need to promote a better appreciation of and connection with nature among those who display a preference for the digital setting.

4.3. Analysis of the perception of time and desire in contexts of nature and technology

The next table provides a descriptive analysis of how perceptions and behaviours vary by gender in two contexts: when participants are in places surrounded by nature and when they are using technology and the internet. The descriptive analysis shows significant differences in the perceptions and desires of boys and girls in contexts of nature and use of technology. Girls enjoy time in nature more and have less desire to return home (median of 8 and 7.55 respectively), compared with boys (median of 8 and 6.95), with *p*-values of 0.004 and 0.000. In the context of technology, boys find that time passes faster and they would prefer to continue using technology (median of 8 and 5.65), compared with girls (median of 7 and 5.02), with *p*-values of 0.000 in both cases (Table 2).

Table 2. Descriptive analysis of preferences and behaviour by gender.

	Total	**Girls**	**Boys**	
	Mean ± SD Median (IR)	Mean ± SD Median (IR)	Mean ± SD Median (IR)	*p*-value
When I am in places surrounded by nature: time passes slowly/quickly	7,05 ± 2,76 8 (5-9)	7.31 ± 2.49 8 (6-9)	6.83 ± 2.97 8 (5-10)	0.004
When I am in places surrounded by nature: I want to go home / I do not want to go home	7.23 ± 2.50 8(5-9)	7.55 ± 2.29 8 (6-10)	6.95 ± 2.66 7 (5-9)	0.000
When I use technology and the internet: time passes slowly / time passes quickly	7.07 ± 2.64 7 (5-10)	6.67 ± 2.53 7 (5-9)	7.43 ± 2.68 8 (6-10)	0.000
When I use technology and the internet: I want to stop using it and do other things / I would use it all the time	5.34 ± 2.36 7 (5-10)	5.02 ± 2.18 5 (4-6)	5.65 ± 4.00 5 (4-7)	0.000

Note: SD = standard deviation; IR = interquartile range.

An association was found between the perception of time in nature ("time passes slowly–time passes quickly") and the desire to continue using technology ("I want to stop using it and do other things–I would use it all the time"), with a correlation coefficient of $r = -0.167^{**}$. When calculating correlation coefficients by gender, it was found that for girls it was $r = -0.186^{**}$ and for boys it was $r = -0.127^{**}$. This suggests that for girls and boys alike there is a similar negative correlation between the perception of time in nature and the desire to use technology. This means that as they perceive that time passes quicker in nature, it is more likely that they will want to stop using technology and do other things.

4.4. Analysis of the identifying elements of freedom, autonomy, and responsibility

The following table analyses perceptions and behaviours relating to nature and technology in boys and girls. It is noted that there are no significant differences by gender in the perceived danger of natural spaces or in the choice of outdoor activities. However, a notable difference in perceived parental control of time in nature is found, with this being stricter for girls than for boys (p = 0.030). Moreover, boys and girls alike display significant differences in their perception of the risks associated with technology and the internet, with girls expressing greater concern (p = 0.000) (Table 3).

TABLE 3. Descriptive analysis of perceptions and behaviours relating to nature and technology in boys and girls.

	Total	**Girls**	**Boys**	
	Mean ± SD Median (IR)	Mean ± SD Median (IR)	Mean ± SD Median (IR))	*p*-value
You usually choose what to do when you are in these spaces with nature	5.91 ± 2.64 6 (5-8)	6.06 ± 2.44 6 (5-8)	5.80 ± 2.79 6 (4-8)	0.106
You think that spaces with nature are dangerous for a child of your age	2.25 ± 2.26 2(0-4)	2.25 ± 2.18 2(0-4)	2.23 ± 2.32 2 (0-4)	0.269
Grown-ups (my parents or the people I live with) control the time I spend in nature and what I can do	4.54 ± 2.91 5 (2-7)	4.39 ± 2.78 5 (2-6)	4.64 ± 3.02 5 (2-7)	0.030
You usually choose what to do, where to go	6.06 ± 2.36 7 (5-10)	5.82 ± 2.73 6 (4-8)	6.31 ± 2.94 7 (5-9)	0.000
You think that technology and the internet are dangerous for a child of your age	5.42 ± 2.47 7 (5-10)	5.73 ± 2.25 6 (5-7)	5.11 ± 2.61 7 (5-9)	0.000
Grown-ups (my parents or the people I live with) control the time I use technology and the sites I can visit	5.81 ± 2.80 6(4-8)	5.78 ± 2.71 6 (4-8)	5.82 ± 2.88 6 (4-0)	0.309

Note: SD = standard deviation; IR = interquartile range.

The correlations between the tendency to choose activities in natural spaces and other variables show some interesting patterns. Firstly, there is a significant negative correlation between freedom of choice in nature and the perceived danger of these spaces (r = -0.075**), suggesting that people who choose more actively do not perceive these settings as dangerous. There is also a similar negative correlation with the level of parental control over

outdoor activities (r = -0.054**), suggesting that people who perceive more freedom to decide are less subject to strict control. Furthermore, a significant positive correlation was found between freedom of choice in nature and autonomy in the choice of activities and places (r = 0.150**), suggesting that those who choose more in nature also tend to have more autonomy in general. No substantial correlations were found with perception of risks associated with technology and the internet nor with parental control of use of technology, which suggests that these variables are independent of freedom of choice in natural settings.

5. Discussion and conclusions

It is not technology that restricts the bidirectionality that should exist harmoniously between the child and nature; rather, it is what is distinctively human, which is actually between the two opposing poles, that repels feelings of belonging in the natural world through this constructed artificiality. From individuality, we can see that young children misunderstand (which in a way is also a form of learning) how, in line with the possibilities their society offers them, there is a technological opposite of rare materials that we have decided is unstoppable and which thinks and (to a certain extent) speaks in a similar way to our species and more productively. Consequently, uncoupling and fragmenting these networks that with little or no sustainability we have fed with an artificial *other*, is no easy task. In this analysis we have sought to demonstrate that something can still be added from an inclusive perspective to the topic and question of nature deficit and technology surplus, taking into account what we already knew from previous research.

With regards to the objective that focussed on establishing these preferences and behaviours by gender, it is apparent that boys display a greater preference than girls for technology and the internet, and that boys' perception is that they use it more intensively. These results should be no surprise as they were already been found by other studies (Guevara-Arayón, 2020; Sabater & Fernández, 2015; Serrate et al., 2023) that highlight gender differences in access to and use of technology, often largely deriving from the market's offer of applications and networks aimed at both sexes in the group in question. In contrast to what we might expect, it may seem surprising that there is data indicating that boys display a greater preference than girls for going out into the street rather than staying at home surrounded by screens. Especially because in this stage of childhood, it is normal to prefer to occupy space outdoors in parks and squares interacting (playing) with others, as part of the socialisation process. Perhaps for this reason we should continue to pay attention to the results obtained relating to the possibly stronger addictive effects of technology on boys than on girls, based on indicators that show that boys find time goes faster when they are surrounded by screens. This means that if they could choose regarding some of the causes that shape their experience of technology, they would prefer to continue using it even after the time limit or restriction that adults have set for them to use it responsibly.

Focussing on gender differences again, girls display more liking for and enjoyment of time spent in nature than boys do, as well as less desire to return home when they complete their free time in these spaces. Going a little further, results keep appearing that indicate that public spaces, natural and digital alike, are perceived as dangerous, an indicator that is significantly representative at a greater percentage in girls than in boys. In fact, we could go on to add that girls also perceive greater parental control in these public spaces, especially in natural spaces. Considering these findings, this could be because families are more protective of girls because of their gender, meaning that this situation is shaped by a more complex perception of risk at a social level and protective constraints that have been passed down with a certain hegemonic tradition in family units that generally reproduce different patterns with their daughters than the ones they follow with their sons. Even so, we also observe that boys and girls who tend to display greater freedom of choice of activities in any space (whether natural or digital) perceive these spaces to be less dangerous and, interestingly, respondents who report greater freedom of choice in natural spaces are subject to less control and restriction

by adults. Affecting the regulation of behaviour a little more, we can see that respondents who choose nature more also tend to have more autonomy in general. This means that a good pattern of teaching that enables children to participate in decision making throughout their process of socialisation helps with appropriate autonomous construction of their identity and regulates the spaces that they occupy and the time they dedicate to these spaces.

In both cases, it is apparent that children who report enjoying nature more tend to spend more time in it and show less preference for staying at home. As a result, we have been able to establish that the more people like nature and natural spaces, the less their interest in technology and the time they spend on it. These results should make us aware of the necessary responsibility of public authorities and administrations as well as families and the education system in general to strengthen nature as a space that belongs to children by right, where appropriate and better childhood development is favoured while at the same time guaranteeing sustainable advances in the process of socialisation (Caballero et al., 2024; Gutiérrez et al., 2024; Muñoz-Rodríguez, 2021). Regarding possibilities for future work, we should perhaps say that the behaviour of these other educating agents is something that we well know can boost or hinder any outlook based on the predominant world views regarding nature in childhood and their direct implications for educational practice.

The present work has some methodological limitations that should be noted, such as the sample being limited to a specific geographical and educational context. Although a broad sample of students from years 5 and 6 of primary education from particular autonomous regions of Spain was taken, the results cannot be generalised to other geographical, educational, or cultural contexts. For example, results might vary in other countries or regions or among students from different educational stages. There are also the sex and age quotas and the possible control for other socio-demographic variables given that, although these were controlled for, we did not consider controlling for other socio-demographic variables (such as *socio-economic level*, *ethnicity*, or *family characteristics*) that could influence use of technology or the connection to nature, which introduces potential bias into the results.

As possible future studies, it is necessary to bear in mind the need to consider mixed methods that combine quantitative and qualitative results and add verbal explanations by the children relating to the questions analysed, as well as longitudinal studies that make it possible to observe changes over the lifespan of the participating sample. It would also be of interest to test this information with families' perceptions of the link that their sons and daughters display with screens and with nature and to consider the differences.

We would however like to conclude with the most important pair: aspiring to re-nature educational processes is something legitimate, a human right with implications for human identity. However, it must be done considering the inherent complexities of our social condition (in this case, the gender differences we have identified in this work that are below the surface in childhood) and we must keep ourselves up to date pedagogically with fair prevention and intervention in what happens in educational reality with the nature–technology pairing. This should be an invitation to reflection, because at least for the moment the greatest guarantee that we anticipate is that if we wish to be part of a more sustainable world, an example is needed of how to channel these provisions, and that is a question for the first page of the instructions.

Authors' contributions

Sara Serrate-González: Conceptualisation; Writing (original draft); Writing (review and editing); Visualisation.

Judit Alonso-del-Casar: Conceptualisation; Writing (original draft); Writing (review and editing); Visualisation.

Carmen Patino-Alonso: Data Curation; Methodology.

José-Manuel Muñoz-Rodríguez: Conceptualisation; Supervision; Visualisation.

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Climate emergency and vocational education and training. Topic of scientific interest: A systematic review of the literature

Emergencia climática y formación profesional. Tópico de interés científico: una revisión sistemática de la literatura

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Abstract

Climate change, the main challenge of the 21st century, demands urgent educational responses and cultural changes. Vocational education and training (VET) is providing an invaluable opportunity to face the climate emergency and stimulate the socio-ecological transition. Therefore, it is necessary to investigate the extent to which the climate emergency constitutes a consolidated topic of study in educational research focused on VET. Using the PRISMA protocol, we have undertaken a systematic review of literature (2015-2024) indexed in SCOPUS, WOS, ERIC, TESEO and SciELO. Microsoft Excel has been used for the content analysis. Based on the categorization of the information, we have responded to nine research questions on contextual characteristics, the methodological framework and the interpretive evaluation of the studies. The results have revealed growing scientific production, especially in Europe and the global south, with a predominance of theoretical studies over participatory ones. Although the central theme has pointed towards critical frameworks and comprehensive solutions, most studies have adopted reformist approaches that minimize community participation. It has also become evident there is a greater concern for detecting problems rather than for clarifying key concepts, which are essential for effective implementation of sustainability. Furthermore, the preference for green knowledge and skills to the detriment of teacher training and collaboration networks could be hindering the integration of good practices and affecting educational quality. It has been concluded that most studies do not address the climate emergency from a holistic and transformative perspective that questions our cultural identity and promotes a new development paradigm in which ecological well-being and social aspects are placed as core issues.

Keywords: climate change, vocational training, socio-ecological transition, environmental education for sustainability, climate emergency, eco-social justice, SDG 13.

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Resumen

El cambio climático, principal desafío del siglo XXI, exige respuestas educativas y cambios culturales urgentes. La formación profesional (FP) se presenta como un espacio valioso para enfrentar la emergencia climática y estimular la transición socioecológica. Por ello, es necesario conocer en qué medida la emergencia climática constituye un tópico de estudio consolidado en la investigación educativa centrada en la FP. Utilizando el protocolo PRISMA, se ha realizado una revisión sistemática de literatura (2015-2024) indexada en SCOPUS, WOS, ERIC, TESEO y SciELO. Para el análisis de contenido, se ha empleado Microsoft Excel. A partir de la categorización de la información, se ha dado respuesta a nueve cuestiones de investigación sobre las características contextuales, el marco metodológico y la evaluación interpretativa de los estudios. Los resultados han revelado una creciente producción científica, especialmente en Europa y el sur global, con predominancia de los estudios teóricos sobre los participativos. Aunque la temática central ha apuntado hacia marcos críticos y soluciones integrales, la mayoría de los estudios han adoptado enfoques reformistas que minimizan la participación comunitaria. También se ha evidenciado una mayor preocupación por detectar problemas que por aclarar conceptos clave, esenciales para una implementación efectiva de la sostenibilidad. Más aún, la preferencia por el conocimiento y las habilidades verdes en detrimento de la formación de profesorado y las redes de colaboración estarían dificultando la integración de buenas prácticas y afectando a la calidad educativa. Se ha concluido que la mayoría de los estudios no abordan la emergencia climática desde una perspectiva holística y transformadora que cuestione nuestras señas de identidad cultural y promueva un nuevo paradigma de desarrollo en el que se sitúen el bienestar ecológico y las cuestiones sociales como ejes centrales.

Palabras clave: cambio climático, formación profesional, transición socioecológica, educación ambiental para la sostenibilidad, emergencia climática, justicia ecosocial, ODS 13.

1. Introduction

Since the mid-20th century, the impact of human activities on the Earth's natural systems has become increasingly evident, of which the vast use of fossil fuels is a standout. The increase in emissions and concentration levels of atmospheric greenhouse gases (GHG) has raised global temperatures by 1.1 ºC, placing us close to the 1.5 ºC threshold, that once exceeded, experts warn, would lead us to a point of no return that would endanger the systems that maintain the Earth's balance and sustain humanity (Richardson et al., 2023). Extreme phenomena caused by climate change warn of the proximity of planetary boundaries (Rockström et al., 2009). We are facing what the scientific literature has begun to call *the anthropocene era* (Crutzen & Stoermer, 2000; Crutzen, 2002), a term coined by the biologist Eugene F. Stoermer and popularized in 2000 by the atmospheric chemist Paul J. Crutzen to define a new geological epoch in which human activity has become the main force of change in life on the planet, compromising the stability of the planet Earth and generating chain effects such as alterations in the water cycle, the melting of glaciers and polar ice caps, rising sea levels, changes in marine and terrestrial ecosystems, ocean acidification, deforestation or loss of biodiversity, with significant impact on food security and human health (Steffen et al., 2011). We have sufficient evidence to justify the declaration of a state of climate emergency (CE hereafter) with economic, social and environmental implications (Intergovernmental Panel on Climate Change [IPCC], 2023).

This worrying reality requires the coordinated action of society as a whole, and it is therefore imperative to take action that stimulates collective awareness and transforms the patterns that govern human behaviours within the time constraints that condition possible solutions (Yeves & Javaloyes, 2018). Specific actions and individual and collective commitments are required to preserve the environment and promote more sustainable socioeconomic models that allow

us to even rethink our relationship with nature. The 21st century must mark the beginning of a new era in which we recognize that we are eco-dependent and interdependent beings and, therefore, must aim for a new civic ethic that moves in the direction of eco-social justice. This implies redesigning a new development paradigm in which ecological well-being and social issues are placed at the core, embracing fairer and more democratic criteria that encourage citizen participation, transformative public policies, inclusion, human rights and adaptation and mitigation measures to climate threats resulting from socioeconomic structures (Chandramohan & Bhagwan, 2023; McGrath & Russon, 2023; Monk et al., 2023). In short, it is about questioning our cultural identity and promoting ways of feeling, thinking and acting that contribute to the care and protection of our planet, recognizing the potential of education as a transformative force for the global challenges humanity faces (VET Africa 4.0. Collective, 2023).

Since the first world conference on the environment in 1972, this issue has been present in political agendas and the media, with key milestones such as the Brundtland Report (1987) and the Rio Earth Summit held in Rio de Janeiro (1992). However, the potential of education as a catalyst for fairer lifestyles did not gain momentum until the millennium development goals (2000-2015) when education for sustainable development (ESD) gained recognition and relevance in the context of global development. The result of these interests has been different initiatives that take increasingly holistic approaches, highlighting the current Agenda 2030 adopted in 2015 by the United Nations General Assembly, which recognizes education for sustainability (EfS) as a determining factor for global balance. Since then, these issues have been the subject of growing interest in educational systems, reflected in initiatives such as the European Green Deal, that considers the role of education in moving towards a climate-neutral Europe (Comisión Europea, 2021); the European Framework of Competencies for Sustainability (GreenComp) (Bianchi et al., 2023); and, in Spain, the Action Plan on Environmental Education for Sustainability (PAEAS hereafter) (Ministry for the Ecological Transition and the Demographic Challenge [MITECO] and Ministry of Education and Vocational Training [MEFP], 2021), advocating a strategic approach aligned with environmental education for sustainability (EEfS, hereafter).

At a national level, and in the context of initial vocational training (IVET, hereafter), the context under study, the two ministries mentioned above (MITECO and MEEP), through the PAEAS (2021-2025), urge the promotion of different values and the generation of educational spaces that direct individual and collective concerns towards effective actions that modify the vision, the model and the social purposes regarding the CE and the environmental emergency. From this perspective, as López et al. (2022) suggest, it is essential to integrate the socio-ecological crisis transversally into education, both in the formal curriculum and in the promotion of extracurricular resources and initiatives that prioritize these issues in non-formal and informal socio-educational contexts. In this sense, although climate literacy (understood as the scientific knowledge necessary to understand the climate system) is essential to train technical personnel, professionals and other agents in making informed and responsible decisions, it is insufficient on its own, since it does not address the CE from all its dimensions. For this reason, a joint effort is necessary to complement this approach with social and civic cooperation that involves and activates the commitment of the entire community, prioritizing educational needs in the face of the urgency of the planetary emergency (López et al., 2022). Educational responses that must come from all stages and levels of education, among which is VET, contemplated in current Spanish regulations (Organic Law 3/2022, of March 31, on the Organization and Integration of Vocational Training) as *D* training level and which constitutes the educational level of reference in this systematic literature review (SLR).

VET, an educational level traditionally linked to unsustainable production models, shows limited commitment to socio-environmental well-being. Recently, awareness of the need for VET to address the CE has increased, although academic literature barely addresses this issue or does so from limited approaches that do not reconsider conventional perspectives; representing a significant challenge and opportunity to improve the relevance and impact of VET in this field (McGrath & Russon, 2023; Ramsarup et al., 2024).

Given this scenario, EEfS becomes an urgent requirement to promote social transformation and build a culture of environmental care in the educational community, forming a critical and participatory citizenship, capable of understanding problems, making decisions and acting accordingly. However, the urgent challenge requires renewing EEfS, strengthening themes such as eco-dependence, CE and eco-citizenship; reformulating methodologies and interventions, and promoting inclusive citizen participation (MITECO & MEFP, 2021). In this context, taking advantage of the global momentum and renewed attention resulting from the 2030 Agenda can be an added value to our efforts to address high-level issues such as climate change (CC hereafter) from a broader and more effective perspective. In this sense, vocational training stands out as the ideal setting from which to train professional profiles that will drive fairer economies, educating for an informed, committed and active citizenry, with a positive impact on quality of life, professional development, social equity and environmental protection.

The current management model and the traditional educational inertia, marked by obstacles and resistance to curricular innovation and renewal, limit the development of educational projects focused on EEfS, despite the regulatory advances supported by the 2030 Agenda. National and international reports point to poor results that prevent inclusion and social mobility (Parveva, 2020). Consequently, the focus of educational policies is on educational transformation and, in the educational context of VET, the PISA-VET initiative was born to evaluate professional skills and the quality of the educational system (Organization for Economic Cooperation and Development [OECD], 2024). For its part, the Organic Law 3/2022, of March 31, on the Organization and Integration of Vocational Training promotes the green economy and sustainability, highlighting the importance of Vocational Training in the ecological transition and the fight against CC. Thus, the new law encourages a combination of humanistic and professional training and underlines the need to develop eco-social skills to train professional profiles in regard to climate and social awareness.

In this process of creating citizen awareness and reactivation, the commitment and training of VET teachers and placement supervisors are essential. However, training processes require changes such as increasing educational resources and creating a culture of collaboration between educational centres, companies and the community environment, which allow the exchange of ideas, collective reflection and mutual learning. It is through this social dialogue and democratic strengthening that knowledge can be generated and educational quality optimized, promoting identities committed to eco-social justice (MITECO & MEFP, 2021).

Despite the growing interest in integrating CC and EEfS in education and in rethinking approaches to VET, the scientific literature shows that there are very few studies that consider the link between VET, CC and EEfS as a relevant factor for a fair transition (McGrath & Russon, 2023). This reveals a gap in the comprehensive preparation of professional profiles, highlighting the urgency of greater research focus, and this is the premise on which this systematic review is based, the contribution of research in the field of educational sciences, which seeks to guide future research and educational policies and curricular practices in regards to how VET addresses the CE.

Given this scenario, the general objective of this study is to determine the extent to which the CE constitutes a consolidated topic of study in educational research focused on VET; a general objective that takes the following specific goals as a reference:

- Identify the context, the predominant themes and the reference methodological approaches in the scientific literature on climate emergency in VET,
- Investigate emerging topics and approaches and their evolution within the framework of the climate emergency in VET.

2. Method

2.1. Research methodology

Due to the large volume of scientific literature available digitally, the SLR method is crucial to effectively synthesize, interpret and evaluate existing information. For a review to be considered systematic, it must comply with methodological and transparency principles that ensure reliable answers to specific research questions (García-Peñalvo, 2022). The PRISMA (preferred reporting items for systematic reviews and meta-analyses) protocol is widely recognized and used as a reference in various disciplines. Therefore, given the complexity of the research problem, and in order to respond to the objectives set, we opted for a SLR on the state of the art under the methodological guidelines of the PRISMA 2020 statement, thus guaranteeing the rigor and quality of the review process (Page et al., 2021). The systematic review reflected in this work has been developed following distinct phases (Valverde-Berrocoso et al., 2022).

- Phase 1: research questions (RQ hereafter). These questions have been organized around three dimensions or variables: (1) contextual characteristics, which identify the distribution in time, geographic location and predominant themes of the reviewed studies; (2) methodological framework, which recognizes the methodologies, methodological designs, research techniques and sample profiles; and (3) interpretive evaluation, which determines the key findings and conclusions of the reviewed studies (Table 1).

Table 1. Research questions and their dimensions.

Dimension	Research questions
Contextual	**RQ1.** How are publications on the CE in VET distributed over time in percentage terms?
	RQ2. What is the geographical distribution of publications across different continents?
	RQ3. What are the predominant topics in the publications?
Methodological	**RQ4.** What methodologies are most frequently identified in the studies included in the review?
	RQ5. What type of study is most commonly used in the studies reviewed?
	RQ6. What research techniques are most prominent in the selected studies?
	RQ7. What profile do the samples most commonly used in research on the CE in the context of VET have?
Interpretative	**RQ8.** What are the most significant findings from the literature reviewed?
	RQ9. What are the key conclusions from the studies reviewed?

- Phase 2: search strategy and information sources. Document selection was undertaken using the SCOPUS, Web of Science (WOS), ERIC, TESEO and SciELO databases, using keywords in English and Spanish related to VET, CC and EEfS. The search was limited to open access scientific articles and academic papers published in the last ten years. To maximise the effectiveness of the search, Boolean operators (AND/OR) were used, treating compound terms as a single unit.

- Phase 3: eligibility criteria. Books, scientific articles and PhD theses focused on the environment, the CE, sustainability and/or the sustainable development goals (SDGs) in the context of VET were included. Studies outside the field of social sciences and education were excluded.
- Phase 4: study selection and data extraction process. The initial search identified 1734 documents, of which 1204 studies were analysed according to title and abstract, applying inclusion and exclusion criteria, resulting in the exclusion of 1160 documents. The remaining 44 were reviewed in full text, resulting in 14 articles being excluded for not meeting the minimum standards. Three articles were then incorporated, thus completing the final sample for the review (n = 33).
- Phase 5: coding and data synthesis. Microsoft Excel software was used to collect data and synthesize information, including identifying data of the source (author, title, year of publication, DOI, source) as well as keywords, summary and relevant research topics (context, topics, methodology, typology and research techniques, sample, findings and conclusions). For content analysis, we categorized the information, obtaining a series of categories and subcategories associated to the dimensions and research questions.

Each of these phases are discussed in detail below.

2.2. Search strategy and information sources.

The search process began with the definition of the criteria for selecting the documents to be analysed. The experience of the authors responsible for this study, the topics covered by it (CC and VET) and the descriptors marked by the search engines and databases used have been the references used in the definition of the search criteria shown in Table 2.

TABLE 2. Search criteria for the selection of documents in the SLR.

Criteria	Definition
Tipology	Books, scientific articles, and academic papers indexed in relevant bibliographic databases for educational research and positively valued by the scientific community, such as SCOPUS, Web of Science (WOS), Educational Resources Information Center (ERIC), and TESEO. Additionally, the electronic library for scientific dissemination, SciELO, is used.
Search descriptors	The search terms were *VET*, *TVET*, *vocational training*, *vocational education* or *professional training*; *climate change*; *climate emergency*; *climate action*; *global warmi*ng; *greenhouse effect*; *curricular greening*; *environment*; *green skills*; *sustainability*; *environmental education*; *greening*; *green transition*; *socioecological transition*; *global challenges*; *SDG-13*.
Availability	Open access, free, and available in full text.
Timeframe	Limited time frame to the last ten years, covering the period from 2015 to 2024, both years included.
Language	Spanish and English.

Several key decisions were made to carry out the search. The selection of databases was determined by their thematic breadth and national and international relevance in the educational field and other disciplines, thus ensuring a complete and detailed compilation of the relevant literature on the topics of interest. The keywords used in the searches were chosen with the idea of accurately and exhaustively reflecting the relevant topics of the study,

with synonyms also incorporated to broaden the search. With this information, specific search equations were designed to obtain a relevant set of primary sources in the databases (García-Peñalvo, 2022). Boolean connectors (AND/OR) were used to create formulas, combining keywords in such a way that they formed an effective search strategy in the selected search engines, in accordance with the guidelines of each database (Table 3).

Table 3. Advanced search equations in databases.

Database	Equation
SCOPUS	TITLE-ABS-KEY("climate change" OR "climate emergency" OR "climate action" OR "global warming" OR "greenhouse effect" OR "curricular greening" OR "environment" OR "sustainability" OR "environmental education" OR "greening" OR "green transition" OR "green skills" OR "socioecological transition" OR "global challenges") AND TITLE-ABS-KEY("VET" OR "TVET" OR "vocational training" OR "vocational education" OR "professional training")
WOS	ALL=(("climate change" OR "climate emergency" OR "climate action" OR "global warming" OR "greenhouse effect" OR "curricular greening" OR "environment" OR "sustainability" OR "environmental education" OR "greening" OR "green transition" OR "green skills" OR "socioecological transition" OR "global challenges") AND ("VET" OR "TVET" OR "vocational training" OR "vocational education" OR "professional training"))
ERIC/SCIELO	("climate change" OR "climate emergency" OR "climate action" OR "global warming" OR "greenhouse effect" OR "curricular greening" OR "environment" OR "sustainability" OR "environmental education" OR "greening" OR "green transition" OR "green skills" OR "socioecological transition" OR "global challenges") AND ("VET" OR "TVET" OR "vocational training" OR "vocational education" OR "professional training")

2.3. Eligibility criteria

Deciding which documents should be reviewed and which ones should be excluded required the definition of eligibility criteria (Table 4); these criteria were established based on the topics under study (CC and FP) and the scientific nature of the document.

Table 4. Definition of inclusion criteria.

Criteria	Definition
Context	Books, scientific articles or PhD theses directly applicable to the context of VET
Object of study	Topic focused on the environment, the climate emergency, sustainability and/or the sustainable development goals (SDGs)
Field	Studies within the disciplinary field of social and educational sciences

2.4. Data selection and extraction process

Data extraction has been carried out in three screening stages. The first stage, identification, has pivoted on the initial search for documents in the specialized databases WOS, SCOPUS, ERIC and TESEO using the core terms of the research, both in English and Spanish: *vocational*

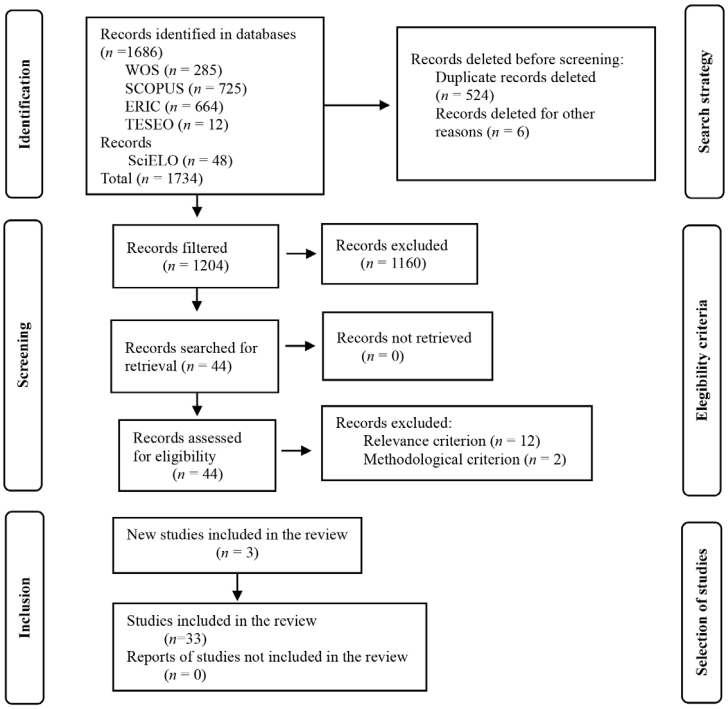
training, *climate change*, *climate emergency*, *environmental education*, *environment*, *sustainability* and *curricular environmentalization*. Additionally, the SciELO scientific electronic library has been reviewed, expanding the search with new concepts in both languages: *green skills*, *green transition*, *socio-ecological transition*, *climate action*, *global warming*, *greenhouse effect*, *greening*, *global challenges* and *SDG 13*, also in both languages. For a correct query, different combinations of all the keywords and synonyms have been made, posing specific search equations following the logic of the Boolean operators (AND/OR). This systematic search has been carried out over the months of March, April and May 2024. As a result, 1734 studies were identified, leaving a total of 1204 records for screening.

During the second screening stage, after an initial analysis based on the reading of titles and abstracts of the documents, 1160 publications were excluded as they did not specifically address VET linked to environmental issues or sustainability, and that were outside the field of social and education sciences. After applying the first filter, we examined the full text of these 44 sources, resulting in the exclusion of 14 studies.

Finally, during the third stage of inclusion, 3 additional studies have been added, completing the final sample of documents for the SLR (n = 33). The addition of these investigations has enriched and completed the review; one of them is a key source in the reviewed literature, and the other two works meet the inclusion criteria.

These filtering stages, aligned with the general phases of the SLR process, are illustrated in the flowchart presented in Figure 1. The identification stage corresponds to the application of the search strategy and selection of initial information sources. The screening stage refers to the application of the eligibility criteria to determine the relevance of the studies. Finally, the inclusion stage coincides with the final selection of studies and the extraction of data for data coding and synthesis.

FIGURE 1. PRISMA 2020 flowchart for SRL.



Source: adapted from Page et al., 2021.

After selection of the final studies for our review (33), we developed a template using Microsoft Excel software to synthesize the information and facilitate content analysis, including identifying data of the source (author, title, year of publication, type of document, nature of the data) as well as keywords, textual quotes or relevant research topics.

2.5. Data coding and synthesis

Regarding the analysis of qualitative information from the reviewed documents, a content analysis has been carried out that has allowed us to interpret the data by categorizing or coding the information, from which a series of categories have been obtained, organized in three main dimensions: (1) contextual (Table 5); (2) methodological (Table 6), and; (3) interpretive (Table 7), directly linked to the research questions.

Table 5. Definition of categories linked to the contextual dimension.

Code	Category	Meaning	Subcategory
TD	Temporal distribution	Classification of documents by year of publication to detect increases or decreases in the number of studies published per year	2015-2016-2017-2018-2019-2020-2021-2022-2023-2024
GL	Geographic location	Classification of publications by continent to identify the number of studies published in each region	Europe (EU) – Africa (AF) – Asia (AS) – America (AM) – Oceania (OC)
T	Topics	Study topics and areas of interest in research on CC and VET	Green campus (GC) – Curriculum/ Training (CT) – Community/ Businesses (CB) – Research (R) – Institutional culture (IC) – Skills (S)

Table 6. Definition of categories linked to the methodological dimension.

Code	Category	Meaning	Subcategory
M	Methodology	Methodological approach adopted in the research	Quantitative (QUAN) – Qualitative (QUAL) – Mixed (MX)
TY	Typology	Design or set of methods used to approach the study	Theoretical (TH) – Applied (AP) – Field (F) – Instructional (I) – Descriptive (DE) – Exploratory (EX) – Explanatory (EP) – Evaluative (EV) – Case studies (CS)
TC	Techniques	Set of tools and instruments used to collect information and analyze data	Documentary (DO) – Observational (OB) – Participatory (PA) – Survey (SV)
S	Sample	Documents or part of the population with which the research is carried out	Students (ST) – Teachers (T) – Management staff (MS) – Experts (EXP) – Companies (CM) – Educational community (EC) – Organizations and governments (OG) – University (U) – Social agents (SA) – Research staff (RS) – Documents (D)

TABLE 7. Definition of categories linked to the interpretive dimension.

Code	Category	Meaning	Subcategory
H	Findings	Results obtained in the reviewed studies, including data, patterns, and relevant observations	Definition (DEF) – Barriers (BA) – Good practices (GP) – Action proposals (AP) – Teacher protagonism (TP) – Technological innovation (TI) – Importance/ Contribution to SDGs (ODSC)
C	Conclusions	Interpretations, judgments and recommendations derived from the findings of the reviewed studies, highlighting the relevance and potential applications of the results	VET reform (VET R) – VET research (VETRS) – VET training (VETT) – VET networks (VET NET) – Green jobs (GJ)

The independent participation of all researchers in entering, verifying and contrasting information has guaranteed accuracy and the absence of bias that can appear in individual studies.

3. Results

Based on the categorization of the information, we present the results organized according to the previously established dimensions, in order to answer the nine research questions about the contextual characteristics, the methodological framework and the interpretive evaluation of the 33 studies reviewed (Figure 2).

FIGURE 2. Authors and year of the different documents analyzed for the SLR.

3.1. Contextual characteristics in educational research on the CE and VET

RQ1. How are publications on the EC in VET distributed over time in percentage terms?

Regarding the year of publication, the analysis has revealed an increasing trend in the number of publications, going from 3.03% in 2015 and 2016 to 27.27% in 2023. In 2024, publications reached 18.18%, a percentage that has also been recorded in 2020. Other less notable years were 2022 with 12.12%, as well as 2021, 2019, and 2018, all with an identical

percentage of 6.06%. In contrast to the results in those years, no publications on the subject were recorded in 2017.

RQ2. What is the geographical distribution of publications across the different continents?

In relation to those places where research was carried out, five continents have been identified, with Europe ranking first, with the largest contribution (32.43%), followed by Asia (29.73%) and Africa (24.32%). America (8.11%) and Oceania (5.41%), showing a lower contribution in the production of documents.

RQ3. What are the predominant topics in the publications?

Regarding the topics, it has been shown that the category with the greatest presence is *research* (39.13%), while the least present is *green campus* (4.35%). This finding underlines a clear tendency towards the generation of scientific knowledge that supports sustainable educational practices that are beneficial for the educational community and society, instead of focusing on the specific environmental management of the campus infrastructures and services. Secondly, the topic *curriculum*, (17.39%) regarding the integration of sustainability into the curriculum, has stood out. Thirdly, the *competencies* (15.22%) necessary to face CC and promote socio-environmental balance; followed by *community and companies* (13.04%), referring to the necessary collaboration between educational institutions, companies and community to connect theory with practice; and *institutional culture* (10.87%), concerning the integration of sustainability in institutional culture and promotion of good practices in all areas and decisions of institutions.

3.2. Methodological framework in educational research on CE and VET

RQ4. What methodologies are most frequently identified in the studies included in the review?

It has been observed that qualitative methodology (53.33%) is widely used, followed by mixed approaches (36.66%). In contrast, quantitative methodology has been used less frequently, with a presence of 10% across all reviewed studies.

RQ5. What type of study is most commonly used in the reviewed studies?

Theoretical research works (34.01%) were those most frequently found in the review, followed by field studies (25.77%), which included interviews, questionnaires, observations and ethnographic studies, and studies applied to specific contexts (14.43%), which also included participatory action research and expansive learning. On the other hand, there was a higher frequency of research based on case studies (10.31%) and instructional designs (6.18%) compared to descriptive (3.09%), evaluative (3.09%), exploratory (2.06%) and explanatory (1.03%) designs.

RQ6. What research techniques are most prominent in the selected studies?

Regarding the most commonly used techniques, surveys have stood out (42.17%), including interviews and questionnaires. In second place are documentary techniques, which include content, comparative, reflective and mapping analyses, and equate to 40.96%. At a greater distance are participatory techniques (12.04%), which integrate focus groups, community cafes, art programs, workshops, among others; and finally, observational techniques make up only 4.82% of the total.

RQ7. What is the profile type that the samples most commonly use in research on the CE in the context of VET?

Regarding the sample used, the category *teaching staff* appears more frequently in non-theoretical studies (15.28%), in the same way that *documentation* is equally predominant in theoretical studies (15.28%). Other categories that have stood out are *students* and *educational community*, with 12.5% respectively. *Companies* (11.11%) as well as *organizations and governments* (9.72%) have also been widely used. However, with less representation we have found *experts* (5.56%), *community* (5.55%), *research staff* (5.55%) and *managerial staff* (4.54%), with *university* (3.03%) being the least common category amongst the studies.

3.3. Interpretive assessment in educational research on the EC and VET

RQ8. What are the most significant findings from the literature reviewed? Most of the findings from the documents analysed have focused on *barriers* (32.91%), shortcomings or problems that hinder or prevent the development of sustainable practices. Notwithstanding, great weight has also been given to the *action proposals* (27.85%) that are necessary to include the climate emergency in VET and make EEfS effective, and to the study of *good practices* (16.45%), referring to success stories that have proven to be effective and successful in addressing sustainability in VET and can serve as a model or reference for sustainable VET. To these trends has been added *teacher protagonism* (7.59%), which explores the role of teachers in the implementation of changes and improvements in VET; *technological innovation* (6.33%), focused on skills and technologies in teaching for green innovation; and *importance and contribution of the SDGs* (6.33%) in VET. Finally, 2.38% focused on the *definitions* or image associated with the terms CE and sustainability.

RQ9. What are the key findings of the reviewed studies?

The categories *VET research* and *green jobs* have been identified as the main findings (23.91%). This suggests a predominant trend towards the development of academic research and educational policies to address global challenges with an eco-social perspective, as well as towards the promotion of green skills and environmental technologies to support a greener industry. Another significant conclusion was *VET reform* (21.74%), focused on changing traditional educational practices in favour of comprehensive curricular models and educational approaches. On the contrary, the least frequent conclusions were *formative VET*, referring to the training and professional development of teachers and companies, and *VET networks*, which highlights the importance of participation and collaboration between institutions, companies and communities for equity and eco-social justice, both with 15.22%.

4. Discussion

Taking as a reference the object of study, which was to uncover the extent to which the CE constitutes a consolidated topic of study in educational research focused on VET, we conclude that, although there is a growing interest and greater attention being paid to these topics in academic research, the literature shows that studies that explore the link between CC and VET are still scarce (McGrath & Russon, 2023). This results in highlighting that it is especially rare to find research works that address CC from a holistic and transformative perspective, which question our cultural identity and point in the direction of eco-social justice (VET Africa 4.0. Collective, 2023).

Regarding the research questions on the contextual characteristics of the documents, the SLR has indicated a growing increase in research on VET and sustainability since the approval of the 2030 Agenda in 2015, with a clear intensification of academic interest from 2020 onwards, most likely due to the impact of the health crisis caused by the covid-19 pandemic, which brought with it a series of changes in the Earth's human and natural systems that drove the production of new research topics. The decrease in 2021 probably reflected the adaptation and reorganization process of the scientific community in the academic field, while the rebound since 2022 could be explained by the consequences that covid-19 had on ecosystems and the renewed commitment to environmental issues (López-Feldman et al., 2020). This increase has been particularly evident in European countries and in the global south. According to McGrath and Yamada (2023), this is due to the fact that countries in the north have greater funding, which often perpetuates dynamics of external leadership and extractivism that influence the direction and focus of research agendas. However, there are recent efforts to promote more responsible and socially engaged participation from developing countries; a trend that would explain the growing visibility of countries in the global south in academic publications on skills, theoretical and methodological approaches, probably due to their high vulnerability to the impacts of CC (Monk et al., 2023), data which are consistent with the research by Persson

et al. (2023), who also point out "a rapid growth of research on VET and a green transition in the so-called Global South and European countries" (p. 373).

Despite these data, the research priorities in these studies have been diverse. While it is true that the predominant theme of theoretical studies points towards the generation of scientific knowledge that supports sustainable educational practices that are beneficial for the educational community and society, in practice, more than half of the research adopts reformist approaches focused on specific areas (Ramsarup et al., 2024), such as the curriculum, identified in numerous documents as the best solution to address CC; competencies for sustainability; collaboration between institutions, communities and companies; the creation of ecological institutional culture, and; specific environmental management in campus infrastructures and facilities. This reality has revealed a significant gap between academic interest in greening VET and its effective implementation in this context, which currently tends towards fragmented responses rather than systemic or transformative ones (McGrath & Russon, 2023; Chandramohan & Bhagwan, 2023; Monk et al., 2023).

Regarding the questions related to the methodological framework, the results indicate that qualitative methodology is the most used, followed by mixed methodology, and quantitative methodology is barely present, consistent with the findings by Trott et al. (2023). Furthermore, theoretical studies and field research prevail over applied and participatory studies, with case studies being more frequent than instructional, descriptive, evaluative, exploratory and explanatory designs. Consequently, the most commonly used research techniques have been surveys and documentary techniques, as opposed to participatory and observational techniques. This distribution suggests that there is a disconnect between theoretical knowledge and its practical application, which is limiting action and, therefore, the capacity of studies to generate sustainable practices (Ramsarup et al., 2024).

Regarding the study sample, we observed that the research tends to focus on documents, teachers or students, with less presence of community participation, and almost no university involvement. These findings have corroborated the conclusions by VET Africa 4.0 Collective (2023), in regard to VET not adequately addressing the EC, since the different intervention perspectives are not being considered nor is the inclusive participation of citizens, necessary for a balanced and lasting future, being promoted. Likewise, they also highlight the fundamental role of universities in developing skill ecosystems and promoting social mobilization. Along these lines, Monk et al. (2023) argue that adopting a new approach to effectively address CC requires integrating the social context and diverse knowledge perspectives so as not to leave anyone behind (López et al., 2022).

The answers obtained in this study to the research questions on interpretive assessment highlight the barriers and/or problems that hinder or prevent the development of good practices stand out. In this sense, the problems that stand out are training challenges, such as "the infrastructure, the equipment", (Muwaniki et al., 2024, p. 439), "the syllabuses/ curricula" (Legusov et al., 2021, p. 10) and/or "the shortage of qualified personnel [...], which negatively impacts the competence of students at the end of the training and their employment prospects". Economic challenges, such as "the high cost of education, which affects disadvantaged students" (Legusov et al., 2021, p. 13). Cultural challenges, referring to "core beliefs in productivism, industrialization and economic growth"; and/or "to deeply rooted educational and sociocultural routines, such as the student as learner, alienation from problems, a bias toward cognitive knowledge, and rapid 'problem solving'" (Weijzen et al., 2024 p. 331). And institutional challenges, related to the organization and internal structure of institutions, including educational policies, regulations, rules, bureaucracy, among others. Improvements have been proposed to overcome these barriers, such as curricular updating, the establishment of an evaluative framework, the integration of political economy and skills ecology (Ramsarup et al., 2024), and success stories to green VET. A prominent example has been the German INEBB project as an effective transfer mechanism to integrate the SDGs into business VET (Lambini et al., 2021).

The priority given to barriers, proposals for action and good practices suggests that current practices focus more on overcoming immediate obstacles and seeking specific practical solutions, despite the fact that teacher commitment and training are crucial for raising awareness and citizen reactivation, as well as establishing a solid conceptual basis to effectively address CC (MITECO and MEFP, 2021).

In relation to the key findings, the need to advance academic research and develop policies "and flexible regulations to balance changing market needs" has been highlighted (Pavlova, 2019, p. 155). In addition, the importance of environmental skills and technologies has been highlighted to create a qualified workforce that promotes the conscious use of natural resources and renewable energy, with a positive impact on CC. This is consistent with Persson et al. (2023), who emphasize technological innovations and green skills education, and with Li et al. (2023), who argue that green technology in vocational training is essential to foster sustainable awareness, knowledge, attitudes, practices, skills and values.

On the other hand, it has been considered urgent to reform conventional educational practices of VT towards ecosocial models, through specific proposals that try to promote equity and social justice. This includes, according to Lotz-Sisitka et al. (2024), the incorporation of political-economic-ecological debates, as well as giving voice to local communities. For their part, McGrath and Powell (2016) propose replacing productivism (VET) with a post-productivist vision that promotes "a vision of work that is decent, solidary [that supports student action], gender-conscious, environmentally sensitive and intergenerational, addressing poverty, inequality and injustice" (p. 18) Furthermore, Moldovan (2015) points out the need to prioritise the implementation of a new assessment framework, policies and action plans to green the organisational culture while considering the participation of specific recipients to ensure inclusion (Yilmaz, 2024). These results are in line with previous studies by Paryono (2017), who highlights the importance of humanistic and social values to achieve transformative and sustainable approaches for the benefit of people, communities and the planet; and by Powel (2012), who points out that VET can significantly contribute to human development and the social changes needed to fight CC and poverty.

Although teacher and business training and professional development, along with the creation of collaborative networks between institutions, communities and/or businesses, have been less common in the reviewed literature, Janhonen-Abruquah et al. (2018) point out the importance of teacher training to ensure sustainable educational practices. Likewise, Ramli et al. (2022) show that networking is the most influential factor in learning, which favours teacher training in VET.

5. Conclusions and future lines of research

The results of this study allow us to assert that, while it is true that there is a growing interest in these topics in scientific research, the principles of ecosocial justice are barely present in most of this scientific production. The CE is not approached from a holistic and transformative perspective that questions our cultural identity and promotes a new development paradigm (Chandramohan & Bhagwan, 2023; SAJEE, 2023; VET Africa 4.0. Collective, 2023); rather it is worked on from transitional approaches focused on research into specific areas or subsystems within society (Persson et al., 2023). As suggested by authors such as McGrath and Powell (2016) and Lotz-Sisitka et al. (2024), evidence suggests that incorporating political, economic and ecological debates, and adopting a post-productivist vision of work are essential steps to respond to the demands of the CE. Although these measures are critical, they are insufficient on their own for a comprehensive approach that requires large-scale changes; changes linked to transformative transitional approaches aimed at human, supportive and sustainable development (Persson et al., 2023). In this sense, it is not only crucial to opt for research that promotes sustainability (United Nations Educational, Scientific and Cultural Organization, and International Centre for Technical and Vocational Education and Training [UNESCO-UNEVOC], 2017), but it is also necessary to strengthen and direct research activity towards study topics such as eco-dependence, planetary boundaries or the CE and eco-

citizenship; and towards educational aspects that allow reformulating teaching methodologies, encouraging citizen participation (MITECO and MEFP, 2021) and promoting inclusive and transformative public policies.

In hindsight, the SLR has been useful to determine to what extent the CE constitutes a consolidated topic of study in educational research focused on VET, as well as to contextualize the perspectives employed to address it in the literature. However, some of the limitations of the study should be noted. The main one could be related to the linguistic scope and the sources of information used, since local studies with a more specific level of indexing at a regional level or less visible in scientific databases have not been considered, which may have limited the representation of all ongoing research.

The results obtained could guide future research agendas that prioritize the identified gaps and underexplored areas in the field of vocational training and CE, allowing for an increase in scientific production, as this is an emerging topic. In this context, it would be advisable to explore how the findings of the review can contribute to the formulation of educational policies and curricular practices, offering a framework to address the CE in VT and promoting the training of professional profiles demanded by citizens competent in sustainability.

Finally, as a future line of work complementary to the study carried out, we suggest that a SLR based on the gender perspective be carried out, as scientific production in this field increases. The incorporation of these approaches will be essential to advance the study of the CE and the VT, favouring a holistic and transformative understanding.

Authors' contributions

M.ª de Fátima POZA-VILCHES: Conceptualization; Supervision; Writing (review and editing).

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Characterising educational research on climate change in the climate emergency era (2017–2024)

Caracterización de la investigación educativa sobre cambio climático en la era de la emergencia climática (2017-2024)

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Abstract:

Recent national and international statements have put the state of the climate in a new paradigm, that of a climate emergency demanding urgent action. In this context, contributions from educational research are essential to inform educational policies and practices. Previous studies identified a marked increase in scientific literature on this topic over the period from 2008 to 2017. Seven years on, with more than 2300 climate emergency declarations having been issued by jurisdictions representing over one billion people, it seems timely to update the characterisation of this field. This documentary study aims to examine educational research on secondary education students' understanding of climate change during the period from 2017 to 2024. The study builds on an earlier review (1993–2017) and analyses current trends in the field. Following the PRISMA-ScR guidelines, an action protocol was developed, eligibility criteria were defined, and records were retrieved from the Web of Science and Scopus databases. The CADIMA online application, designed for systematic evidence synthesis, was employed to streamline the process. This resulted in 55 articles being identified. The analyses found that the increase in publication volume noted up to 2017 has continued, with research expanding to new geographic regions and including a broader range of participants. The findings also indicate new research directions, including emotional dimensions, personal contexts, and methodological approaches such as social representation theory. This study offers an updated overview of the field, intended to support education professionals in both pedagogical practice and research.

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Keywords: students, review, secondary education, high school, environmental education, climate emergency, climate education, CADIMA.

Resumen:

Las últimas declaraciones nacionales e internacionales sitúan la realidad climática en una nueva dimensión, la de una emergencia climática ante la que es imperativo actuar. En este escenario, las contribuciones de la investigación educativa son determinantes en la orientación de políticas y prácticas educativas. La literatura científica al respecto sufrió un incremento en su producción en el período 2008-2017. Siete años después y con más 2300 declaraciones de emergencia climática promulgadas por jurisdicciones que representan a más de mil millones de personas, parece oportuno actualizar la caracterización de este ámbito. Mediante un estudio documental, se pretende caracterizar el campo de la investigación educativa en relación con la comprensión del cambio climático por estudiantes de educación secundaria en el periodo 2017-2024. Con ello, se busca actualizar una revisión previamente realizada (1993-2017) y analizar las tendencias dentro del campo de estudio. Se siguió la declaración PRISMA-ScR, se planificó el protocolo de actuación, se establecieron los criterios de elegibilidad y se utilizaron las bases de datos de Web of Science y Scopus para la búsqueda de registros. En el proceso, se utilizó la aplicación online CADIMA, diseñada para sistematizar síntesis de evidencias. Como resultado, se identificaron 55 artículos. Los análisis desvelan que el incremento en la producción identificado hasta 2017 se mantiene en la actualidad, con una ampliación de horizontes geográficos y un mayor rango de participantes. Por otro lado, sugieren nuevas líneas de investigación tanto en lo que se refiere a tópicos e interés (dimensión emocional y contextos personales) como a propuestas metodológicas (teoría de las representaciones sociales). Este trabajo presenta una panorámica del campo de estudio con la pretensión de que sea de utilidad a los y las profesionales de la educación tanto en su praxis pedagógica como investigadora.

Palabras clave: estudiantes, revisión, educación secundaria, instituto, educación ambiental, emergencia climática, educación climática, CADIMA.

1. Introduction

Anthropogenic climate change (CC), defined as long-term change in the Earth's meteorological dynamic owing to human activities (IPCC, 2023), is undoubtedly one of the most important challenges of the 21st century (Debernardi et al., 2024). Because of its unprecedented impact on all aspects of life in society, social and political bodies (both nationally and internationally) have spoken about this phenomenon as an *emergency* and, since 2017, many groups and governments have called for and issued climate emergency declarations (Wilkinson & Clement, 2021). So far, 2,357 declarations have been made by jurisdictions representing more than a billion people (CEDAMIA, 2024). Similarly, various United Nations bodies have stressed the urgency of providing a global and local response that makes it possible to construct an environmental scenario that is as favourable as possible (United Nations, 2015a). Specifically, a need has been identified to educate new generations (who are the ones who will inherit this future) in how to lead and participate in the climate struggle.

In this emergency situation, education is a potential catalyst for citizen action (Ladrera & Robredo, 2022). According to the United Nations (2015b), teaching is and will remain crucial to promote awareness raising and the human capacity to mitigate and adapt to CC. In this regard, intergovernmental discourse insists firmly on the urgent need to integrate the climate

emergency into curricula, offering children and adolescents socioeducational spaces where they can access knowledge and develop the skills and attitudes needed to give active support (individually and collectively) to the necessary and urgent mitigation and adaptation strategies and policies. In this sense, González-Gaudiano et al. (2020) propose an emergency curriculum that, among other things, addresses the way the topic is addressed from individual disciplines, which limits the level of discussion, participation, reasoning, and reflection that is essential to address complex and controversial social and political questions. They call for a climate-emergency curriculum that considers and values contributions from other disciplines within the social sciences, which through their own methodologies and content make it possible to promote in depth the climate commitment from critical and ethical positions. A curriculum that cannot hide or delay the urgency of a transition towards a decarbonised and fair society while at the same time needing to project a "hope based on more constructive ways of coping with this threat" (Ojala, 2012, p. 636).

To do so, it is crucial to provide the different stakeholders from the educational community with well-founded resources to direct and facilitate the paradigm change on the climate topic; in other words, pedagogical research must prioritise the climate emergency as one of its key pillars. As one of the various educational elements or aspects to take into account, it is opportune to explore how students perceive, construct, and apply knowledge of CC. Furthermore, to facilitate access to the information generated and guide future research, this field of study should be characterised.

Therefore, the present work starts from the results of the review by García-Vinuesa and Meira-Cartea (2019) in which they offered a first inventory and characterisation of educational research into secondary education students' comprehension of CC in the 1993–2017 period. Seven years later, there is a need to update this review as no more recent ones have been found since its publication that offer an overview of the evolution of the field up to the present day. Consequently, this documentary study sets out to complement the results obtained in this earlier review and, using the systematic scoping review method (Codina, 2021; Gutierrez-Bucheli et al., 2022; Tricco et al., 2018), to offer a renewed perspective on the evolution of pedagogical research relating to the subject of the climate for the 2017–2024 period.

The following specific objectives are proposed:

1. To identify high-impact literature on secondary education students' comprehension of CC, that is to say, adolescents aged between 12 and 18 years.
2. To update the characterisation of the field of educational research focussed on adolescent students' comprehension of CC.

2. Methodology

A documentary methodological design was used to explore the scientific evidence regarding secondary education students' comprehension of CC. In order to offer a rigorous, traceable and transparent overview of the topic, the systematic scoping review method was used to do this (Gutierrez-Bucheli et al., 2022; Tricco et al., 2018).

Systematic scoping reviews are used in studies that synthesise evidence to explore the situation of a specific academic-scientific field in a wide-ranging and systematic way (Codina, 2021). This type of study pursues a variety of objectives, such as reviewing the extent, variety, and characteristics of the available evidence on a specific topic of study; assessing the utility of undertaking a more in-depth exploration of the topic; synthesising the methods and results identified in the area of knowledge examined; updating and complementing previous reviews; and identifying new research opportunities (Codina, 2021; Tricco et al., 2018).

This study follows the PRISMA-ScR declaration [the supplementary material includes the checklist that the authors of the declaration propose (Tricco et al., 2018)]. Codina (2021)

recognises the suitability of this technique for synthesising evidence in the field of educational research. It is especially recommended for the field of environmental education (Gutierrez-Bucheli et al., 2022). As a support tool for completing the process, the CADIMA online application was used. Its features guide and facilitate the realisation of collaborative and transparent systematic reviews (Kohl et al., 2018).

Accordingly, and as PRISMA-ScR recommends, the protocol that guided the review process was planned and registered (Segade-Vázquez et al., 2024) and its implementation is described below.

2.1. Eligibility criteria

To guide the type of question and establish the eligibility criteria, the PCC (population, concept, and context) framework was used. This is recommended for scoping systematic reviews in the field of education (Gutierrez-Bucheli et al., 2022; Zawacki-Richter et al., 2020). In line with this, the population was defined as *students*, the concept as *climate change*, and the context as *secondary education*. In addition, three other criteria were used to match the search to that done by García-Vinuesa and Meira-Cartea (2019): a time filter for the 2017-2024 period; another for publication type (only published articles; books, book chapters and grey literature were excluded); and, finally, a linguistic filter (only texts written in Spanish, Galician, English, and Portuguese).

To define the eligibility criteria objectively and adequately and avoid different interpretations by the reviewers, an internal consistency test was done using the kappa index calculation offered by CADIMA. A random sample was taken of 20 records that were assessed in parallel by two reviewers, giving a kappa index value of 0.649, which is considered to be good. The exact definition of the eligibility criteria can be consulted in Table 1 in the supplementary material.

2.2. Procedure for searching for and selecting records

The search was done from the network of the Universidade de Santiago de Compostela through its subscription to the Spanish Foundation for Science and Technology. The consultations were done on 24 April 2024 in the Scopus and Web of Science (WoS) databases, which are well-known for their rigour, their scope, and the notable scientific reach and of their indexed collections (Codina, 2021). To construct the search query, the concepts used by García-Vinuesa and Meira-Cartea (2019) were taken into account (*student, climate change, global warming, secondary, middle school*, and *high school*), combining them in the title, abstract, and keywords fields. The following search algorithm was used: (TITLE-ABS-KEY (student*) AND TITLE-ABS-KEY (“climate change” OR “global warming”) AND TITLE-ABS-KEY (“secondary” OR “middle school*” OR “high school*”)).

The searches of the two databases were done and the records obtained were entered into CADIMA where they were combined, and duplicates were eliminated automatically and manually. Once the initial sample had been obtained, the eligibility criteria were applied in two phases: one, by reading the titles and abstracts, and another by reading in-depth the full texts that passed phase one. The selection process was done by two reviewers in parallel.

2.3. Limitations

Despite the planned systematisation for carrying out this scoping review, no review process is without limitations. Therefore, to interpret the results that emerge, it is necessary to consider such constraints inherent to these processes. In particular, the following limitations should be noted in this review: a linguistic bias owing to the language competences of its authors, with only texts written in Spanish, English, Galician, and Portuguese being accepted. In addition, it should be noted that the selected databases

mainly index articles in English, although they increasingly include journals that publish in other languages. In relation to this, 25 records from WoS and Scopus were excluded from the analysis as they were written in other languages. Another typical limitation results from the restricted access to some articles. In our case, the full text of three studies could not be accessed and so they could not be assessed.

Finally, it is also worth recalling that, despite using a sufficiently broad search string, some studies might not have been identified owing to the wording of the abstract or the authors' choice of title and keywords. This happened with three studies of interest, which were incorporated once the final selection of records had been reviewed (Figure 1).

3. Results

Next, the results obtained, which complement the findings of the review by García-Vinuesa and Meira-Cartea (2019) are presented, offering an up-to-date characterisation of the field of research into education, CC, and secondary education students. Figure 1 is a flow chart illustrating the search and selection process in which 55 studies from the 2017-2024 period were identified. Before continuing, the reader should be aware that although the study presented has prioritised an exhaustive search, the limitations described above (type of publication, language, sources consulted, etc.) mean these results cannot be generalised nor can defining patterns be established in scientific literature on the topic. However, the resulting inventory of studies does provide an overview of this field of research, identifying the principal authors, reference institutions, and new thematic and theoretical lines in educational research regarding the climate emergency and secondary education students.

FIGURE 1. Flow chart of the exploratory systematic review process.

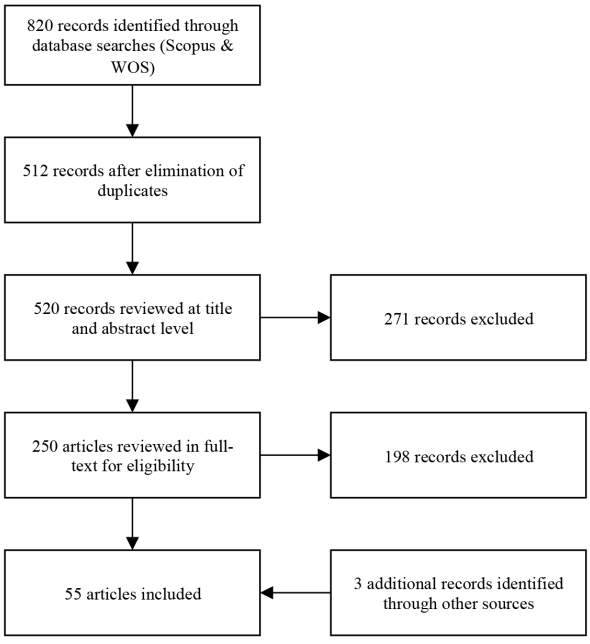


Table 1 presents the data extracted that enable a first approximation to the characterisation of the field of study in the period investigated.

TABLA 1. Datos descriptivos que caracterizan los estudios identificados en la revisión sistemática exploratoria

Authors	Year	Universities**	Country	*n*	Age	Origin	Design
García-Vinuesa, A., Carvalho, S., & Meira-Cartea, P. Á.	2024	Universidade de Santiago de Compostela	Spain	141	15-20	Portugal	MM
Ndetei, M., Wasserman, D., Mutiso, V., Shanley, J., Musyimi, C., Nyamai, P., Munyua, T., Swahn, S., Weisz, J., Osborn, T., Bhui, K., Johnson, N., Pihkala, P., Memiah, P., Gilbert, S., Javed, A., & Sourander, A.	2024	University (U) of Nairobi, Harvard U., U. of Oxford, U. of Basel, U. of Helsinki, U. of Maryland, U. of Turku**	Kenya, Sweden, USA, United Kingdom, Switzerland, Finland	2652	14-18	Kenya	QT
Cebrian, G., Moraleda, A., Olano, J., Boqué, A., & Prieto, J.	2024	U. Rovira i Virgili, U. Camilo José Cela, U. de Málaga	Spain	372	14-18	Spain	QT
De Rivas, R., Vilches, A., & Mayoral, O.	2024	Universitat de València	Spain	944	15-17	Spain	MM
Morote, A., & Hernández, M.	2024	Universitat de València, Universidad de Alicante	Spain	1328	12-18	Spain	MM
Ágoston, C., Balázs, B., Mónus, F., & Varga, A.	2024	ELTE Eötvös Loránd University, University of Debrecen	Hungary	112	16-18	Hungary	QT
Morote, A.	2023	Universitat de València	Spain	575	12-18	Spain	MM
Kirbiš, A.	2023	University of Maribor	Slovenia	1508	12-34	Slovenia	QT
Jiménez-García, M., Pérez-Peña, M.C., & López-Sánchez, J.A.	2023	Universidad de Cádiz	Spain	565	12-24	Spain	QT
Tolppanen, S., Kang, J., & Tirri, K.	2023	University of Eastern Finland, University of Helsinki	Finland	1703	12-15	Finland	QT

Authors	Year	Universities**	Country	*n*	Age	Origin	Design
Antronico, L., Coscarelli, R., Gariano, L., & Salvati, P.	2023	Italian National Research Council	Italy	420	13-20	Italy	QT
De Pascale, F.	2023	University of Palermo	Italy	≈110	16-18	Italy	QL
Goel, A., Iyer-Raniga, U., Jain, S., Addya, A., Srivastava, A., Pandey, R., & Rathi, S.	2023	Indian Institute of Technology, RMIT University**	India, Australia, France	693	12-19	India	QT
Sánchez-Almodóvar, E., Gómez-Trigueros, I., & Olcina-Cantos, J.	2022	Universidad de Alicante	Spain	784	13-16	Spain	QT
Bishoge, O., Ajayi, D., Mfinanga, S., & Aremu, A.	2022	Pan African University Life and Earth Sciences Institute, University of Ibadan**	Nigeria, Tanzania	685	12-23	Tanzania	QT
Sarrasin, O., von Roten, F., & Butera, F.	2022	University of Lausanne	Switzerland	639	14-22	Switzerland	QT
García-Vinuesa, A., Meira-Cartea, P. Á., Caride Gómez, J. A., & Bachiorri, A.	2022	U. de Santiago de Compostela, U. degli Studi di Parma	Spain, Italy	398/ 209	15-17	Spain, Italy	MM
Morote, A., & Hernández, M.	2022	Universitata de València, Universidad de Alicante	Spain	575	12-18	Spain	MM
Deisenrieder, V., Müller, S., Knoflach, B., Oberrauch, A., Geitner, C., Stötter, J., & Keller, L.	2022	Leopold-Franzens U., Pedagogical University Tyrol	Austria	≈170/ ≈251	13-15	Germany, Austria	QL
Calixto-Flores, R.	2022	Universidad Pedagógica Nacional Ciudad de México	Mexico	45	16-20	Mexico	QL
Ladrera, R., & Robredo, B.	2022	Univerdidad de La Rioja	Spain	219	14-16	Spain	MM

Authors	Year	Universities**	Country	*n*	Age	Origin	Design
Piscitelli, A., & D'Uggento, A.M.	2022	U. of Naples Federico II, U. of Bari Aldo Moro	Italy	1975	13-21	Italy	QT
Bishoge, O., Aremu, A., Ajayi, D., & Mfinaga, S.	2022	Pan African University, University of Ibadan**	Nigeria, Tanzania	685	14-20	Tanzania	QT
Moser, S., y Sebauer, S.	2022	University of Bern**	Switzerland, Austria	1129	16-20	Austria	QT
Winter, V., Kranz, J., & Möller, A.	2022	U. of Vienna, Research Institute of Forest Ecology**	Germany, Austria	80	15.9*	Austria	QL
Sigit, D., Azrai, E., Suryanda, A., Ichsan, I., Cahapay, M., Rahman, M., Portal, P., & Susanti, R.	2022	Universitas Negeri Jakarta, U. Mohammad Husni Thamrin, Mindanao State U., U. of Dhaka, U. of Campinas**	Bangladesh, Brazil, Philippines, Indonesia	366	-	Indonesia	QT
Jurek, M., Frajer, J., Fiedor, D., Brhelová, J., Hercik, J., Jáč, M., & Lehnert, M.	2022	Palacký University	Czechia	462	14-19	Czechia	QT
Kutywayo, A., Chersich, M., Naidoo, N., Scorgie, F., Bottoman, L., & Mullick, S.	2022	University of the Witwatersrand	South Africa	924	15.8*	South Africa	QT
Ganatsa, M., Tsakaldimi, M., & Ganatsas, P.	2021	Aristotle University	Greece	600	12-15	Greece	QT
Feucht, F., Michaelson, K., Hany, S., Maziarz, L., & Ziegler, N.	2021	U. of Toledo, Bowling Green University**	USA	≈700	16-19	USA	QL
Calculli, C., D'Uggento, A., Labarile, A., & Ribecco, N.	2021	University of Bari Aldo Moro	Italy	≈920	13-17	Italy	MM
Canaza-Choque, F.A., Escobar-Mamani, F., & Huanca-Arohuanca, J.W.	2021	U. Católica de Santa María, U. Nacional del Altiplano, Universidad Nacional de San Agustín de Arequipa	Peru	102	16-18	Peru	CL

Authors	Year	Universities**	Country	*n*	Age	Origin	Design
Haugestad, C., Skauge, A., Kunst, R., & Power, S.	2021	University of Oslo, University of Copenhagen	Denmark, Norway	362	16-22	Norway	MM
Bello-Benavides, L., Cruz, G., Meira-Cartea, P., & González-Gaudiano, É.	2021	Universidad Veracruzana, U. de Santiago de Compostela	Spain, Mexico	858	15-17	Mexico	CT
Zeeshan, M., Sha, L., Tomlinson, K., Azeez, P.	2021	Bharathidasan University	China, India	717	12-18	India	CT
Khan, N., Karpudewan, M., & Annamalai, N.	2021	Universiti Sains Malaysia	Malaysia	211	14-15	Malaysia	CT
García-Vinuesa, A., Carvalho, S., Meira-Cartea, P., Á., & Azeiteiro, U.	2021	Universidade de Santiago de Compostela, U. de Aveiro	Spain, Portugal	219	16-17	Portugal	CT
Ratinen, I.	2021	University of Lapland	Finlandia	665	12-15	Finland	CT
Calixto-Flores, R.	2020	Universidad Pedagógica Nacional Ciudad de México	Mexico	67	15-21	Mexico	CL
Ratinen, I., & Uusiautti, S.	2020	University of Lapland	Finlandia	665	12-15	Finland	CT
Wu, J., & Otsuka, Y.	2020	Tokio City University**	China, Japan	657	16-17	China	CT
Montero-Pau, Álvaro, N., Gavidia, V., & Mayoral, O.	2020	Universitat de València	Spain	407	16.1*	Spain	CT
García-Vinuesa, A., Bello-Benavides, L., & Iglesias, L.	2020	Universidade de Santiago Compostela y Universidad Veracruzana	Spain, Mexico	298 /300	14-18	Spain, Mexico	CT
García-Vinuesa, A., Mucova, S., Azeiteiro, U., Meira-Cartea, P. Á., & Pereira, M.	2020	Universidad de Santiago de Compostela, Lúrio University, Universidade de Aveiro	Spain, Portugal, Mozambique	256	16-18	Mozambique	CT

Authors	Year	Universities**	Country	*n*	Age	Origin	Design
Lehnert, M., Fiedor, D., Frajer, J., Hercik, J., & Jurek, M.	2019	Palacký University	Czechia	462	14-19	Czechia	CT
Jarrett, L., & Takacs, G.	2019	University of Wollongong	Australia	229	13-16	Australia	MM
Ezze, E.	2019	University of Nigeria	Nigeria	312	-	Nigeria	CT
Majer, J., Slapničar, M., & Devetak., I.	2019	University of Maribor, Univerity of Ljubljana	Slovenia	1012	14-15	Slovenia	CT
Busch, K., Ardoin, N., Gruehn, D., & Steveson, K.	2019	North Carolina State University, Stanford University	USA	453	14-18	USA	CT
Pinheiro, J., Cavlacanti, G., & Barros, H.	2018	U. Federal do Rio Grande do Norte, U. Potiguar	Brasil	36	15.5*	Brasil	MM
Brandmo, C., & Bråten, I.	2018	University of Oslo, University of Copenhagen	Norway	281	17.1*	Norway	CT
Sanchis, R., Solaz-Portolés, J., & Sanjosé, V.	2018	Universitat de València	Spain	151	12-15	Spain	CT
Gasparetto, M., Teixeira, D., Roazzi, A., & Campello, B.	2018	Federal University of Pernambuco**	Brasil	200	16.7*	Brasil	CT
Valdez, R., Peterson, M.N., & Stevenson, K.	2017	Department of Forestry and Environmental Resources, Department of Parks, Recreation & Tourism Management	USA	1158	12-14	USA	CT
Li, C., & Monroe, M.	2017	University of Missouri, University of Florida	USA	728	14-18	USA	CT

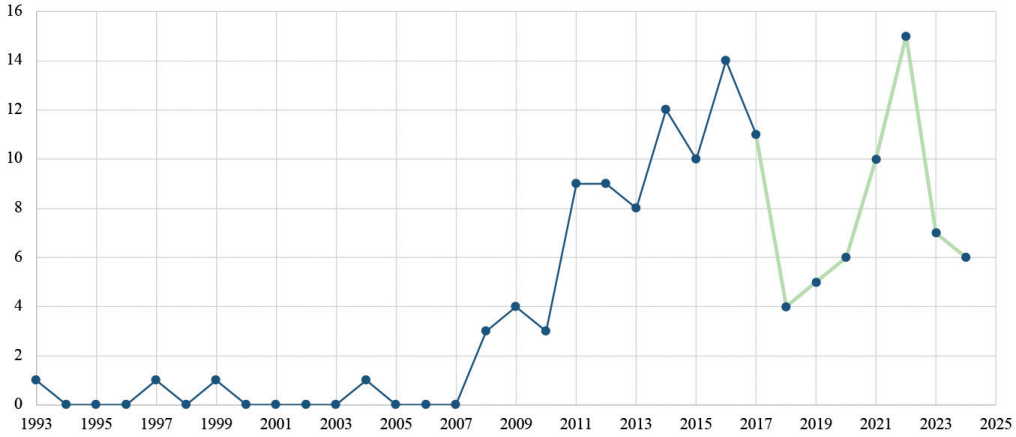
*Mean age. **Only the universities that led the research are listed, although in some cases research centres, high schools, and other institutions participated.

Note: the list of references of the identified studies can be consulted in the supplementary material. U = university; QT = quantitative; QL = qualitative; MM = mixed methods; n = sample.

3.1. Publication trends

In the 1993-2017 period, García-Vinuesa and Meira-Cartea (2019) identified an upwards trend in the publication of research centred on secondary education students' comprehension of CC. As the result for the 2017–2024 period show (Figure 2), this pattern, which started in 2008, has continued over time. However, the number of publications fell slightly in the years 2018 and 2019. Despite this, four and five studies were published in these two years, two and three more than in the first year of the previously identified increase in publications. It should be noted that the data for 2024 only cover January, February, March, and April, and so it is plausible that new studies will be published over the course of the year.

FIGURE 2. Publication trends by year.



3.1.1. Principal journals

Table 2 shows the journals that have published articles on the topic of this review. In comparison with the results of the previous review, the journal *Sustainability* emerges as the journal with the most publications, 9 in total, while in the previous period it only boasted one publication. This result is also notable because this journal is not from the field of education, but instead WoS catalogues it in the areas of environmental sciences, environmental studies, and sustainable science and technology. The following 6 journals (with 4, 3, and 2 publications) do belong to the areas of education, whether they are journals dedicated to environmental education or science teaching, while journals from other areas of knowledge are also found among the remaining journals with just 1 publication each (29 in total). So, over the last 7 years, 50.9% of articles on the topic were published in journals from the area of education and social sciences while 49.1% were in journals from other areas of study such as psychology or environmental sciences and sustainability.

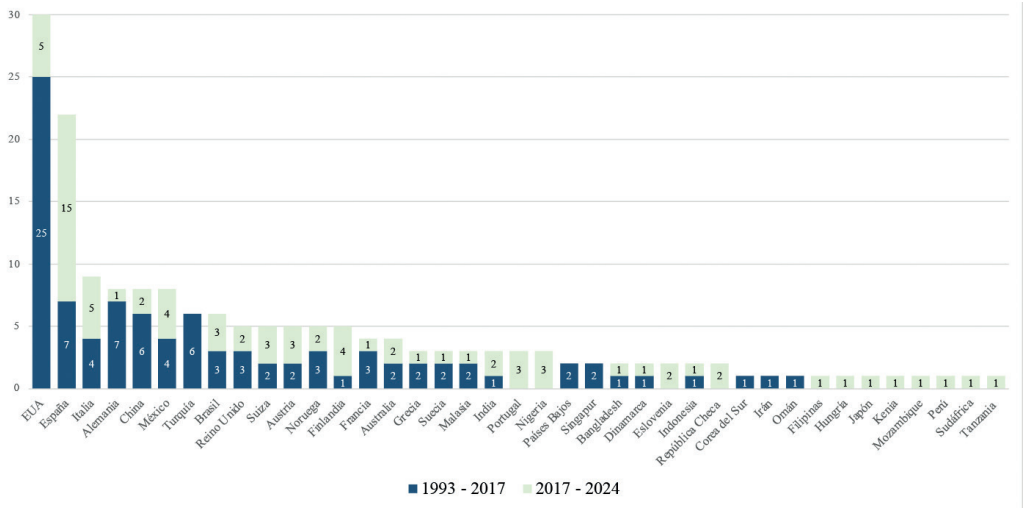
3.1.2. Overview and international scope

The addition of 12 new countries to the 27 in the previous review has been identified. Figure 3 shows that the United States is still the country that leads the most research, although its collaborations have reduced notably, going from 25 studies to five in the 2017-2024 period. In contrast, in the last 7 years, the largest number of research works (15 studies) have come from Spanish institutions, putting them at the forefront of educational research on CC. The total number of studies in Figure 3 does not match the results of the review as many of them are the product of interuniversity collaborations (Table 1).

TABLE 2. Journals and number of publications.

Journal	Articles
Sustainability	9
Environmental Education Research (EER), *Enseñanza de las Ciencias*	4
International Research in Geographical and Environmental Education (IRGEE)	3
Social Sciences, *Education Sciences*, *Revista Mexicana de Investigación Educativa*	2
Acta Chimica Slovenica; *BMC Psychiatry*; *Children's Geographies*; *Climate*; *Culture and Education*; *Current Research in Environmental Sustainability*; *Ecopsychology*; *Environmental Quality Management*; *Estudos de Psicologia*; *Frontiers in Psychology*; *International Journal of Behavioral Development*; *International Journal of Disaster Risk Reduction*; *Journal of Environmental Accounting and Management*; *International Journal of Science Education*; *Investigações em Ensino de Ciências*; *Jàmbá: Journal of Disaster Risk Studies*; *Journal of Cleaner Production*; *Journal of Environmental Psychology*; *Journal of Geography*; *Journal of People, Plants and Environment*; *Journal of Public Health and Development*; *Learning and Individual Differences*; *Opción*; *Review of International Geographical Education Online*; *Revista Complutense de Educación*; *Revista de Ciencias Sociales*; *Revista Electrónica Educare*; *Social Indicators Research*; *The Journal of Education Research*	1

FIGURE 3. Country of origin of the institutions that have researched secondary education students' comprehension of climate change.

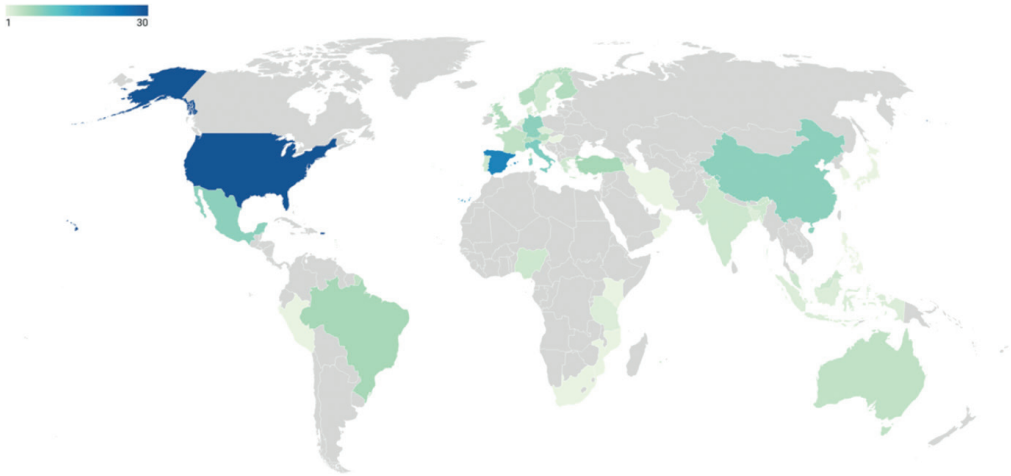


Italy also stands out in this period with 5 studies, as do Finland and Mexico, with 4 each, and Switzerland, Austria, Nigeria, Portugal, and Brazil(which leads the South America region in publications) with 3 studies. Among the newly added countries, Nigeria (the principal exponent in Africa) and Portugal, Czechia, and Slovenia, with 2 current publications each, also stand out.

So, the principal research activity is located in North America and Europe (Figure 4), which (apart from Eastern Europe) are responsible for the majority of the studies, 73.9% of the total.

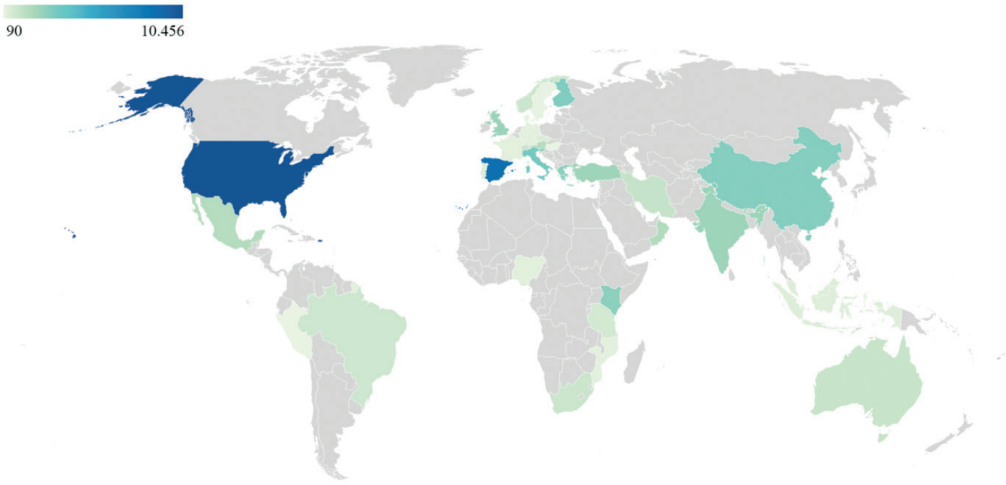
The other geographical regions are principally represented in Asia by China, India, and Turkey (9.8%) (east, south and west, respectively), while Australia, the Philippines, Indonesia, Malaysia, and Singapore produced 12 studies in south-east Asia and Australia (6.9%). The majority of the studies from Africa are from countries in the south and east such as Kenya, Tanzania, Mozambique, and South Africa, which, along with Nigeria, represent 4% of the universities that have carried out research.

Figure 4. Number of studies carried out and country of origin of the research institutions (1993–2024).



On the other hand, Figure 5 offers an overview of the international scope of the research, in this case considering the provenance of the students participating in the studies. In total, more than 56 000 students from 36 nationalities participated, with 65% of this population concentrated in North America and Europe.

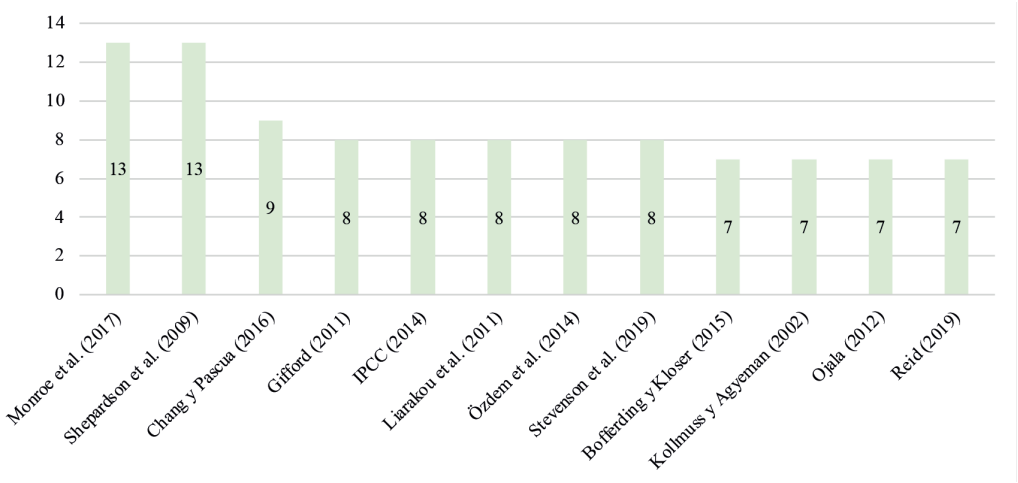
Figure 5. Secondary education students who have participated in studies on comprehension of climate change (1993-2024).



3.2. Bibliographic statistics

More than 3000 bibliographic references were counted, reflecting the trends, key documents, and schools of thought that guide this field of research. Figure 6 shows the 12 most-cited documents in the inventory of studies in this review. First place in the ranking is shared by the study by Shepardson et al. (2009) and the systematic review by Monroe et al. (2017), with 13 references each. On the one hand, the work of Shepardson et al. (2009) is a key study in the trajectory of educational research into secondary education students' comprehension of CC. On the other hand, the work by Monroe et al. (2017), which examines the literature to identify studies that describe and assess effective educational activities on CC, has had a significant impact in scientific literature in the last seven years. They are followed by the study by Chang and Pascua (2016), on the same line as the study by Shepardson et al. (2009), with 9 citations. This work by the current editor of the journal *IRGEE*, Chew-Hung Chang, shows that research

FIGURE 6. Most-cited documents in the 2017-2024 period.



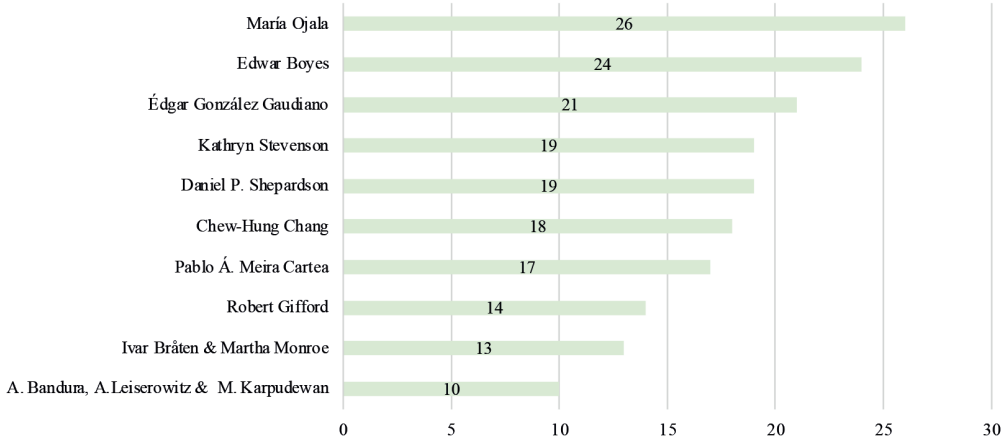
in relation to alternative conceptions of CC is still relevant, even though there is a large amount of literature on this topic.

Third place in order of citations is held by five studies with eight citations each. This group of studies represents lines of interest within the field of research. In this way, Robert Gifford (2011) is point of reference in environmental psychology with his study on the psychological barriers that hinder or impede decision making on decarbonised behaviours in everyday life. The IPCC's reports again appear as the most used documents to validate the scientific foundations of CC, in particular the report of Working Group III which is responsible for examining and assessing the possibilities of mitigation (IPCC, 2014).

On another note, the studies by Liarakou et al. (2011) and Özdem et al. (2014) follow the line of research initiated by Daniel Shepardson and Edward Boyes (García-Vinuesa & Meira-Cartea, 2019) by exploring students' comprehension or beliefs and serving as key works to establish the state of the question of other similar research works. The study by Kathryn Stevenson and her team from North Carolina State University, in the USA, stands out, suggesting a shift in the scientific community's interest in other cognitive aspects of climate action beyond the conceptual content. In this case, attention is centred on the sense of concern generated by the climate crisis as a catalyst for pro-climate actions and their possible links to the close environment of adolescents in the US (Stevenson et al., 2019).

Finally, there is another group of four studies with seven citations. One of them, aligned with the studies by Liarakou et al. (2011) and Özdem et al. (2014), focuses on comprehension of CC (Bofferding & Kloser, 2015). For their part, Kollmuss and Agyeman (2002) analyse different explanatory behavioural models to identify decisive aspects of environmental behaviours, while Maria Ojala (2012) is a reference figure with regards to the emotional dimension of CC. Finally, the article by Alan Reid, editor of EER, outlines his journal's future editorial line in relation to what he calls climate change education in a study of the possibilities and obstacles of education and research in this regard (Reid, 2019).

FIGURE 7. Most cited authors in the 2017-2024 period.



When focusing the analysis on main authors, the scenario changes. Figure 6 presents the most cited authors, considering only those authors who are listed as lead authors and excluding self-citations.

Two women stand out in this analysis of the 2017–2024 period: Maria Ojala, who appears as the most cited author, climbing eight places compared to the 1993-2017 period, and Kathryn Stevenson in fourth place with 19 citations. Both authors represent and reinforce the hypothesis of a paradigm shift in educational research, consolidating interest in the emotional dimension as an essential aspect in the search for mitigation and adaptation proposals in education. In relation to the results of the previous review by García-Vinuesa and Meira-Cartea (2019), only three authors (and their teams) are still in this ranking: Edward Boyes, Daniel Shepardson, and Anthony Leiserowitz, representing authentic well-established schools of thought in this field of research that have promoted and collaborated with a new generation of researchers under their supervision. On the other hand, the presence in this ranking of Robert Gifford and Albert Bandura highlights the importance of contributions from psychology in this educational field.

Finally, in this analysis it is worth noting the incorporation in this ranking of two significant researchers in the expansion of research in environmental education and CC in the context of Latin America and Iberian Peninsula: Édgar J. González-Gaudiano in Mexico (Universidad Veracruzana) and Pablo Á. Meira-Cartea in Spain (Universidad de Santiago de Compostela). Their contributions have served to explore the educational reality of CC in Spain and Mexico

from the framework of social representation theory and from more critical environmental education focuses, generating significant collaborations on both sides of the Atlantic.

4. Discussion and conclusions

In the era of the climate emergency, educational research's interest in CC seems to be sustained and to be opening up horizons in different aspects relating to the study of its comprehension by secondary education students.

On the one hand, with regards to geographical context, studies have been identified in 12 new countries: Slovenia, Philippines, Hungary, Japan, Kenya, Mozambique, Nigeria, Peru, Portugal, Czechia, South Africa, and Tanzania. Although no definite pattern can be established, these results underline the importance of educational research addressing the specific and contextual needs of the groups studied. The increase in the diversity of the participating student population suggests that this field values the exploration of contextualised realities, as recommended by studies and international reports (United Nations, 2015a; Monroe et al., 2017), with the aim of offering effective educational responses that are adapted to the climate emergency. This interest is also reflected in the fact that the research published over the last seven years has tripled the number of students who have participated in this type of study compared with the previous two decades (García-Vinuesa & Meira-Cartea, 2019), principally driven by the increase in quantitative studies, which represent 67% of the studies in this period compared with 46% in the 1993-2017 period, thus making it possible to access a larger population. These results represent a valuable contribution to knowledge of this group's perception of the climate emergency.

Another notable aspect relates to the focus and priorities of research into education and climate change. The analysis of the most referenced documents suggests a paradigm shift towards what we could consider to be education for the climate emergency and not for climate literacy. In this sense, the theoretical article by Reid (2019) sets out a series of recommendations directed towards both research and teaching-learning in what he calls *climate change education* in a situation of emergency. An education that should be based on ethical positions that ensure global climate justice. Under this premise, it is necessary to make the root of the causes of the problem visible from an outlook that is interdisciplinary and multidisciplinary, local and global, with social and holistic learning processes that address the uncertainty surrounding the causes and possible solutions of mitigation and adaptation. We agree with Reid (2019) that education for climate change in times of climate emergency requires integration of the values and beliefs of educators and students, considering the circumstances of their everyday lives and the influences of culture, class, gender, and personal beliefs that affect perceived risk and coping strategies. It is vital to use evidence and foster critical thinking to confront denialist ideologies and cognitive biases, and deal with difficulties understanding the huge amount of information that is held and is generated in current society. Also, strategies should be developed that promote leadership and collaboration by all of the stakeholders in the educational community, overcoming obstacles such as polarisation and scepticism, and adapting situations and proposals for action so that socioeducational policies can respond to the complex challenges of the climate emergency. This focus is also apparent in the contributions by the studies of Maria Ojala relating to the emotional dimension of the problem, or Kathryn Stevenson, on experiences and perceptions of concern, that open new horizons for a pedagogy for the climate emergency.

In conclusion, international effort from the field of educational research in relation to CC and its comprehension by adolescent students is notable, with institutions from a total of 39 countries having proposed and carried out research. We acknowledge that it is certain that other pieces of research will have been published that have not been identified in this systematic scoping review. In this analysis, the cases of countries such as Canada or Russia stand out as they have advanced research systems but are not represented in this review. This could, as we noted above, be because of linguistic limitations, but it could also be because their institutions and researchers use editorial circuits that are not connected to the selected databases.

It should be mentioned that the analyses presented have been limited by questions of scope and there are still many data to analyse in this collection that can guide future studies and proposals. Even so, the results presented, along with the work of García-Vinuesa and Meira-Cartea (2019), offer an inventory of studies that make it possible to respond to the objectives of this study and provide an overview of the characterisation of this topic, in particular over the last three decades.

With it, we seek to make a wide array of findings and evidence available to the scientific and educational community that can be useful both in research (identifying schools of thought, networks of collaboration, states of the art, trends, new horizons, etc.) and in educational policies and practices (helping to make informed decisions, suggesting new teaching and learning methodologies, recognising difficulties and opportunities, and references of interest).[1]

Authors' contributions

Marta Segade-Vázquez: Conceptualisation; Data curation; Formal analysis; Methodology; Research; Visualisation; Writing (original draft); Writing (review and editing).

Antonio García-Vinuesa: Conceptualisation; Data curation; Formal analysis; Funding acquisition; Methodology; Research; Validation; Visualisation; Writing (original draft); Writing (review and editing).

Ana Rodríguez-Groba: Conceptualisation; Project administration; Research; Supervision; Validation; Writing (review and editing).

Júlio J. Conde: Funding acquisition; Visualisation; Writing (review and editing).

Artificial Intelligence (AI) Policy

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Articles

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College English teaching in a digital environment: The experience of China

La enseñanza del inglés universitario en un entorno digital: la experiencia de China

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Abstract:

The study aims to evaluate the efficacy of mobile applications within language education, as well as to understand how this technology affects language learning outcomes and student perceptions. The research methodology rests on the development and testing of mobile technology interventions for learning English in an educational setting. The study used a mixed approach to analyze the data. This included a language proficiency test, such as the College English Test 4 (CET-4). Additionally, attitudes towards the mobile assisted environment for learning English by conducting a qualitative survey using a 5-point Likert scale were assessed. Two popular applications in China (Keke English and Lanren English) were used according to the research objectives. The study involved a sample of 190 students studying English as a foreign language (EFL) at three public colleges in China. The distribution of language proficiency levels in both the control and experimental groups showed differences in the preliminary test, while the experimental group demonstrated a slightly higher level of language proficiency. After the intervention, in the experimental group, there were significant improvements in various aspects of language proficiency. The improvement is evident in the post-test results of the experimental group, as reflected by a *t*-value of approximately 13.249. This result suggests the effectiveness of the intervention. Negative percentages (≈-50.0% and ≈-16.7%) indicate a decrease in the proportion of students with the B1 (intermediate) level after the intervention. Thus, some students managed to reach higher levels of language proficiency (B2, C1). The practical significance of the research findings lies in their potential to improve the practice of language teaching, especially in the context of English language teaching in Chinese colleges.

Keywords: educational applications, English as a foreign language, gamification, learning strategies, mobile technology.

Resumen:

El estudio tiene como objetivo evaluar la eficacia de las aplicaciones móviles en la enseñanza de idiomas, así como comprender cómo esta tecnología afecta a los resultados del aprendizaje de idiomas y a las percepciones de los alumnos. La metodología de investigación

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se basa en el desarrollo y la prueba de intervenciones de tecnología móvil para aprender inglés en un entorno educativo. El estudio utilizó un enfoque mixto para analizar los datos. Este incluyó una prueba de competencia lingüística, como el College English Test 4 (CET-4). Además, se evaluaron las actitudes ante el entorno asistido por dispositivos móviles para aprender inglés mediante la realización de una encuesta cualitativa basada en una escala Likert de 5 puntos. Se utilizaron dos aplicaciones populares en China (Keke English y Lanren English) de acuerdo con los objetivos de la investigación. El estudio involucró a una muestra de 190 alumnos que estudian inglés como lengua extranjera (EFL) en tres universidades públicas de China. La distribución de los niveles de competencia lingüística tanto en el grupo de control como en el experimental mostró diferencias en la prueba preliminar, mientras que el grupo experimental demostró un nivel de competencia lingüística ligeramente superior. Después de la intervención, en el grupo experimental, hubo mejoras significativas en varios aspectos de la competencia lingüística. La mejora es evidente en los resultados de la prueba posterior del grupo experimental, como refleja un valor *t* de aproximadamente 13.249. Este resultado sugiere la eficacia de la intervención. Los porcentajes negativos (≈-50.0 % y ≈-16.7 %) indican una disminución en la proporción de alumnos con el nivel B1 (intermedio) después de la intervención. Así, algunos alumnos lograron alcanzar niveles más altos de competencia lingüística (B2, C1). La importancia práctica de los hallazgos de la investigación radica en su potencial para mejorar la práctica de la enseñanza de idiomas, en especial en el contexto de la enseñanza del inglés en las universidades chinas.

Palabras clave: aplicaciones educativas, inglés como lengua extranjera, gamificación, estrategias de aprendizaje, tecnología móvil.

1. Introduction

Learning English as a foreign language is essential for international, political, and cultural communication, as well as for collaboration and group work in the international classroom. Mobile technologies have become more popular over the last decade and have provided an opportunity to move towards 21st-century education (Zhai & Ma, 2022). The use of mobile technology in teaching and learning English creates a new learning environment for both teachers and students.

1.1. English language education and assessment in China

Like other countries, China has made great efforts to improve the system of English language education and assessment in the past two decades. Foreign language education, generally English language education, is an obligatory course from grade three at primary school to graduate school. Besides, college English language education is obligatory for all college students and graduate students including those who are enrolled in master's courses or doctoral courses. Currently, each year at least 60 million Chinese university students are learning English and taking English examinations (Edwards, 2017). Chinese students have to take numerous tests and examinations at different levels. Besides quizzes and tests at school, they have to pass unified English examinations administered by local education committees or the National Education Examination Authority. On the whole, the goals of English language education at the higher education level are to develop students' ability to use English in their future work and social interactions and to raise their cultural awareness to meet the needs of China's social development and international exchanges.

1.2. Mobile learning environment

China's dedication to modernization and innovation in education has led to the widespread integration of digital technologies in English language teaching (Shahrol

et al., 2020). From the implementation of online learning management systems to the introduction of virtual classrooms and language learning applications, colleges in China have been using digital tools to enrich the teaching and learning experience. The covid-19 pandemic has accelerated the transition to distance teaching and learning, prompting teachers to quickly adapt to the virtual environment (Başal & Kaynak, 2020). Regardless of the results, distance learning has become the de facto method of education delivery. Thus, this crisis has stimulated innovation in the education sector (Zhao & Watterston, 2021). When colleges faced the challenges of maintaining continuity of learning during an unprecedented period of upheaval, the importance of digital literacy, resilience, and adaptability became apparent.

Digital technology refers to the use of digital systems, tools, and devices that process, store, and transmit data in electronic form (Clark-Wilson et al., 2020). The development of digital technologies and their integration into English teaching has raised concerns about their potential impact on the future of education (Romero-Hall & Jaramillo, 2023). In this scenario, teachers act as guides and coordinators. Their main task is to help students effectively navigate the vast array of online resources and educational applications to achieve their language goals. Mobile devices are the most commonly used type of technology among students in the learning process. It consists of portable two-way communications devices, computing devices and the networking technology that connects them (Bernacki et al., 2020). Currently, mobile technology is typified by internet-enabled devices like smartphones, tablets and watches. This has led to a significant increase in mobile learning in English classrooms, both in high-tech and low-tech environments, in developed and developing countries (Theodoulou & Curwood, 2023).

As students become more aware of the availability of these devices, it is likely that they will spend more time using mobile language learning resources. This includes language learning applications (for example, Duolingo), tangible resources (such as Busuu), and online classes conducted via video conferencing platforms. In the classroom, teachers can play a crucial role in encouraging students to use their devices creatively and productively. The use of images, audio, video recordings, and other media effectively facilitates the language learning process (Xu et al., 2023). However, teachers still feel uncomfortable using this technology in the classroom, even when they are familiar with the devices.

Thus, the mobile learning environment has led to a paradigm shift in education, breaking down traditional barriers and altering the dynamics of teaching and learning (Liu & Cai, 2023). No longer confined to physical classrooms, students have the freedom to access course materials, interact with teachers, and collaborate with their peers anytime, anywhere. This unprecedented level of flexibility allows students to customize their educational experience according to their needs, schedules, and preferences. These opportunities contribute to a culture of continuous learning and self-discovery (Zhang, 2024). Through the use of multimedia content, gamified learning activities, and real-time feedback mechanisms, mobile language courses engage students in dynamic and experiential learning processes, enhancing memorization and understanding. Technology not only provides a productive learning environment, but it also motivates students to learn the language and improves their learning outcomes (Girón-García & Bernad-Mechó, 2024).

1.3. Technological landscape in language education

Technology-assisted language learning has become an important issue in language education research. Researchers have examined the impact of online platforms, mobile applications, virtual reality, and other digital resources on language proficiency, engagement, and motivation (Han et al., 2021; Kurhila & Kotilainen, 2020). The ever- evolving technological landscape in language education continues to present new opportunities for research and innovation. At the same time, it poses challenges for students in Chinese colleges who require further study. Limited access to technology in certain regions of China can prevent students from utilizing online resources and language-learning tools (Su & Zou, 2022). In addition,

English-language interfaces and instructions on technology platforms may be inconvenient for students who are not proficient in English (Wong & Looi, 2024).

2. Literature review

More and more studies have addressed the use of technology in education, focusing on factors that either support or hinder the integration of mobile devices into classrooms (Bećirović et al., 2021; Jugembayeva & Murzagaliyeva, 2024). The existing literature emphasizes technocentric factors when evaluating teacher behavior. Consequently, the way teachers use mobile technologies is seen as a criterion for assessing their abilities in digital education. One of the studies found that technology enhances the motivation, efficiency, and communication frequency of language learners. It also helps to develop students' language skills, such as speaking, listening, vocabulary, and grammar. Additionally, it encourages the acquisition of metacognitive and metalinguistic knowledge, as well as provides opportunities for feedback from peers (Hockly & Dudeney, 2018). However, mobility is a challenge for any type of learning. As students access these technologies, their need for formal learning may decrease.

2.1. Mobile-assisted language learning as a widespread model

Mobile devices equipped with GPS and location sensors are ideal machines to provide assistance in specific situations. For instance, they can offer students useful phrases when they are traveling, or a medical dictionary when visiting a doctor (Zhou & Wei, 2018). Virtual and augmented reality applications and simulations are opening up more opportunities for immersive communication experiences. Although these technologies are still in their early stages of development, they are advancing at a rapid pace, suggesting that they may soon become more efficient (Godwin-Jones, 2019).

Mobile pedagogy is widely used in language teaching for distance education. Mobile-assisted language learning (MALL) involves the use of mobile devices, such as personal digital assistants and smartphones. In the past, the main reasons for the poor quality of teaching were technological limitations, such as low sound quality, unstable network connections, and the high cost of new technologies (Cakmak, 2019). However, the development of mobile technologies and user-friendly smartphones mitigates these limitations. Over time, MALL has become a popular language learning model, especially in non-English speaking countries, as it promotes convenient language learning.

Communication via voice messages and text notes allows for language interaction (García et al., 2018). Language learning becomes more dynamic and accessible through social interaction rather than being limited to specific circumstances. Due to the availability of authentic language environments, language learners can delve into the process of communication with native speakers. Modern technologies improve English teaching and learning by providing a more authentic learning experience through their ubiquitous and connected nature (Loewen et al., 2019). These benefits expand the possibilities of knowledge and content sharing, multimedia presentation, and language learning.

Recent empirical research has examined the practice of teaching English through mobile applications (Nuraeni et al., 2020). Some authors have proposed a mobile- based pedagogical system to enhance the skills of English language teachers in using mobile technologies to teach the language. However, the latest studies have shown that hybrid teaching methods have not produced the expected results and technology has weakened the role of teachers (Yang, 2020). Technocentric focus receives more scientific attention than pedagogical innovations.

2.2. Research on different CALL models

The development of educational technologies and artificial intelligence is rapid, especially in the field of intelligent computer-assisted language learning (iCALL).

Consequently, the technology of automatic speech recognition (ASR) is becoming a potential solution to some of the challenges in education (Bashori et al., 2021). ASR- based technologies and applications attract the attention of researchers and practitioners due to their numerous features. These technologies offer more opportunities for practice, consistent and objective feedback, as well as various techniques for visual presentations of educational materials.

The above features are in line with the principles of sociocultural theory and are considered to be the most significant aspects of effective classroom instruction.

Moreover, in addition to more extensive interaction in the target language and real-time feedback, ASR-based technology can also provide L2/FL students with more control over their self-learning. This creates a less threatening environment for self- study (McCrocklin, 2019). Technological advances in iCALL have opened up a range of learning opportunities, including videos with subtitles, mobile games, and virtual reality tools. Research has confirmed the positive impact of these technologies on students' vocabulary, particularly in terms of productive vocabulary learning and their self-confidence in learning. These findings could pave the way for integrating these tools into teaching English as a second language (Jiang et al., 2022).

Pedagogical beliefs have been identified as crucial factors for the success of technology integration. Nevertheless, there is a lack of studies that have incorporated pedagogical beliefs into technology adoption models. One of these studies explored the Technology Acceptance Model (TAM) by analyzing the pedagogical beliefs of English teachers at a university in China (Liu et al., 2017). In particular, the study explored how the constructivist and/or transmissive pedagogical beliefs of teachers influence four key constructs of the TAM: perceived usefulness, perceived ease of use, attitude towards use, and intention to use. The results indicated that teachers' transmissive pedagogical beliefs do not significantly affect their attitudes towards information and communication technology or their perception of its usefulness.

However, transmissive beliefs significantly influence teachers' perception of the ease of using technology. Compared to teachers of other subjects, foreign language teachers were the least inclined to use technology, and its implementation was slow and unproductive. In addition, the cultural backgrounds of language teachers, especially those who are not native speakers of the language they teach, can influence their pedagogical beliefs and practices. This, in turn, can affect their approach to integrating technology into the classroom. However, few studies have explored such effects among language teachers in the Chinese cultural environment; and even fewer researchers have focused on how the pedagogical beliefs of Chinese language teachers influence their intention to utilize the digital environment in their practice (Dağdeler et al., 2020).

Artificial intelligence technologies are an important element of the digital educational environment. Currently, the prevalence of ChatGPT and other large language models (LLM) has caused significant challenges in education, especially for English language learning in China. To address these issues, research has explored the beliefs of EFL (English as a Foreign Language) teachers from Chinese universities regarding the integration of LLM into language education (Gao et al., 2024). The study found concerns among EFL teachers at Chinese universities, including the neglect of traditional learning resources, concerns about academic integrity, and the over-reliance on technology. An analysis of data from previous studies proves that although a technological environment can potentially become a powerful educational tool, this environment requires students to regulate their learning. In other words, students must make decisions about what to study, how to study it, when to change plans and strategies, and when to increase efforts (An et al., 2020).

To create a positive learning experience, it is essential to design a suitable learning environment. This is the place where students acquire knowledge and skills. Online learners must have access to all necessary resources, such as learning outcomes and job requirements. Those attending night classes can access content both in the classroom and through mobile

technology (Tsai & Tsai, 2018). Learning environments should enhance social interaction between students and instructors through wikis, social media platforms, and blogs. This approach blurs geographical barriers, creating a collaborative learning space for individual and group interactions.

2.3. Problem statement

The study aims to evaluate the efficacy of mobile applications within language education, as well as to understand how this technology affects language learning outcomes and student perceptions. To achieve this goal, it is necessary to accomplish the following objectives:

1. Assess the level of language proficiency of students before and after participating in a mobile-assisted English language learning program.
2. Study the perception, attitudes, and experience of students regarding the use of mobile applications for learning English.
3. Explore the potential benefits of integrating mobile technologies into language education at colleges.

3. Methods and materials

3.1. Research design

The research methodology is based on the development and testing of a mobile technology intervention for learning English within the educational process. A mixed approach was used to analyze the data. Mixed approach combines elements of quantitative research and qualitative research in order to answer the research question. This study used a sequential explanatory design of mixed approach as it includes quantitative data collection and analysis, qualitative data collection and analysis, and a greater focus on quantitative data. This includes a language proficiency test for students and a qualitative evaluation of the English language learning environment.

The study lasted one academic semester (4 months). The first stage was the selection of applications and the design of an intervention program. This stage included defining learning outcomes, selecting appropriate learning materials and resources, and organizing content into sequential modules. An analysis of popular language learning apps was carried out and those that met the learning objectives and curriculum were selected. The second stage was the development of the pedagogical approach and teaching methods for the language learning intervention (the choice of educational strategies, methods and classroom activities that promote active participation, interaction and meaningful use of language among students). The second stage is largely based on the decisions and framework established in the first stage. The choice of programmes and the design of the intervention programme provide the basis on which the pedagogical approach and teaching methods can be effectively built. In the final stage, the effectiveness of the intervention was evaluated.

3.2. Mobile-assisted language learning intervention

This learning course (intervention) is designed to help college students in China improve their English proficiency through interactive mobile learning activities. The training program covers a variety of language skills, including listening, speaking, reading, and writing. The course is based on two popular applications in China (Keke English and Lanren English), which are in line with the research objectives.

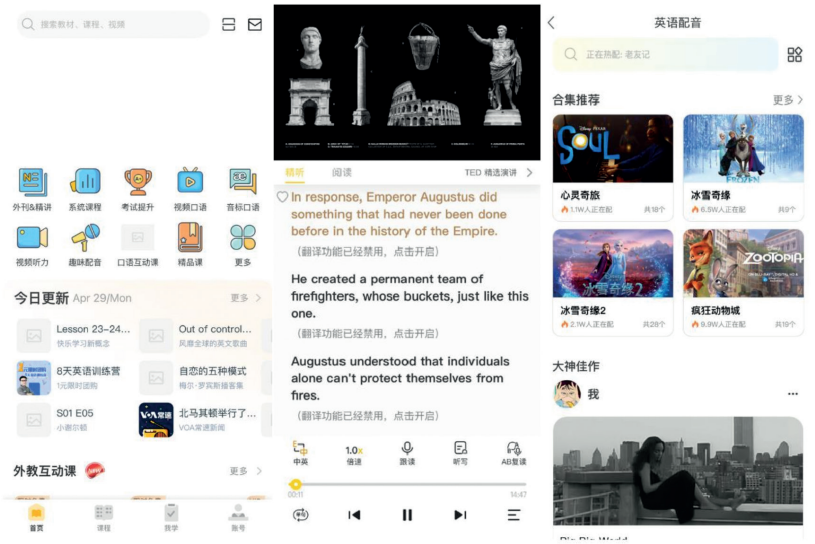
3.3. Theoretical basis

Keke English is a mobile application that provides comprehensive materials for learning English, from English books to TED talks. There has been little research on this app, but the

studies that do exist have proven its effectiveness in language learning. The theoretical basis is that this app gives learners a positive perception of vocabulary learning. Such mobile language learning has resulted in an enjoyable and innovative experience of learning and studying vocabulary through mobile apps, which can definitely increase the time and space for learners to study. Using Keke English, students can practice speaking, listening, reading, and writing in English. The application also offers online courses and other resources for many popular English language tests, such as TOEFL and IELTS (Figure 1).

Figure 1. Keke English mobile application.

Figure 2. Lanren English mobile application.



Lanren English is an application that offers a wide range of materials for learning English, such as news podcasts, English movies and songs, TED talks and books, as well as vocabulary for various English language tests. Users can also practice speaking and get reports from the application (Figure 2).

3.4. Curriculum development

The training was structured in such a way that each lesson (held twice a week) included a specific amount of time allocated to working on applications. These applications were alternated each session, and both had a structured system that allowed for organizing classes within a comprehensive course. The applications offer a variety of practice activities that can be tailored to specific classes and topics. Students can spend 15-20 minutes practicing vocabulary on an application or 20-30 minutes doing listening exercises with the other one. Within the current program, this part of the lessons lasted less than 30 minutes. The practice of self-learning by students outside of classes was encouraged, but not monitored.

3.5. Sample

The study involved a sample of 190 students studying English as a foreign language at three public colleges in China. By the third and fourth years of study, students typically reach a certain level of English proficiency. It was expected that these students would be more deeply involved in academic studies compared to first-year students. The participants were randomly selected from all the students enrolled in the third and fourth years. The lists of students were provided by the college administrations. The students received invitations to participate in the study by e-mail. Among 300 students, 190 provided responses with consent. Students who did not agree to participate were excluded from the study. Thus, the sample consisted of 190 students aged 20 to 26 years. Before the study, it was confirmed that all the included participants had at least one type of mobile device (for example, smartphone or tablet). Then, the participants were randomly divided into two groups – experimental and control. There were 95 students in each group. The educational program of the control group has not changed. The experimental group underwent English language training through a mobile-assisted learning program.

3.6. Survey

The initial level of data collection was the College English Test 4 (CET-4) (Practice Test 4). This is a standardized English proficiency test conducted in China, primarily for college students. The CET-4 evaluates the level of English proficiency of examinees in reading, listening, writing, and translation skills. CET-4 and CET-6 are equivalents to international standardized English tests, such as IELTS and TOEFL. The results of the CET-4 are presented as scores on a scale. The scaled scores range from 0 to 710 for each section (reading, listening, writing, and translation), which are combined into one the overall score. The test does not directly correspond to the specific levels of the Common European Framework of Reference for Language (CEFR). Nevertheless, the results were converted to the CEFR scale according to the following principle:

- A1 (beginner): scores below 200.
- A2 (elementary): scores from 200 to 300.
- B1 (intermediate): scores from 301 to 400.
- B2 (upper intermediate): scores from 401 to 500.
- C1 (advanced): scores from 501 to 600.
- C2 (proficient): scores above 600.

This conversion of CET-4 scores into CEFR levels increased the quality of the assessment process. Thus, language proficiency levels were accurately tested and reported in a standardized way that was specifically designed for this study. After the intervention, the test was conducted again.

Data collection for the current study also included a survey of students in the experimental group in order to assess the mobile-assisted environment for learning English. The survey was based on the scale used by the previous authors (Gao & Shen, 2021) and adapted for this study. The questionnaire consists of fifteen questions, assuming 5-point scores on the Likert scale (Appendix 1). The 5-point Likert scale is one of the most common formats. It provides a balanced range of response options while keeping the survey concise (Chan, 2016). In addition, it was used in the original questionnaire. The points are distributed as follows: (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree and (5) Strongly agree. The scale used in the questionnaire assess students' attitudes and behavior towards using mobile applications for various English language learning activities, including communication, co- education, self-study, vocabulary practice, and access to online courses. The scale also reflects students' preferences for mobile learning compared to traditional methods. The survey was conducted online in Google Forms in the final stage of the study. The participants received a link to the survey in their emails.

3.7. Statistical processing

The data obtained from the survey were calculated and analyzed using the statistical program SPSS 25. The reliability of the measures utilized in this study was tested using Cronbach's alpha. The interpretation of Cronbach's alpha internal consistency indicators is as follows: >0.9 = excellent; >0.8 = good; 0.7 = acceptable; 0.6 = questionable; and >0.5 = poor. Cronbach's alpha values were 0.88 in the pre-test and 0.90 in the post-test. This result suggests acceptable internal consistency.

To evaluate the effectiveness of the proposed model, the study involved conducting a t-test and calculating the standard deviation of the sample. These methods allowed the researchers to examine the difference in pre-test and post-test indicators for the mobile-assisted learning program. Both qualitative and quantitative data collected using these tools were verified through a detailed discussion and analysis of the results.

3.8. Research limitations

Some potential limitations of the study include the possibility of generalizing the results, as the sample may not fully represent English language learners in China.

Additionally, the availability and quality of selected language learning platforms may vary. These differences between the platforms potentially affect the effectiveness and functionality of the platforms.

3.9. Ethical issues

In this study, all the processes involving human participants were conducted in accordance with ethical research standards. Informed consent was obtained from all participants included in the study. No ethical standards were violated.

4. Results

The pre-test and post-test results revealed the level of language proficiency in the control and experimental groups (Table 1). The distribution of language proficiency levels in the control group was as follows: 4.2% of A1 (beginner), 13.1% of A2 (elementary), 60.8% of B1 (intermediate), 17.5% of B2 (Upper Intermediate), and 4.4 % of C1 (advanced). None of the participants in the control group reached the highest level of language proficiency (C2 or proficient). In the experimental group that used the mobile learning program, the distribution of language proficiency levels in the preliminary test was somewhat different. Thus, 4.4% of the participants had A1, 8.6% had A2, and 52.3% had B1. In addition, 26.0% were at the B2 level, 8.8% were at the C1 level, and none of the participants reached the C2 level.

After the intervention, both the control and experimental groups underwent a post- test to assess changes in language proficiency. In the control group, the participants showed a less noticeable improvement in their language proficiency compared to the participants in the experimental group. The post-test distribution of language proficiency levels in the control group was as follows: 4.5% of A1, 13.3% of A2, 61.0% of B1, 17.7% of B2, and 4.6 % of C1. In addition, a small percentage of participants (0.9%) achieved the highest level of proficiency (C2), which indicates some progress in language skills. Participants in the experimental group demonstrated varying degrees of improvement in language proficiency after the intervention. There were 0% of students who had A1 level, and 4.3% moved to the elementary (A2) level.

A significant proportion of students with a B2 level significantly increased (43.5%). A significant number of participants (43.5%) advanced to the B2 level, while some students (21.7%) reached C1. Moreover, 4.3% of the participants achieved the highest level of language proficiency (C2), demonstrating exceptional language proficiency.

These results suggest that the intervention had a positive effect on the participants' language skills at different levels of language proficiency.

Table 1. Pre-test and post-test results.

Language proficiency level	Control group		Experimental group	
	Pre-test	Post-test	Pre-test	Post-test
A1 (Beginner)	4.2%	4.5%	4.4%	0.0%
A2 (Elementary)	13.1%	13.3%	8.6%	4.3%
B1 (Intermediate)	60.8%	61.0%	52.3%	26.1%
B2 (Upper intermediate)	17.5%	17.7%	26.0%	43.5%
C1 (Advanced)	4.4%	4.6%	8.8%	21.7%
C2 (Proficient)	0.0%	0.9%	0.0%	4.3%

The test showed a significant improvement in the results of the experimental group. Consequently, a mobile learning intervention has proven to be more effective at improving English language proficiency than traditional learning. The standard deviation *(s)* of the sample is approximately 0.45. A *t*-value of approximately 13.249 indicates a significant difference between the pre-test and post-test scores for the mobile learning program (experimental group). In a paired *t*-test, the *t*-value measures the size of the difference relative to the variability within the sample. A larger *t*-value suggests that the observed difference is less likely to have occurred by chance. In this case, a *t*-value of 13.249 suggests that the difference between the pre-test and post-test scores is very significant and can hardly be explained by a random variation. Values such as ≈-50.0% and ≈-16.7% imply a decrease in the percentage of students with the B1 (intermediate) level after the intervention. Negative percentages indicate a decrease or reduction in the percentage of students relative to the baseline or control point (after the intervention compared to the point before the intervention). This shift in the

distribution of students according to their skill levels is linked to the transition of students to higher levels of language proficiency (B2, C1, etc.) and not to a decrease in their overall level of proficiency. Table 2 shows the distribution of students' responses on a 5-point Likert scale. These responses reflect their personal attitudes towards the mobile-assisted English language learning program.

TABLE 2. Participants' responses on the 5-point Likert scale.

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. I use mobile applications to communicate with friends in English.	5	10	20	45	15
2. I use mobile devices to discuss English with my classmates.	8	12	15	40	20
3. If I have any questions, I prefer to use mobile applications rather than asking English teachers.	10	20	25	30	10
4. When I find it difficult to pronounce English words, I use mobile applications to learn correct pronunciation.	3	7	15	40	30
5. I use mobile applications to read articles and news in English.	6	10	18	40	21
6. I use English language learning applications installed on my mobile devices to improve my English skills outside of the classroom.	2	5	10	45	33
7. I prefer to learn English using mobile applications rather than using textbooks.	5	10	20	45	15
8. I prefer to use mobile devices to learn English rather than computers.	10	15	20	40	10
9. I use mobile applications to search for synonyms and antonyms to improve my writing skills in English.	5	10	25	40	15
10. I use mobile applications to access English language test samples and evaluate my learning progress.	8	12	20	40	15

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
11. I rely on the help of mobile applications in learning English.	5	10	15	45	20
12. I use mobile applications to find online English language courses.	5	8	18	40	24
13. I share English language learning materials with my classmates through mobile applications.	10	15	20	40	10
14. After classes, I watch videos on learning English in mobile applications.	8	12	20	40	15
15. I prefer mobile-assisted English language classes to traditional classroom activities.	5	10	20	45	15

The results of the Likert ratings for the intervention gives an idea of the perceived benefits and experience of students in the program. The majority of students (45-50%) agree or completely agree with statements indicating their preference for using mobile applications for various English language activities. This shows a clear propensity for mobile learning methods compared to traditional approaches. A significant number of students (40-45%) noted that they use mobile apps for a wide range of English language learning activities, including communication, learning vocabulary, reading articles, accessing educational materials, and watching videos. Therefore, mobile applications can be comprehensive and effective educational tools. Additionally, many students (35-45%) expressed confidence in the effectiveness and reliability of mobile applications for language learning purposes. This fact suggests a positive perception of mobile applications as valuable tools for improving English language proficiency. To quantify this data, the average score for each item on the Likert scale was calculated (Table 3).

Table 3. Average scores for each item on the Likert scale.

Elemento	Puntuación media
1. I use mobile applications to communicate with friends in English.	≈ 2.42
2. I use mobile devices to discuss English with my classmates.	≈ 2.45
3. If I have any questions. I prefer to use mobile applications rather than asking English teachers.	≈ 2.89

4. When I find it difficult to pronounce English words. I use mobile applications to learn correct pronunciation.	≈ 3.47
5. I use mobile applications to read articles and news in English.	≈ 3.58
6. I use English language learning applications installed on my mobile devices to improve my English skills outside of the classroom.	≈ 3.76
7. I prefer to learn English using mobile applications rather than using textbooks.	≈ 3.86
8. I prefer to use mobile devices to learn English rather than computers.	≈ 3.42
9. I use mobile applications to search for synonyms and antonyms to improve my writing skills in English.	≈ 3.47
10. I use mobile applications to access English language test samples and evaluate my learning progress.	≈ 3.37
11. I rely on the help of mobile applications in learning English.	≈ 3.74
12. I use mobile applications to find online English language courses.	≈ 3.73
13. I share English language learning materials with my classmates through mobile applications.	≈ 3.45
14. After classes. I watch videos on learning English in mobile applications.	≈ 3.45
15. I prefer mobile-assisted English language classes to traditional classroom activities.	≈ 3.86

In general, the data indicate that students see mobile applications as useful and effective tools for learning English. Participants clearly preferred mobile teaching methods over traditional approaches to learning. These results highlight the importance of integrating technology into language instruction to enhance engagement, accessibility, and effectiveness in the context of language learning. Statements 6, 7, 11, 12 and 15 received the highest average

scores, indicating strong agreement among students regarding their preferences for using mobile applications for various English learning activities. The students expressed confidence in the efficacy of mobile applications for achieving language learning goals.

5. Discussion

The results of the study demonstrated a significant improvement in the level of language proficiency in both the control and experimental groups. The control group showed slightly less significant progress compared to the experimental group, which used a mobile learning program. The students in the experimental group had varying levels of improvement at different skill levels. For instance, 4.3% of the participants moved to the elementary (A2) level. There was a considerable increase in the proportion of students with B2 (43.5%). A large number of the students (43.5%) advanced to the B2 level, showing a high level of language proficiency. A significant part of the participants (21.7%) reached C1, while 4.3% of the participants managed to achieve the exceptional level of language proficiency (C2).

Stakeholders involved in teaching English language should inform content and mobile software developers about the potential of smartphones in solving problems related to language learning and educational applications (Kacetl & Klímová, 2019). By collaborating with developers, stakeholders can help create more learning-friendly mobile applications that make vocabulary learning easier for language learners and are suitable for learning activities (Rosell-Aguilar, 2018). Thus, this scientific work was aimed at filling this gap and identifying the benefits of mobile-assisted learning.

Compared to the traditional approach to learning, digital learning tools can lead to better achievements among students without technical knowledge. It can be assumed that students were more interested in the interactive content of the course and digital educational resources. Students showed a lower inclination to use mobile apps for communication, with average scores of approximately 2.42 for communicating with friends and 2.45 for discussing English with classmates. Their preference for mobile applications over asking teachers when they have questions also registered a moderate score of around 2.89.

Another study examines the problems of language teachers related to open distance learning in higher education institutions (Jie & Sunze, 2023). University professors participated in semi-structured interviews and expressed their opinions on how mobile technologies affect the processes of teaching and learning in higher education institutions. In particular, four topics related to the teaching of English in the context of mobile technologies were discussed: technological mediation, progressive pedagogy, English language teaching, and learning flexibility (Kusmaryani et al., 2019). The findings revealed that mobile technologies and pedagogical innovations are not a problem for teachers. Instead, the challenges include psychological anxiety, expanded teaching roles, and learning flexibility. Based on the above results, the authors proposed a theoretical basis for digital education and a learning model for digital language media. The current study also presented an intervention model based on mobile-assisted language learning. Although the opinions of the teachers were not collected, an analysis of the responses on the Likert scale showed that most students prefer to use mobile applications for various English language activities. For instance, they reported an average score of 3.47 for using apps to improve pronunciation, while reading articles and news in English, scored higher at 3.58. This result indicates a strong propensity for mobile-assisted learning methods.

A similar article reports on the results regarding learning strategies used by a group of Chinese EFL learners in a mobile technology environment (Gao & Shen, 2021). According to the findings, the mobile technology environment changed the way Chinese EFL students adopted a specific set of learning strategies. These strategies differed in type

and frequency from those typical of teacher-led and exam-oriented language classes. The data from our study indicates a strong preference for mobile- assisted English language classes over traditional classroom activities, with an average score of 3.86. This preference highlights a growing acceptance of modern, technology- driven approaches to language education.

Other studies have argued that digital gamification is an entertaining and enjoyable method to support learning English as a second language. This method can effectively reduce the gap between learning and educational practice (Dehghanzadeh et al., 2021). The use of applications and gamification is considered one of the most well-known teaching methods to motivate students and increase their engagement in the learning process. The reason is that various elements (both dynamics and mechanics) provided by a gamified environment boost motivation and interest in learning English (Ishaq et al., 2021). Another study confirms the results of the current experiment using the example of one of the most popular language learning applications on the market: Busuu (Shibata, 2020). The data was collected through an online questionnaire, similar to the one used in the current study. The results show patterns of usage and which features students consider to be most valuable for learning a language. The high expectations of users and the fact that one third of respondents use Busuu as their only source of learning suggest that a significant number of users view applications as a reliable tool for learning languages. These findings are consistent with those obtained from the analysis of other popular applications in China (Keke English and Lanren English).

6. Conclusions

The study highlighted the importance of integrating mobile technology into language education to improve learning experiences, engagement, and overall language proficiency. This approach provides a modern and interactive way of learning, allowing students to practice and enhance their language skills outside the classroom. The results of the study demonstrated a significant improvement in the level of language proficiency in both the control and experimental groups. The control group showed slightly less significant progress compared to the experimental group, which used a mobile learning program. The students in the experimental group had varying levels of improvement at different skill levels. For instance, 4.3% of the participants moved to the elementary (A2) level. There was a considerable increase in the proportion of students with B2 (43.5%), showing a high level of language proficiency. A significant part of the participants (21.7%) reached C1, while 4.3% of the participants managed to achieve the exceptional level of language proficiency (C2). In this study, the participants also shared their opinions on a mobile-assisted environment for learning English using a questionnaire on the Likert scale. The analysis of their responses revealed that the students prefer to use mobile applications for various English language classes, which indicates a strong propensity for mobile learning methods. The students expressed confidence in the effectiveness and reliability of mobile applications for language learning, emphasizing the obvious advantages of introducing technology into language education. The calculated average scores for each item on the Likert scale once again confirmed the positive perception of mobile applications as valuable tools for learning English. The students reported using mobile applications for a wide range of activities, including communication, vocabulary improvement, reading, and access to educational materials. These findings highlight the usefulness of mobile applications in improving English language proficiency.

This study has implications for understanding and designing mobile technology learning for EFL students in order to develop effective strategies for improving their learning experience. The findings could form the basis for initiatives that aim to support the professional development of language teachers. These initiatives could help educators implement innovative pedagogical approaches and effectively integrate technology into their teaching practice. Future research may focus on the problem of developing digital literacy skills and student independence.

Author's contributions

Ke Li: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Writing (original draft); Writing (review and editing).

Artificial Intelligence (AI) Policy

The authors do not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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Appendix 1

The survey to assess the attitudes towards the mobile-assisted environment for learning English among students in the experimental group

1. I use mobile applications to communicate with friends in English.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

2. I use mobile devices to discuss English with my classmates.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

3. If I have any questions, I prefer to use mobile applications rather than asking English teachers.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

4. When I find it difficult to pronounce English words, I use mobile applications to learn correct pronunciation.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

5. I use mobile applications to read articles and news in English.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

6. I use English language learning applications installed on my mobile devices to improve my English skills outside of the classroom.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

7. I prefer to learn English using mobile applications rather than using textbooks.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

8. I prefer to use mobile devices to learn English rather than computers.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

9. I use mobile applications to search for synonyms and antonyms to improve my writing skills in English.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

10. I use mobile applications to access English language test samples and evaluate my learning progress.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

11. I rely on the help of mobile applications in learning English.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

12. I use mobile applications to find online English language courses.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

13. I share English language learning materials with my classmates through mobile applications.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

14. After classes, I watch videos on learning English in mobile applications.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

15. I prefer mobile-assisted English language classes to traditional classroom activities.
    1. Strongly disagree
    2. Disagree
    3. Neutral
    4. Agree
    5. Strongly agree

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PISA 2022: The impact of school-environment predictors on the performance of Spanish students

PISA 2022. El impacto de los predictores relacionados con el entorno escolar sobre el rendimiento del alumnado español

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Abstract:

The impact of school environment on academic performance has become more important over recent years. However, there are no specific studies of the impact of school environment variables on the performance of secondary school students in the PISA domains of science, reading and mathematics. This article aims to analyse the influence of a set of predictors relating to the school environment (climate, well-being, and bullying) on student performance in all three PISA domains. The sample comprises 28781 Spanish students (14459 male students, 50.24%; 14322 female students, 49.76%) from 935 schools, who participated in PISA 2022. A two-level hierarchical linear model was used: students and schools. The results show that male students score higher than female students in mathematics and science, while female students score higher in reading. Male students have a more favourable opinion of school well-being than female students. Students' economic status is a strong predictor of performance in all three PISA domains. School climate, school well-being, and bullying have more impact on performance in mathematics and science than in reading. Students in private schools perform better than those in public schools. The results of the final models explain more than 21% of the differences between students in performance in the three areas and more than 50% between schools. These findings suggest a need to create an environment that promotes student learning, reinforce students' sense of belonging to the school, and implement anti-bullying measures in schools.

Keywords: bullying, school well-being, school climate, gender differences, economic status, achievement, PISA, multilevel model.

Resumen:

En los últimos años, ha cobrado relevancia el impacto del entorno escolar sobre el rendimiento académico. Sin embargo, no existen estudios específicos sobre el impacto de las variables relacionadas con el entorno escolar sobre el rendimiento del alumnado de educación secundaria en las áreas de PISA: ciencias, lectura y matemáticas. Este artículo

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pretende analizar la influencia de un conjunto de predictores relacionados con el entorno escolar (el clima, el bienestar y el *bullying*) sobre el rendimiento del alumnado en las tres áreas de PISA. La muestra está formada por 28 781 estudiantes españoles (14 459 estudiantes de género masculino, 50.24 %; 14 322 estudiantes de género femenino, 49.76 %) procedentes de 935 centros educativos, quienes han participado en PISA 2022. Se ha utilizado un modelo jerárquico lineal de dos niveles: estudiantes y centros. Los resultados muestran que el alumnado de género masculino obtiene más puntos que el alumnado de género femenino en matemáticas y ciencias, mientras que el alumnado de género femenino destaca en lectura. El alumnado de género masculino tiene una opinión más favorable hacia el bienestar escolar que el alumnado de género femenino. El entorno económico del alumnado es un fuerte predictor del rendimiento en las tres áreas de PISA. El clima de aula, el bienestar escolar y el *bullying* tienen más impacto en el rendimiento en matemáticas y ciencias que en lectura. Los estudiantes de centros privados obtienen mejor rendimiento que los de centros públicos. Los resultados de los modelos definitivos explican más del 21 % de las diferencias de rendimiento en las tres áreas entre los estudiantes y más del 50 % entre centros educativos. Estos resultados sugieren la necesidad de crear un entorno que promueva el aprendizaje de los estudiantes, de reforzar el sentido de pertenencia del alumnado al centro y de implementar medidas en los centros educativos contra el acoso escolar.

Palabras clave: acoso escolar, bienestar escolar, clima de aula, diferencias de género, entorno económico, rendimiento, PISA, modelo multinivel.

1. Introduction

The Programme for International Student Assessment (PISA) assesses the competences of students aged 15-16 who are completing Obligatory Secondary Education (OSE) in three core areas (science, reading, and mathematics). Such competences represent the knowledge they should have so they can face situations in the academic, work, and personal worlds (Ministerio de Educación, Formación Profesional y Deportes, 2023).

The study by Huang et al. (2024) aims to understand the relationship between these predictors and the school environment (school climate, school well-being, and bullying) in the PISA 2018 study. The results show that school climate and school well-being both reduce the effects of bullying on academic performance. This specific study lays the foundations for an in-depth examination of the influence of predictors relating to school environment on performance in the core areas of PISA: gender, economic status, the school climate, school well-being, bullying, and school ownership.

1.1. Theoretical framework

Regarding the first predictor, students' gender, research has found significant differences in performance in the three areas of PISA. The work by Torppa et al. (2018) analyses gender differences in Finnish students who participated in PISA. The results reveal that female students score higher than male students in reading, as they display a more positive attitude towards reading. The work by Manu et al. (2023) shows that parents' economic status affects boys' reading performance more than that of girls. The work by Eriksson et al. (2020) analyses differences in performance by gender in the editions of PISA between 2000 and 2015. The results indicate that male students perform lower than female students in reading, while performing higher than them in mathematics and science. In this respect, the work by Stoet and Geary (2022) finds that this difference is because boys' professional aspirations are oriented towards the sphere of mathematics and science more than those of girls, owing to the gender stereotypes associated with careers in the STEM field (science, technology, engineering, and

mathematics) (Bottazzi & Lusardi, 2021). The work by Sortkaer and Reimer (2018) explains that the gender differences in the PISA 2012 study are because of a correlation between school well-being and performance, that is stronger in male students than in female ones.

With regards to the second predictor, economic status, research has shown its impact on students' academic performance (Xie & Ma, 2019). The work by Eriksson et al. (2022) notes the influence of context on the performance of students participating in the 2018 edition of PISA, so that in the societies with the widest performance gap, the ESCS (index of economic, social, and cultural status) represents 31% of the variance in mathematics and science and 29% in reading. Accordingly, economic status explains the difference in performance between students who are located in the top and bottom quartiles that PISA establishes (Hanushek et al., 2022). The work by Yeung et al. (2022) finds that economic status is a strong predictor of student performance, as parents' educational level influences their children's academic expectations (Gamazo & Martínez-Abad, 2020). The work by Kang and Cogan (2020) finds that students with a low economic status have fewer learning resources in the home, which results in them facing greater difficulties than students with a high status when applying their knowledge to problem solving.

In connection with the third predictor, school climate, this can be defined as surroundings that foster learning based on the quality of relations between students and teachers (Ministerio de Educación, Formación Profesional y Deportes, 2023). Research has shown the impact of a positive school climate on student performance (Izaguirre et al., 2023; Ramazan et al., 2023). The work by Gómez and Suárez (2020) points out that school climate is a variable that influences the performance of students who participated in the 2015 edition of PISA, underlining the importance of the relationship between teachers and students to promote learning (Zysberg & Schwabsky, 2021), as well as the opinion of students on teaching quality (Rohatgi & Scherer, 2020). The work by Teng (2020) reveals that school climate has a more significant influence on the performance of students with a low economic status than on those with a high economic status, underlining the impact of school climate when reducing the gap in performance by economic status (Trinidad, 2020). Several studies find significant differences in favour of female students in perception of the school climate by gender (Alshammari et al., 2022; González-Moreno & Molero, 2023).

In relation to the fourth predictor, school well-being, this can be understood as the conditions that foster students' sense of belonging to the school and promote their integral development in the physical, psychological, and social dimensions (Ministerio de Educación, Formación Profesional y Deportes, 2023). Research shows its impact on student performance, with a more positive attitude towards learning among students who have a sense of belonging to the school (Burns et al., 2020; Haw & King, 2023; Tan et al., 2022). The work by Kiuru et al. (2020) finds that school well-being affects students' academic performance. This is explained by the sense of integration and good relations with their peers in the school (Craggs & Kelly, 2018; Korpershoek et al., 2020). In this sense, the work by Arslan (2021) reflects that students with a higher school well-being index display a lower level of bullying and better academic performance. Various studies find significant differences in favour of female students in school well-being by gender (Hernández et al., 2017; Jiang et al., 2024).

The fifth predictor, bullying, can be defined as a type of behaviour in which a person or group of people deliberately and repeatedly causes harm to and upsets another. Bullying can be physical (hitting), verbal (insults), and relational (spreading lies) (Ministerio de Educación, Formación Profesional y Deportes, 2023). Research shows the negative influence of bullying on students' academic performance (Karakus et al., 2022; Molina-Muñoz et al., 2023; Ozyldirim & Karadağ, 2024), owing to worse school well-being (González-Gallardo et al., 2021; Murphy et al., 2022). Giménez et al. (2024) reveal that bullying had a negative influence on performance in science, reading, and mathematics in the 2018 edition of PISA, with a particular impact on male students' scores in mathematics. Various studies find significant differences in bullying by gender, with female students experiencing more bullying than male students, which has a stronger effect on reducing the academic performance of girls than that of boys (Riffle et al., 2021; Zhou et al., 2024).

With regards to the sixth predictor, ownership of the school, the study by Aparicio et al. (2017) points out that students from private schools perform better than ones from public schools, owing to the effect on performance of the economic status of the students who attend a given school (Le Donné, 2014). However, other studies (Larsen et al., 2023; Pivovarova & Powers, 2019) conclude that, after adjusting for economic status, students being educated in public or private schools does not explain differences in their performance.

The literature review underlines the need to progress in knowledge of the influence of the cited predictors on the three core areas of PISA (science, reading, and mathematics). There are four reasons that justify this research. Firstly, it uses a solid sample that is representative at a national level in the in the PISA 2022 study. Secondly, it uses a multilevel model with 2 levels (students and schools) in Spain. Thirdly, it includes both the influence and the effect size of the three variables relating to school environment that have the most impact on the areas of PISA, namely, school climate, school well-being, and bullying. Fourthly, this work provides political leaders with knowledge of the variables relating to the school environment that have the biggest influence on student performance so that they can take measures to improve performance in science, reading, and mathematics at the level of educational policy; and it provides teachers with knowledge of didactic actions that strengthen the school climate and school well-being.

Therefore, the first objective of this work is to identify significant differences by gender in the variables relating to the school environment. Drawing on this objective, the following hypotheses are proposed:

- Hypothesis 1. There are significant gender differences in perception of the school climate.
- Hypothesis 2. There are significant gender differences in school well-being.
- Hypothesis 3. There are significant gender differences in bullying.

The second objective is to analyse the influence of a set of predictors on school environment in performance in science, reading, and mathematics by the Spanish students who participated in PISA 2022. From this objective, the following hypotheses are proposed:

- Hypothesis 4. Students' gender is a significant predictor of performance in the three core areas of PISA.
- Hypothesis 5. Economic status predicts student performance.
- Hypothesis 6. School climate has a significant effect on performance.
- Hypothesis 7. School well-being has a significant effect on performance.
- Hypothesis 8. Bullying has a significant effect on performance.
- Hypothesis 9. The ownership of the school predicts the performance of the students.

2. Method

2.1. Research design

This research is a non-experimental *ex post facto* investigation. There is no direct control of independent variables and participants cannot be assigned at random to the experimental groups as the phenomenon has already happened (Kerlinger & Lee, 2002).

2.2. Participants

In the 2022 edition of PISA, 30 800 Spanish students aged between 15 and 16 years participated (15 561 male students, 50.52%; 15 239 female students, 49.48%) from 966 schools.

The majority were in the 4th year of OSE (Obligatory Secondary Education) (Ministerio de Educación, Formación Profesional y Deportes, 2023).

The sample was selected through multi-stage sampling with a 95% confidence interval and a 5% sampling error (OECD, 2023). In the first stage, the schools in each autonomous region that 15-year-old students could be enrolled in were sampled, taking into account the ownership of the schools. These schools were systematically sampled with selection likelihoods in proportion with the estimated size of the population of 15-year-olds. In the second stage, back-up schools for each sampled school were identified in case a school decided not to participate in PISA.

In the third stage, samples of the students were taken within the schools included in the sample. Once the schools had been selected, a list of students aged 15 years in each school in the sample was prepared.

In the fourth stage, based on this list, 42 students were selected at random, a target figure established by the OECD for all of the countries that participated in the PISA study.

The real sample comprises 28781 Spanish students (14459 male students, 50.24%; 14322 female students, 49.76%), from de 935 schools (63.2% public, 36.8% private). In the configuration of the final sample, 2019 students were excluded as they did not report complete information for all of the variables.

Table 1. Details of the PISA 2022 sample in Spain.

Autonomous region / Autonomous city	***n***	**Schools**
Andalusia	1610	51
Aragon	1359	44
Asturias	1560	49
Cantabria	1646	52
Castile-La Mancha	1453	51
Castile and León	1687	54
Catalonia	1501	50
Extremadura	1655	54
Galicia	1715	57
Balearic Islands	1492	51
Canary Islands	1419	52
La Rioja	1361	47
Madrid	1726	52
Murcia	1605	52
Navarra	1741	52
Basque Country	3115	94
Valencia	1532	51
Ceuta	345	12
Melilla	259	10
Spain	28781	935

2.3. Tools

This study analyses variables included in the following instruments of the PISA 2022 study (Ministerio de Educación, Formación Profesional y Deportes, 2023):

- **The student questionnaire.** This gathers information about the family, school, and academic environments, as well as specific aspects about anxiety and self-efficacy in mathematics. Its Cronbach's alpha coefficient is .81, which indicates a good level of internal consistency of the items (Hernández-Sampieri & Mendoza, 2018). The following variables from this questionnaire have been taken into account (Ministerio de Educación, Formación Profesional y Deportes, 2023):
  - **Gender.** Dummy variable. (0 = male, 1= female).
  - **Economic status.** Normalised variable. This score is given by the number of books at home (0 = 0-10 books, 1 = 11–25 books, 2 = 26-100 books, 3 = 101-200 books, 4 = 201-500 books, 5 = more than 500 books).
  - **School climate.** Normalised variable. This is an index created from the students' opinions on a set of six items (0 = strongly disagree, 1 = disagree, 2 = agree, 3 = strongly agree).
    - The teachers at my school are respectful towards me (mean = 2.85).
    - If I walked into my classes upset, my teachers would be concerned about me (2.42).
    - If I came back to visit my school three years from now, my teachers would be excited to see me (2.01).
    - When my teachers ask how I am doing, they are really interested in my answer (2.31).
    - The teachers at my school are friendly towards me (2.24).
    - The teachers at my school are interested in students' well-being (2.89).

  The mean of these items is combined to create the school climate index.

  - **School well-being.** Normalised variable. This index is created from students' answers to six items (0 = strongly disagree, 1 = disagree, 2 = agree, 3 = strongly agree).
    - I make friends easily at school (1.61).
    - I feel like I belong at school (2.99).
    - Other students seem to like me (2.17.)
    - I feel like an outsider (or left out of things) at school (1.75).
    - I feel awkward and out of place in my school (2.07).
    - I feel lonely at school (1.61).

  The mean of these items is combined to create the school well-being index.

  - **Bullying.** Normalised variable. This index is created from the frequency with which students experienced some type of bullying during the 12 months prior to the test, reflected in a set of nine items (0 = never or almost never, 1 = a few times a year, 2 = a few times a month, 3 = once a week or more).
    - Other students left me out of things on purpose (1.21).
    - Other students made fun of me (1.40).
    - I was threatened by other students (1.12).
    - Other students took away or destroyed things that belonged to me (1.23).
    - I got hit or pushed around by other students (1.14).
    - Other students spread nasty rumours about me (1.28).
    - I was in a physical fight on school property (1.13).

- I stayed home from school because I felt unsafe (1.17).
- I gave money to someone at school because they threatened me (1.03).

The mean of these items is combined to create the bullying index.

The reliability and validity of the *economic status* (Cronbach's alpha = .79), *school climate* (Cronbach's alpha = .81; McDonald's omega =.82), *school well-being* (Cronbach's alpha = .85; McDonald's omega = .86), and *bullying* (Cronbach's alpha = .77; McDonald's omega = .78) variables show good levels of internal consistency for the items. These items derive from a process that is divided into three stages.

First, a group of experts in mathematics in each country apply the questionnaire to a sample of 100 students in a small-scale validation test, identifying items that have a negative score and do not measure the aspects they set out to measure. Secondly, modifications and linguistic revisions are made to the items to ensure a translation that is adapted to each country. Finally, a field study is carried out to validate the constructs and measurements before the principal test. The aim is to identify the items from the test that show insufficient validity and reliability of scoring before the large-scale application (OECD, 2023).

- **The school questionnaire.** Directed at the management team, this collects information about the administrative and didactic organisation of the schools and the learning environments. Its Cronbach's alpha coefficient is .90, which indicates an excellent level of internal consistency of the items (Hernández-Sampieri & Mendoza, 2018). From this questionnaire, we have taken into account ownership [dummy variable (0 = public, 1 = private)].

TABLE 2. Description of the variables.

Variable	Type of variable	Response options
Gender	Nominal	0 = male 1 = female
Economic status	Scale	Normalised variable
School climate	Scale	0 = strongly disagree 1 = disagree 2 = agree 3 = strongly agree
School well-being	Scale	0 = strongly disagree 1 = disagree 2 = agree 3 = strongly agree
Bullying	Scale	0 = never or almost never 1 = a few times a year 2 = a few times a month 3 = once a week or more
Ownership of school	Nominal	0 = public 1 = private

2.4. Data analysis

The points that the students have scored in the three central areas [science, reading, and mathematics (dependent variables)] are obtained by means of the Rasch model and are reported through scales, with a mean score of 500 points and a standard deviation of 100 (OECD, 2023).

To calculate students' performance in each area, independent estimates were carried out for each of the ten plausible values and the mean of the scores was calculated (Wu & Adams, 2002).

The PISA 2022 database provides ten plausible values that PISA assigns to each student. In the area of science, the ten plausible values are 492.92, 490.91, 491.22, 490.06, 490.22, 492.09, 491.16, 491.89, 491.29, and 489.62; in the area of reading, 480.96, 481.06, 482.07, 480.66, 480.07, 481.46, 479.41, 480.73, 480.62, and 481.60; and in the area of mathematics, 480.9, 482.16, 481.82, 482.46, 482.12, 480.82, 482.75, 482.14, 481.34, and 481.98.

This study used a linear hierarchical model in which the influence of a set of predictors on the dependent variables is analysed at two levels: students and schools (Tourón et al., 2023).

The MLwiN 2.36 program was used for data analysis, enabling the estimates to be calculated by the iterative generalised least squares (IGLS) procedure (Goldstein, 2003).

3. Results

The results of Student's *t*-test show significant differences (sig. <.001) in school climate (male students = .15 points; female students = .22 points), school well-being (male students = .42 points; female students = .17 points), and bullying (male students = -.44 points; female students = .40 points). To measure the effect size, the eta-squared coefficient was calculated (Cohen, 1998), which makes it possible to obtain an estimate of the shared variance between each effect and the dependent variable (Tourón et al., 2023), so that three effect sizes are differentiated: small ($p \geq .01$), medium ($p \geq .06$), and large ($p \geq .14$). The results show that school climate has a large effect on performance in science ($p = .24$) and mathematics ($p = .28$), and a medium one on reading ($p = .068$), as well as a large effect of school well-being on performance in science ($p = .21$) and mathematics ($p = .26$), and a medium one on reading ($p = .061$). Likewise, the results indicate a large effect of bullying in all three areas: science ($p = .19$), mathematics ($p = .23$), and reading ($p = .16$) (Tourón et al., 2023).

The modelling process starts by formulating the null model, which does not have predictor variables and so has no explanatory power, but this is essential as it establishes the base line and provides information about the initial variance in the two levels (Tourón et al., 2023).

3.1. Performance in science

Table 3 shows the results of the null model. The fixed parameter indicates the value of the intercept or the mean performance in science for the students who make up the sample.

Table 3. Estimate of the null model for performance in science.

Fixed part	
Parameter	**Estimate (standard error)**
Constant	489.66 (5.12)
Random part (variance in science performance)	
Level 1. Learners	5870.75 (48.05)
Level 2. School	1002.68 (54.82)
-2 restricted likelihood log	356 444.11
Akaike information criterion (AIC)	356 448.11
Schwarz Bayesian criterion (BIC)	356 460.229
Number of parameters	3

The criterion used to establish whether a parameter is significant is that, when working with $\alpha = 0.05$, the quotient between the estimate of the parameter and its standard error is greater than 1.96 (Gaviria & Castro, 2004).

The data in Table 3 show that the mean performance in science is 489.66 points for all students. These data differ from one another at the level of students (5870.75 / 48.05 = 122.18) and of schools (1002.68 / 54.82 = 18.29).

These parameters are greater than 1.96, and so they are significant and indicate the existence of unexplained variance between students and between schools, which justifies calculating the definitive model to explain the greatest possible amount of variance. The likelihood ratio has a value of 356 444.11 for a null model with three parameters, which is compared with the definitive model.

Based on the data from Table 3, the ICC is calculated, which has a value of .1458; this means that 14% of the variance is variance between centres.

ICC = 1002.68 / (5870.75 + 1002.68) = .1458

This value indicates the proportion of the level 2 variance (schools) in the total variance, that is to say, the variance not explained by the predictors that is attributed to the grouping variable in level 2.

Table 4. Definitive model of performance in science.

Fixed part	
Constant	520.81 (3.82)
Gender	-9.17 (.86)
Economic status of the students	12.58 (.97)
School climate	5.62 (.74)
School well-being	2.35 (.53)
Bullying	-8.07 (.45)
Ownership	10.66 (.37)
Random part	
Between students	4531.88 (34.53)
Between schools	484.81 (28.02)
-2 restricted likelihood log	207 563.12
Akaike information criterion (AIC)	207 567.12
Schwarz Bayesian criterion (BIC)	207 579.08
Number of parameters	9

Table 4 displays the results of the fixed part and the random part of the definitive model.

According to the data in Table 4, the value of the constant is 520.81 points, which corresponds with the mean performance in science for male students of average economic status.

The explanatory variables of the random part are significant in performance in science.

Female students' performance is -9.17 points lower, which explains the gender gap in science in favour of male students

Students' economic status is significant in performance in science. For each point increase in students' economic status, their performance increases by 12.58 points.

The school climate is a significant predictor of performance in science. For each point increase in the quality of relations between students and teachers, performance increases by 5.62 points.

School well-being has an impact on performance. For each point increase in students' school well-being, their performance increases by 2.35 points.

Bullying has a negative influence on performance. For each point increase in the frequency with which students suffer bullying, their performance falls by -8.07 points.

Ownership of the school is a significant predictor of performance in science. Being enrolled in a private school results in students' performance increasing by 10.66 points compared with a public school.

To establish the goodness of fit, the value of the -2 restricted likelihood log from the null model is compared with the definitive model.

The results show a difference of chi-squared of 148 880.99 with six degrees of freedom which is significant at .01; this confirms the better fit of the definitive model compared with the null model. The results indicate that both the Akaike information criterion (AIC) and the Bayesian criterion (BIC) of the definitive model also reduce with regards to the null model, so that the goodness of fit of the definitive model improves.

The R^2 coefficient expresses the proportion of variance of the dependent variable hat can be explained by the predictors included in the definitive model, after having compared the random parameters of this model with those of the null model (Snijders & Bosker, 2012). The predictors of the definitive model explain 23% of the differences in performance in science between the students (R^2 = .227) and 52% of the variability between schools (R^2 = .5164).

Table 5. Estimation of the null model of reading performance.

Fixed part	
Parameter	**Estimate (standard error)**
Constant	469.19 (4.22)
Random part (variance in reading performance)	
Level 1. Learners	6267.60 (51.30)
Level 2. School	1218.36 (65.33)
-2 restricted likelihood log	358 563.32
Akaike information criterion (AIC)	358 567.32
Schwarz Bayesian criterion (BIC)	358 579.458
Number of parameters	3

3.2. Performance in reading

The data in Table 5 show that the mean performance in reading is 469.19 points for all students. These data differ from one another at the level of students (6267.60 / 51.30 = 122.17) and of schools (1218.36 / 65.33 = 18.64).

These parameters, which are greater than 1.96, are significant and show the existence of unexplained variance between students and schools, which justifies calculating the definitive

model. The likelihood ratio has a value of 358 563.32 for a null model with three parameters, which is compared with the definitive model.

The ICC has a value of .1627, meaning that 16% of the variance is variance between centres.

ICC = 1218.36 / (6267.60 + 1218.36) = .1627

Table 6 displays the results of the fixed part and the random part of the definitive model.

Table 6. Definitive model of performance in reading.

Fixed part	
Constant	500.72 (3.66)
Gender	8.47 (.78)
Economic status of the students	9.11 (.93)
School climate	3.48 (.12)
School well-being	1.06 (.27)
Bullying	-7.29 (.47)
Ownership	10.04 (.19)
Random part	
Between students	4914.68 (39.32)
Between schools	611.62 (22.64)
-2 restricted likelihood log	243 891.17
Akaike information criterion (AIC)	243 895.17
Schwarz Bayesian criterion (BIC)	243 907.02
Number of parameters	9

According to the data in Table 6, the mean reading performance for male students with an average economic status is 500.72 points.

Female students' performance is 8.47 points higher, which explains the gender gap in reading in favour of female students

For each point increase in students' economic status, their performance increases by 9.11 points.

With regards to the school climate, for each point increase in the quality of relations between students and teachers, the performance increases by 3.48 points.

For each point increase in students' school well-being, their performance increases by 1.06 points.

As for bullying, for each point increase in the frequency with which students suffer bullying, their performance in reading drops by -7.29 points.

With regards to the ownership of the school, being enrolled in a private school means that performance in reading increases by 10.04 points compared with a public school.

The results show a difference of chi-squared of 114 672.15 with six degrees of freedom, which is significant at .01, which confirms the better fit of the definitive model compared with the null model. The results reveal that both the AIC and the BIC of the definitive model also decrease with regards to the null model, so that the goodness of fit of the definitive model improves.

The predictors of the definitive model explain 21% of the differences in reading performance between the students (R^2 = .2158) and 50% of the variability between schools (R^2 = .4979).

3.3. Performance in mathematics

Table 7. Estimate of the null model of mathematics performance.

Fixed part	
Parameter	**Estimate (standard error)**
Constant	479.98 (4.19)
Random part (variance in mathematics performance)	
Level 1. Learners	5333.47 (43.66)
Level 2. School	1180.77 (62.20)
-2 restricted likelihood log	353 699.55
Akaike information criterion (AIC)	353 703.55
Schwarz Bayesian criterion (BIC)	353 715.671
Number of parameters	3

The data in Table 7 show that the mean performance in mathematics is 479.98 points for all students. These data differ from one another at the level of students (5333.47 / 43.66 = 122.15) and of schools (1180.77 / 62.20 = 18.98).

These parameters are significant. The likelihood ratio has a value of 353 699.55 for a null model with three parameters, which is compared with the definitive model.

The ICC has a value of .1812, meaning that 18% of the variance is variance between schools.

ICC = 1180.77 / (5333.47 + 1180.77) = .1812

Table 8 displays the results of the fixed part and the random part of the definitive model.

Table 8. Definitive mathematics performance model.

Fixed part	
Constant	527.36 (3.92)
Gender	-10.29 (.41)
Economic status of the students	11.78 (.84)
School climate	6.15 (.45)
School well-being	3.32 (.28)
Bullying	-8.86 (.67)
Ownership	9.75 (.32)
Random part	
Between students	4047.54 (37.26)
Between schools	557.86 (28.01)
-2 restricted likelihood log	193 037.51
Akaike information criterion (AIC)	193 041.51
Schwarz Bayesian criterion (BIC)	193 053.625
Number of parameters	9

According to the data in Table 8, the mean performance in mathematics for male students with an average economic status is 527.36 points.

Performance falls by 10.29 points for female students, which explains the gender gap in mathematics in favour of male students.

For each point increase in students' economic status, their performance increases by 11.78 points.

With regards to school climate, for each point increase in the quality of relations between students and teachers, performance in mathematics increases by 6.15 points.

For each point increase in students' school well-being, their performance increases by 3.32 points.

As for bullying, for each point increase in the frequency with which students suffer bullying, their performance in mathematics drops by -8.86 points.

With regards to the ownership of the school, being enrolled in a private school means that performance in mathematics increases by 9.75 points compared with a public school.

The results show a difference of chi-squared of 160 662.04 with six degrees of freedom, which is significant at .01, which confirms the better fit of the definitive model compared with the null model. The results show that both the AIC and the BIC of the definitive model also decrease with regards to the null model, so that the goodness of fit of the definitive model improves.

The predictors of the definitive model explain 24% of the differences in mathematics performance between the students (R^2 = .2411) and 53% of the variability between schools (R^2 = .5275).

4. Discussion and conclusions

The first objective of this work was to identify significant differences by gender in the variables relating to school environment. From this objective, three hypotheses were proposed.

The results mean the first hypothesis, which establishes significant differences in the perception of the school climate by gender, can be confirmed with female students scoring the quality of the relationships between students and teachers higher than male students do (Alshammari et al., 2022; González-Moreno & Molero, 2023).

The results mean the second hypothesis can be confirmed, which establishes significant differences in school well-being by gender, with male students displaying a more favourable opinion than female students of the conditions that foster a sense of belonging to the school. This differs from the results of other studies (Hernández et al., 2017; Jiang et al., 2024), which find significant differences in favour of female students.

The results confirm the third hypothesis, establishing significant differences in bullying by gender, with female students experiencing more bullying than male students (Riffle et al., 2021; Zhou et al., 2024).

The second objective was to analyse the influence of a set of predictors on school environment on the science, reading, and mathematics performance of the Spanish students who participated in PISA 2022. From this objective, six hypotheses are proposed.

The results mean that the fourth hypothesis can be confirmed, which states that gender is a significant predictor of performance in the three central areas of PISA; in this case, in favour of female students in reading. This is in accordance with the results of the works by Torppa et al. (2018) and Manu et al. (2023), who find a more positive attitude towards reading in female students than in male students. Similarly, male students score higher than female ones in science and mathematics, in accordance with the results of other studies (Bottazzi & Lusardi, 2021; Eriksson et al., 2020; Stoet & Geary, 2022), which show that male students' professional aspirations are directed more towards these two areas owing to the gender stereotypes associated with careers in the STEM field.

The results mean that the fifth hypothesis can be accepted, which states that students' economic status predicts their performance (Coleman et al., 1966; Xie & Ma, 2019), particularly in science and mathematics and to a lesser extent in reading. This agrees with the results of the work of Eriksson et al. (2022), which show that, in the 2018 edition, in the societies with the biggest performance gap, the environment had a stronger connection to variance in performance in mathematics and science than in reading. Similarly, the results are in line with other works (Gamazo & Martínez-Abad, 2020; Yeung et al., 2022) which show that the economic and cultural status, which includes the educational level of the parents, has an impact on children's expectations.

The results mean that the sixth hypothesis can be confirmed, which states that school climate has a significant effect on performance (Izaguirre et al., 2023; Ramazan et al., 2023). This underlines the importance of the relationship between teachers and students to promote learning (Zysberg & Schwabsky, 2021), as well as teaching quality (Rohatgi & Scherer, 2020). Similarly, school climate has more of an effect on mathematics and science than on reading, that is, on the areas where male students score higher than female students.

The results also mean that the seventh hypothesis can be conformed, which states that school well-being has a significant effect on performance. This agrees with the results of other research (Burns et al., 2020; Haw & King, 2023; Kiuru et al., 2020; Tan et al., 2022), with a larger effect in mathematics and science than in reading, that is, the areas where male students score higher than female students. In this sense, the work of Sortkaer and Reimer (2018) points to a correlation between school well-being and performance, which is stronger in male students than in female ones.

The results mean that the eighth hypothesis can be confirmed, which states that bullying has a significant effect on performance, in line with the results of other studies (Karakus et al., 2022; Molina-Muñoz et al., 2023; Ozyldirim & Karadağ, 2024). This explains the results of the work by Giménez et al. (2024), which shows that bullying has a negative influence on performance in science and mathematics in the 2018 edition of PISA. It should be observed that female students experience more bullying that male students, with a large effect in the areas where male students outperform female ones (science and mathematics) and in the area where female students outperform male ones (reading).

The results mean that the ninth hypothesis can be confirmed, which states that school ownership predicts student performance, with students from private schools scoring higher than those from public schools, primarily in science and reading (Aparicio et al., 2017), owing to the impact on performance of the economic status of the students who attend a particular school (Le Donné, 2014). However, other studies (Larsen et al., 2023; Pivovarova & Powers, 2019) note that after adjusting for the economic status variable, students being educated in public or private schools does not explain the differences in their performance.

This work draws a series of conclusions that relate to improving performance in science, reading, and mathematics in educational practice.

Firstly, female students have a more favourable opinion than male students of the school climate, which has a large effect on performance in mathematics and science. In this sense, the impact of school climate on performance suggests a need to create an environment that promotes students' learning, so that they feel emotionally secure in schools, something that requires improving the relationship between teachers and students.

Secondly, the large effect of school well-being on performance, in mathematics and science as well, suggests a need to reinforce students' sense of belonging to the school by implementing activities that foster interaction between peers. As in the previous, case, this conclusion invites us to consider in more depth the relationship between school well-being and performance in the STEM areas by gender.

In third place, given the large effect of bullying on performance in the three core areas of PISA, measures must be implemented in schools against intimidation, bullying at school, and cyberbullying.

Fourthly, as private-school students perform better than public-school ones, it is necessary to provide more resources to schools that are publicly funded and located in disadvantaged settings in order to eliminate the performance gap.

The limitations of this work derive from the missing data that affect large-scale international assessments such as PISA, which can be overcome by analysing the cases that have complete information from all variables. Similarly, as this is an *ex post facto* study, it is necessary to take into account the OECD self-reports about the PISA results. They show basic information about the validation of variables which must be complemented with reliability and validity analyses.

In conclusion, this research has identified significant differences by gender in variables relating to the school environment, as well as the influence of predictors that relate to the school environment (school climate, school well-being, and bullying) on the performance of Spanish students in science, reading, and mathematics in PISA 2022.

Author's contributions

Pablo Javier Ortega-Rodríguez: Conceptualisation; Data Curation; Formal Analysis; Investigation; Methodology; Software; Visualisation; Writing (original draft); Writing (review and editing).

Artificial Intelligence (AI) Policy

The authors do not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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What is formative assessment? Conceptualisation and level of knowledge of basic education teachers

¿Qué es la evaluación formativa? Conceptualización y grado de conocimiento del profesorado de educación básica

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Abstract:

For educational research and practice, it is vital to identify how much teachers believe they know about formative assessment, as well as their ideas of the concept. However, there has been little research in this area. Therefore, this research aims to: (1) analyse teachers' perceived level of knowledge of the concept *formative assessment*, establishing whether there are statistically significant differences according to the educational level at which they teach, the training in assessment they have received, the number of training activities on assessment they have completed, and their years of teaching experience; and (2) to analyse teachers' theoretical conception of formative assessment. A mixed design was used with 713 teachers from primary education (39.1%) and secondary education (60.9%). The #EvalFormEPESO questionnaire was used to collect information. Specifically, the item about the level of knowledge of the concept *formative assessment* and an open-ended question requesting its definition. The results show statistically significant differences in the level of knowledge of the concept *formative assessment* depending on the variables studied. Moreover, the definitions teachers provided show incomplete or erroneous conceptions.

Keywords: formative assessment, conceptualisation, definition, training, knowledge, teachers, basic education.

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Resumen:

Para la investigación y la práctica educativa, es fundamental saber el grado de conocimiento que el profesorado considera que tiene sobre la evaluación formativa, así como cuáles son sus ideas sobre dicho concepto. Sin embargo, la investigación en este ámbito es escasa. Por ello, esta investigación se plantea (1) analizar la percepción del profesorado sobre su grado de conocimiento del concepto *evaluación formativa* y valorar si existen diferencias estadísticamente significativas en función de la etapa educativa en la que ejercen docencia, de la formación en evaluación recibida, del número de actividades formativas sobre evaluación realizadas y de sus años de experiencia docente; y (2) analizar la concepción teórica que el profesorado tiene sobre la evaluación formativa. Para ello, se empleó un diseño mixto con 713 docentes de educación primaria (39.1 %) y secundaria (60.9 %). Para la recogida de información, se empleó el cuestionario #EvalFormEPESO. En concreto, el ítem sobre el grado de conocimiento del concepto *evaluación formativa* y una pregunta abierta que solicita su definición. Los resultados muestran que existen diferencias estadísticamente significativas en el grado de conocimiento del concepto *evaluación formativa* en función de las variables estudiadas. Además, las definiciones reportadas por el profesorado muestran que existen concepciones incompletas o erróneas.

Palabras clave: evaluación formativa, conceptualización, definición, formación, conocimiento, profesorado, educación básica.

1. Introduction

Teachers' pedagogical conceptions have a significant impact on their classroom practice and are fundamental for understanding the results of the educational reforms that have been implemented in the education system (Martin et al., 2022). Over recent decades, educational reforms have increasingly focussed on the use of formative assessment processes (Casanova, 22021; DeLuca & Klinger, 2010; Van der Linden et al., 2023) given that there is sufficient evidence to show that their use contributes to improving learning and the outcomes of the teaching-learning process itself (Bennet, 2011; Pastore et al., 2019). Despite the benefits shown by research, the implementation of formative assessment is hindered by certain prior conditions such as teachers' motivation and predisposition, their training and skills in relation to its use, the presence of a favourable classroom environment, and the availability of the necessary tools and strategies for putting it into practice (Pastore & Andrade, 2019; Yan & Pastore, 2022). Accordingly, one of the principal obstacles to the correct application of formative assessment lies in defining it, in conceptualising it with precision, as much as in the characteristics that shape its implementation, an aspect that affects the practical scenario of the assessment (Hanefar et al., 2022; Martin et al., 2022). So, studies like that of DeLuca and Johnson (2017) find that factors such as a lack of assessment literacy and a lack of knowledge and skill for putting it into practice could be behind this situation. Considering the above, we should ask how familiar teachers are with the concept *formative assessment* and what notions they have of it. The present work seeks to provide evidence in this regard.

1.1. Formative assessment

Formative assessment is a practice fostered in the current education system for its pedagogical potential (Casanova, 2021; DeLuca & Johnson, 2017; Van der Linden et al., 2023). It is defined as the collection of activities and assignments integrated into the teaching–learning process that facilitate the systematic gathering of information about all of the elements at play in students' learning for the purpose of producing a fair and well-founded assessment and

providing feedback so that students can achieve greater academic success (Bennet, 2011; DeLuca & Johnson, 2017; Sanmartí, 2019; Yan & Pastore, 2022).

Over recent decades, numerous studies have shown the benefits of using formative assessment in students' learning (Bennet, 2011; DeLuca & Klinger, 2010; Gan et al., 2018; Yan & Pastore, 2022). Among these benefits, its use promotes the development of strategies that favour students' awareness of the place and time of the learning in which they find themselves and their reflection on their strengths and aspects to improve (Hanefar et al., 2022; Jawad, 2020 & Ziqi et al., 2023). Consequently, students develop cognitive and metacognitive skills that help them critically assess their own learning processes and those of their peers (Sanmartí, 2023). To achieve these benefits, William and Leahy (2015) suggest five key strategies for implementing true formative assessment: (1) clarifying, sharing, and comprehending the learning objectives and assessment criteria with students; (2) fostering effective debates, assignments, and activities that favour demonstrating learning; (3) providing feedback and feedforward that enable students to know how they are doing in comparison with learning objectives and how to achieve them to a greater extent; (4) engaging students in their own learning and assessment; and, (5) engaging students in their classmates' learning and assessment process.

1.2. Teachers' conception of assessment

The conception of assessment comprises the ideas, values, and attitudes teachers have of educational assessment (Brown & Gao, 2015; Jawad, 2020), including cognitive and affective aspects linked to the teachers' vision of the education system in general. On the one hand, the cognitive notion of assessment relates to the theoretical knowledge and epistemological beliefs that teachers possess (Pastore & Andrade, 2019). On the other hand, the affective dimension reflects teachers' emotional predisposition towards formative and practical experiences of assessment developed throughout their professional and academic career (Yan & Pastore, 2022). Accordingly, teachers' conception of assessment can be variable and changing (Van der Liden et al., 2023; Hanefar et al., 2022); this change will occur when they display a favourable attitude towards the implementation of new assessment policies. However, Pastore et al. (2019) note that teachers sometimes have ideas and systems that are relatively stable and rooted in the cultural tradition associated with assessment as a means of measurement and grading. This means that teachers are resistant to change and are not proactive in implementing and modifying their practice in a work setting (Martin et al., 2022).

1.3. Formative assessment literacy

Formative assessment literacy refers to the necessary body of knowledge and skills that teachers must acquire to implement assessment that is fair, equitable, and suited to the needs and demands of the education system (Yan & Pastore, 2022). It combines all of the teaching aptitudes necessary to design and implement appropriate and contextualised assessment processes and to make a fair and coherent value judgement about students' performance with the aim of promoting meaningful learning (Pastore & Andrade, 2019). Teachers' formative assessment literacy also requires the facilitation of appropriate experiences to encounter practices that favour self-regulation of students' learning such as self-assessment and co-assessment (Sanmartí, 2023; DeLuca & Klinger, 2010). Similarly, Ziqi et al. (2023) determine that it must be centred on the development of feedback processes, which are one of the decisive indicators of the efficacy of the teaching process.

Formative assessment literacy is currently understood to be a complex interaction with various elements in play. Xu and Brown (2016) lay the foundations for a conceptual framework and identify a hierarchical model comprising six components: (1) the teacher's knowledge base, (2) conceptions of assessment, (3) institutional and sociocultural contexts, (4) training in assessment in practice, (5) the teacher's learning, and (6) the teacher's identity as an assessor.

From a holistic perspective, and using this classification as a reference, Yan and Pastore (2022) suggest that literacy in assessment can be grouped into three major dimensions that make up teacher identity: (1) conceptual, (2) practical, and (3) socioemotional. The conceptual

dimension refers to the fundamental knowledge of formative assessment that teachers must have, including its goals and methods (Pastore & Andrade, 2019); The practical dimension combines the specific techniques and procedures that a teacher must use to develop quality formative assessment, and the socioemotional dimension refers to the teachers' perception and conception of the education system in general and how they understand assessment in particular (Yan & Pastore, 2022). Brown and Gao (2015) indicate that teacher literacy has principally been focussed on summative and centralised assessments. However, as formative assessment has grown in importance, new challenges have emerged for the literacy and training of the teachers, which confront the move towards the construction of a new assessment paradigm (Yan & Pastore, 2022). Therefore, it is vital for teachers' literacy and training to include comprehension of the theoretical principles behind the assessment practices and to provide practices, instruments, and procedures that fit these new proposals (DeLuca & Klinger, 2010). For this to occur, Ziqi et al. (2023) claim that the generalised conception rooted in the more evaluatory vision of assessment must be set aside.

1.4. Teachers' conception and literacy regarding formative assessment

Teachers' ideas of assessment will have a direct impact when implementing formative assessment processes. Accordingly, teachers' level of knowledge of assessment and their conception of it can hinder its successful implementation (Van der Liden et al., 2023). Similarly, teachers' conception and intention is, on the one hand, closely linked to their assessment literacy and, on the other, to their identity as assessors, that is to say, to their beliefs, feelings, and experiences (DeLuca & Klinger, 2010). In this regard, examining teachers' conceptions makes it possible to identify the underlying ideas that guide their assessment practice and also makes it possible to understand better how they design and implement assessment practices (Van der Liden et al., 2023).

In a study by Pastore et al. (2019), teachers relate formative assessment to the process of identifying students' strengths and weaknesses and giving feedback to improve them. However, the results show that the traditional vision of assessment still prevails, as teachers tend to believe that formative assessment is an instrument for supervising and checking students' learning (Casanova, 2021; Sanmartí, 2019). In this case, and concurring with Gan et al. (2018), it is notable that teachers associate formative assessment with the periodic use of various tests (exams, oral and written tests, etc.), above all to assess the cognitive dimension of students' learning.

These results are similar to those obtained by Hanefar et al. (2022) and Ma and Bui (2021), who find that teachers' discourses feature a strong correlation between assessment as improvement and as accountability, indicating that teachers believe that examining students contributes to the development of their learning. From this perspective, a degree of terminological confusion about what formative assessment is can be seen because teachers tend to confuse it with summative assessment when trying to carry it out systematically in everyday teaching practice (Gan et al., 2018; Van der Liden et al., 2023). This confusion could be influenced by contextual factors and by teachers' working environment (Ma & Bui, 2021). So, Pastore and Andrade (2019) determine that factors, such as cultural bias about assessment, the importance educational policies place on student performance, and the deep-rooted traditional conception of assessment, mean that teachers still have a rather limited view of assessment. In accordance with this idea, Hanefar et al. (2022) and Pastore et al. (2019) note that, a small change by teachers in their conception and perception of assessment can be perceived but that this change is linked to more theoretical and discursive aspects. In contrast, few teachers are able to represent and define formative assessment practically, and those who subsequently feel able to apply these processes in the classroom are even rarer. Accordingly, to try to answer this question, this study proposes two objectives: (1) to analyse teachers' perception of their degree of knowledge of the concept *formative assessment*, assessing whether there are statistically significant differences according to the educational stage in which they teach, the training in assessment received, the number of training activities on

assessment carried out, and their years of teaching experience; and (2) to analyse the teachers' theoretical conception of formative assessment.

2. Method

2.1. Study design

A mixed design (Creswell & Plano, 2017) was used to address the research objectives. A transversal quantitative study was performed in response to the first objective. After this, a qualitative and descriptive investigation was performed to contrast the alignment between teachers' level of knowledge of the concept *formative assessment* and their real knowledge of what it is.

2.2. Participants

A total of 713 Spanish teachers from primary education (PE) (39.1%) and Obligatory Secondary Education (ESO) (60.9%) participated. They were selected through random non-probability convenience sampling. The representativeness of the sample was calculated using the data provided by the Ministry of Education, Professional Training, and Sports (Ministerio de Educación, Formación Profesional y Deportes, 2024), which made it possible to establish that the sample was representative. The participants have a mean teaching experience of 11.32 (*SD* ± 11.00) years. Table 1 shows the details of the participants.

Table 1. Details of the study participants.

Variable	*n*	%
Gender		
Male	226	31.7
Female	483	67.7
Others	4	0.6
School		
State	603	84.6
Private–state assisted	110	15.4
Educational level		
Primary Education	279	39.1
Obligatory Secondary Education	434	60.9
Academic year		
1st cycle of PE	90	12.6
2nd cycle of PE	76	10.7
3rd cycle of PE	113	15.8
1st and 2nd year of ESO	181	25.4

3rd year of ESO	111	15.6
4th year of ESO	142	19.9
Employment status		
Public official	423	59.3
Temporary post	182	25.5
Permanent contract	108	15.1
Years of teaching experience		
1-5 years of experience	164	23.0
6-15 years of experience	162	22.7
16-25 years of experience	197	27.6
More than 25 years of experience	190	26.6
Highest academic qualification obtained		
Diploma or bachelor's degree (for PE)	178	25.0
Licentiate degree or equivalent and teaching qualification certificate (certificado de aptitud pedagógica) (for ESO)	259	36.3
Postgraduate title or equivalent (master's and/or doctorate)	276	38.7

Note: PE = primary education; ESO = Obligatory Secondary Education.

2.3. Instrument

An ad hoc questionnaire called "Formative assessment processes in basic education #EvalFormEPESO" was designed and used for data collection. This questionnaire consisted of 50 closed response items divided into 6 dimensions: (1) identifying data, (2) training in formative assessment, (3) purposes attributed to formative assessment, (4) participants and their roles in assessment and grading processes, (5) feedback, and (6) assessment tools. A 6-point Likert-type scale was used to answer the questions with answer levels ranging from 1 (never) to 6 (always). In addition, two open-ended questions were included where teachers were asked to define the concept of formative assessment in accordance with their perception and, whether they felt that anything essential for carrying out quality formative assessment had been omitted. The questionnaire was subjected to a process of content validation. This involved 6 experts (4 women and 2 men) from the field of formative assessment with between 10 and 30 years of experience as university teachers. The experts were asked to assess each item in the questionnaire, using the guide proposed by Escobar-Pérez and Cuervo-Martínez (2008), which has 4 categories of analysis (sufficiency, clarity, relevance, and coherence) assessed by means of a scale with 4 levels ranging from 1 (does not fulfil the criterion) to 4 (fulfils it totally). The questionnaire's reliability was then tested using Cronbach's alpha, which gave a level of internal consistency of $\alpha = .873$ for the scale as a whole. To respond to the objectives set in this study, the items relating to teachers' knowledge of the concept *formative assessment* were used (Table 2). These included one closed and one open question.

Table 2. Items analysed for the research.

Do you know the concept *formative assessment*?
Yes, I know the concept well.
Yes, I know the concept, although I have doubts about its meaning.
I have heard it, but I am not sure what it means.
No, this is the first time I have heard it.
Say what you consider formative assessment to be (give an example).

2.4. Procedure

For the data collection, the email addresses of all of the primary and secondary education centres in Spain were compiled through the webpages of the autonomous communities. The ones that presented this information in a public and accessible form were selected. The questionnaire was uploaded to Google Forms and was sent by email to all of the schools, requesting the participation of the teachers from the educational institution. An information sheet and informed consent sheet were provided along with the questionnaire, in accordance with the principles of ethical research (American Psychological Association, 2010). This study was approved by the research ethics committee of the Universidad Autónoma de Madrid with code CEI-126-2604.

2.5. Data analysis

After collecting the data, the responses to the item "Do you know the concept *formative assessment*?" were coded into three groups for analysis: (1) I know the concept well; (2) I know the concept superficially; and (3) I don't know the concept , I don't know what it means. Subsequently, the descriptors were analysed and the chi-squared test was used to establish whether there were statistically significant differences in knowledge of the concept according to the different variables studied. This was done using the SPSS (version 26) statistics software program.

The teachers' written responses to the open-ended question "Say what you consider *formative assessment to be* (give an example)" were also analysed. To do this, we used the Atlas.ti qualitative analysis software program. First, the terms used the most by teachers in the definitions given were extracted and counted. This was followed by a process of inductive coding with a bottom-up focus. Common elements in teachers' discourses were identified and a list of emerging codes was prepared taking into account the topics of the research and the information from the fragments analysed. The phrases were taken as coding units and the information was organised through a system of open coding. So, 16 initial subcategories were established giving a detailed view of the information collected. After this, all of the citations selected for each subcategory were reviewed, grouping and organising them into 3 broader categories: (1) formative assessment as an aim or moment, (2) formative assessment as an assessment instrument, and (3) formative assessment as a participatory process (see Table 4 for more information about the specific categorisation).

3. Results

Table 3 displays the results for the teachers' reported level of knowledge of the concept *formative assessment* and the differences depending on the variables analysed. Of the teachers, 55.0% say that they know the concept *formative assessment* well, while only 15.3% say that they do not know it. There are statistically significant differences in knowledge of the

concept *formative assessment* according to the educational level at which the teachers teach (χ^2 (a) = 7.289, *df* = 2, *p* <0.05). Teachers from ESO are less familiar with the concept (18.0% compared with 11.0% from PE who say that they do not know the concept). Meanwhile, 59.9% of teachers from PE state they know the concept *formative assessment* well, compared with 51.8% from ESO.

There are also statistically significant differences in knowledge of the concept *formative assessment* by training received in assessment (χ^2 (a) = 272.237 *df* = 4, *p* <0.05). On the one hand, it stands out that 91.1% of teachers who perceive that they have received sufficient training in assessment report knowing the concept *formative assessment* well. On the other hand, 24.0% of teachers, even when reporting that they have received no training in assessment, say they know the concept well. Finally, among the participating teachers who report not having received training in assessment, 43.3% state that they are not familiar with it.

There are also statistically significant differences in teachers' perceived knowledge of the concept *formative assessment* by number of assessment training activities completed (χ^2 (a) = 135.429 *df* = 4, *p* <0.05). The ones who have done more than three training activities claim the best knowledge of the concept *formative assessment* (73.2%) while 35.3% of those who have not done any training activities say they are not familiar with it. Finally, statistically significant differences also appear in teachers' perception by years of teaching experience (χ^2 (a) = 15.617 *df* = 6, *p* <0.05). Although the most common response in all of the groups was "Yes, I know the term well", the respondents with the most teaching experience (more than 25 years) have the highest percentage of this answer (62.1%), while those with the least teaching experience (1-5 years) display the lowest percentage (48.2%). This same trend is maintained with those who say that they do not know the concept, with the ones with the least experience (from 1 to 5

Table 3. Knowledge of the concept *formative assessment*. Differences by educational level, years of experience, training in assessment, and training activities carried out.

			%				
		n	**I know the concept well**	**I know the concept superficially**	**I don't know the concept, I don't know what it means**	***χ²***	***p***
Total		713	55.0	29.7	15.3		
Educational level	Primary Education	279	59.9	29.0	11.1	7.289	**.026**
	Obligatory Secondary Education	434	51.8	30.2	18.0		
Training received	I have received sufficient training	203	91.1	18.0	0.0	272.237	**.000**
	I have received little training	314	51.0	41.1	7.6		
	I have received no training	196	34.0	32.7	43.4		

Trained activities carried out	No training activity	238	31.9	32.8	35.3		
	Between 1 and 3 activities	277	61.7	31.8	6.5	135.429	**.000**
	More than 3 activities	198	73.2	23.2	3.5		
Years of experience	1-5 years	163	48.2	29.9	22.0		
	6-15 years	162	48.8	35.2	16.0		
	16-25 years	197	58.9	29.9	11.2	15.617	**.016**
	More than 25 years	190	62.1	24.7	13.2		

years) being least likely to know what the concept means (22.0%), contrasting with those with the most experience, only 13.2% of whom gave this response.

Regarding the second objective, 653 responses to the question "Indicate what you consider *formative assessment* to be (give an example)" were analysed. The analysis of the most used words took into account all of the calculation of terms used to define *formative assessment*. The word cloud in Figure 1 shows the most notable words. The ones used most often include *process* (*n* = 365), *learning* (*n* = 361), *students* (*n* = 273), and *improvement* (*n* = 194). Words such as *results* (*n* = 55), *feedback* (*n* = 43), and *grading* (*n* = 31) are also notable. In contrast, the words used least frequently were *portfolio* (*n* = 1) and *diagnosis* (*n* = 2). To prepare the word cloud,

FIGURE 1. Word cloud of words used most frequently to define the concept *formative assessment*.

the word is taken as an independent unit and we focus on identifying the words used most frequently in the discourse, regardless of how they are used in it.

TABLE 4. Categorisation used for the analysis derived from the open question.

Category	Subcategory	Code	No. of references	Description
Formative assessment as aim or moment	Improving the teaching–learning process	A_ImpTL	103 citations	Assessment as a process that contributes to improving teaching and students' learning
	Guidance, giving feedback to students	A_Guide	171 citations	Process that helps guide students in their learning process
	Self-regulation of teaching and learning	A_Self_reg	112 citations	Monitoring, managing, or directing one's own learning
	Procedural and integrated into teaching–learning process	A_Inter	122 citations	Assessment as part of the process, not as an isolated activity
	Assessment of student performance	A_ Performance	65 citations	Assessing how an assignment has been done in relation to the objectives set
	Competence assessment	A_ Competence	10 citations	Assesses competence development
	Certifying	A_Cert	97 citations	Checking results and giving a grade
	Mid-course continuous assessment	A_MidC	73 citations	Mid-course tests or assignments done at specific moments
Formative assessment as an assessment instrument		A_Instr	60 citations	Specific data collection tools or methods
Formative assessment as a participatory process	Hetero-assessment	A_Hetero	1 citation	Teachers assess students
	Self-assessment	A_Self	31 citations	Students assess their own work
	Co-assessment	A_Co_a	18 citations	Students assess the work of their classmates
	Shared assessment	A_Shared	18 citations	Assessment is shared between teacher and students
Don't know			23 citations	

After analysing the answers given by teachers, three major categories emerged, giving a total of 16 subcategories. These are shown in Table 4. Next, the results regarding the teachers' conceptions of what formative assessment is were presented based on the categories that emerged in the analysis.

3.1. Formative assessment as aim or moment

In a total of 103 citations analysed, teachers understand formative assessment to be an element that helps improve the teaching–learning process. Despite this, on a small number of occasions teachers report precise information about specific aspects that detail how formative assessment helps produce this improvement, without deeper consideration of more practical and pedagogical aspects.

> "Improving teaching processes"; "directed at continuous improvement of the teaching-learning process"; "it serves to improve the teaching–learning process"; "the type that helps improve the learning process"; "it pursues improvement of the teaching–learning process"; "continuous improvement"; "constant improvement of the learning process" (A_ImpTL).
>
> "Constantly improving the teaching-learning process. With it we can see what, how, when, and how much the students are learning. Based on this, we can regulate class activities, resources, and strategies" (A_ImpTL).

A total of 283 citations defines formative assessment as a practice that contributes to self-regulation, both of the teaching process by teachers and of learning by students. In this sense, teachers determine that formative assessment should help detect errors and difficulties in the teaching-learning process to guide teaching practice and provide feedback to students that helps them improve their performance.

> "Identifying the difficulties and the errors, seeing that the possible causes, and taking decisions to be able to overcome them. It is a matter of self-regulating learning" (A_Guide; A_Self_reg).
>
> "Feedback on performance in an assignment to guide the student's learning" (Eval_Guide).
>
> "Procedural assessment in which the milestones assessed are the starting point for the didactic activities. It is based on obtaining feedback to know exactly where students are with regards to their learning process to plan the actions relating to teaching through the results" (A_Self_reg).

On this line, 122 citations claim that formative assessment has a procedural character, defining it as an element that forms part of the teaching-learning process and emphasising its integrated nature. From this perspective, it is understood to be a continuous process that is done throughout the whole of the process, and not as something that brings it to an end.

> "We do it daily in every observation of work in class. It is almost a methodology, a way of working. It is a way of proceeding in class that obliges you to be constantly changing. When you start a teaching unit, you ask yourself what the class will be like and you even plan for it, but depending on the group, its interests, its starting point, and its diversity... based on the formative assessment, the teaching unit becomes something flexible, just an objective, a target" (A_Inter).
>
> "Assessment of the whole process, not just the end result"; "continuous assessment, not leaving the assessment to the end, but seeing how the process is going" (Eval_Inter).

There are 65 citations from teachers who state that the function of formative assessment is to assess students' performance over a formative period and to identify the level of development of their learning. In this case, only 10 of them allude to the competence-related character of assessment, and the predominant discourse is from teachers who argue that assessment serves to assess students' acquisition of knowledge.

> "Assessment done throughout the teaching-learning process that makes it possible to check whether the students are acquiring competences, basic knowledge..." (A_Performance).
>
> "To see how well the competences have been acquired"; "to know during the learning process how the students' command of the content and competences is developing"; "reflection by students on the learning process and their level of acquisition of competences"; "seeing each child's learning process, not just at the level of content, but also competences" (A_Performance; A_Competence).

However, a traditional vision of the concept of assessment is still found in teachers' discourses, with 97 citations stating that formative assessment is a means of grading students, even if it is in different tests and moments in the teaching-learning process.

> "Exams at the end of each block"; "check the knowledge acquired by the students. e.g: a written exam"; "the teacher assesses academic performance to make the students and their families aware of the academic level acquired"; "at the end of the year or term grading this evolution quantitatively or qualitatively"; "constantly knowing 'how much' the students are learning"; "grading the practice" (A_Cert).
>
> "For example, exam mark plus activities mark" "marks given more or less continuously based on work and assignments done" (A_Cert; A_MidC).

3.2. Formative assessment as an assessment instrument

Something else teachers often do when attempting to define the concept *formative assessment* is equating formative assessment to assessment instruments and procedures. Of the citations analysed, 60 mention the name of some type of assessment instrument. In these cases, teachers only mention the instruments or procedures used, without going into depth in *how* or *to what end* they use them.

> "Exam"; "a written exam"; "written test"; "various exercise options in a written test"; "test, multiple-response, essay questions, short response, linking, identifying images"; "A rubric for a project"; "continuous observation"; "rubrics"; "portfolios, learning portfolio, rubric and assessment targets"; "questionnaires, games, class dynamic" (A_Instr).

3.3. Formative assessment as a participatory process

Some participants define formative assessment by likening it to a participatory process in the assessment by students. From this perspective, 31 citations use self-assessment as equivalent of "formative assessment" and 18 use the term co-assessment as a synonym of it. Therefore, it can be seen that the terms self-assessment and co-assessment are used as substitutes for the concept *formative assessment*, treating formative assessment as synonymous with these practices.

> "Self-assessment and co-assessment of students"; "assessing yourself"; "self-assessment of students"; "self-assessment, co-assessment"; "self-assessment and co-assessment" (A_Self; A_Co_A).

On the other hand, some participants also indicate that these processes are integrated in this practice, and they underline the importance of empowering students so that they have a voice in the assessment process. However, only 18 citations define formative assessment as a collaborative process shared with students where they participate in the assessment of their own practice and in that of their classmates.

> "Students participate in their learning process and are aware of what aspects the subject teacher proposes that are associated with cooperative learning, among other methodologies, as well as self-assessments, co-assessments, and hetero-assessments" (A_shared; A_Self; A_Co_A).

4. Discussion

On the one hand, this study has analysed teachers' self-reported perceptions of their level of knowledge of the concept *formative assessment* and whether there are differences in this according to different variables. On the other hand, it has analysed teachers' theoretical conception of formative assessment.

With regards to the first objective, teachers in primary education report knowing the concept *formative assessment* well more often that teachers in secondary education. In this aspect, Cañadas et al. (2018) note that while the initial training on educational aspects for teachers in primary education lasts for four academic years (didactics, school curriculum, pedagogy, etc.) secondary teachers are trained in these aspects in the teacher training master's, which lasts for only one academic year. Therefore, the didactic-pedagogic training received in initial training could be a factor that results in better literacy among teachers about what formative assessment is.

With regards to the training teachers have received in assessment, the ones who consider they have received the most training and report having done more training activities assert that they know the term well, reporting higher values in all of the items analysed. These results are on the same lines as the studies by Yan and Pastore (2022), Pastore and Andrade (2019), and Ziqi et al. (2023), which underline that assessment literacy is essential for clear knowledge of what formative assessment is and for implementing it in the classroom. Therefore, providing specific training that focusses on formative assessment and its application in the classroom appears to be crucial in both initial training degrees and postgraduate courses and in continuous training for in-service teachers. On this line, it would seem logical to think that recently qualified teachers should have received more specific, exhaustive, and up-to-date initial training. However, the teachers who claim to know the concept best are the ones with more than 25 years of experience. This could indicate that continuous training currently focusses on increasing training in formative assessment and that initial training still does not meet the training needs of future teachers.

With regards to the second objective, the teachers' definitions of what they understand formative assessment to be are analysed. Although the four most frequently occurring words are *process*, *learning*, *students*, and *improvement*, the word cloud reflects the frequency of each word in the whole of the text analysed, without interpreting its contextual significance. This requires a more exhaustive analysis of the qualitative responses to analyse the depth with which teachers define formative assessment and to reach a conclusion on the basis of their generalised ideas of the concept. In this sense, a multitude of conceptions can be seen in teachers' discourses, which display a lack of agreement on what they consider formative assessment to be (Martin et al., 2022). Only a third of the teachers define it as a process that contributes to improving the teaching–learning process. These results are in line with those obtained by Ma and Bui (2021) and Pastore et al. (2019) where teachers also emphasise that for this improvement to occur, students' needs must be identified and the necessary tools and strategies be provided to enable them to progress and advance, an aspect that is not reflected in the definitions given in our study. This is reflected in another of the elements that must form part of the definition of formative assessment and which is only partially recognised by this study's participants: the guiding and regulating function of formative assessment. Less than half of the citations note the value of feedback, with a superficial conception of its purpose and application being apparent (DeLuca & Klinger, 2010; DeLuca & Johnson, 2017; Gan et al., 2018.). This leads us to consider that teachers have a general idea of what formative assessment sets out to be but do not know how to express this accurately, something that previous studies also noted (Hanerfar et al., 2022; Ma & Bui, 2021; Martin et al., 2022).

Moreover, many of the citations show erroneous conceptions that equate formative assessment with the different moments at which assessment can be carried out (initial, continuous, or final). So, some participants liken the concept to carrying out continuous testing throughout the process to establish a final grade. These results, in line with those of Gebril

(2017) and Looney et al. (2018), show a tendency to equate formative assessment with simply compiling marks without a substantial change in the traditional assessment focus.

On the other hand, there is a tendency to use the terms self-assessment and co-assessment or the names of different assessment instruments (rubric, portfolio, observation, etc.) as synonyms for formative assessment. While these tools and strategies can be integral elements in the process (William & Leahy, 2015), their use does not in itself comprise formative assessment. This confusion shows that teachers are unable to argue for how using these instruments or students' involvement in the assessment process is relevant. As a consequence, and in agreement with Martin et al. (2022), Pastore et al. (2019), and Ziqi et al. (2023), it can be seen that teachers' conceptions are still influenced by a superficial view of assessment understood as a measurement instrument or tool and not as a collection of interrelated practices. This could result in lack of knowledge of what formative assessment is, resulting in it not being implemented effectively and no real change in pedagogical practices occurring (DeLuca & Klinger, 2010; Gan et al., 2018). Because of this, and in agreement with Ma and Bui (2021), it is vital to address and work on teachers' ideas and conceptions about formative assessment and foster a critical and reflective conception of it, as without conceptual change, effective implementation of these strategies in the classroom will be extremely challenging.

5. Conclusions

This research has found that although teachers report being familiar with the concept *formative assessment*, they are unable to define it precisely. Accordingly, it is apparent that teachers do not thoroughly define formative assessment and that in some cases they confuse it with specific assessment methods, strategies, and instruments.

Changes must be made to teachers' initial and continuous training, to devote more hours to training in formative assessment processes and their application and to promote a renewed student-centred focus. It is essential to work and reflect with teachers on the reason for and purpose of each assessment practice as this will enable them to reconsider their conceptions and align their methods with educational objectives and promote significant changes in this field. Furthermore, it is essential that training settings offer practices, strategies, and tools (specific guidelines, handbooks, appropriate instruments, etc.) that make it possible to systematically develop effective formative assessment in the classroom.

This study has various strengths, including the fact that it covers a topic that has hitherto received little attention, its large number sample, and the use of a mixed design that has provided an overview of the situation regarding teachers' perceived knowledge of the concept *formative assessment*. It has also made it possible to consider in depth what formative assessment is for teachers, offering a view of the aspects that still need further work and the aspects that efforts to increase assessment literacy should concentrate on more. However, it also has some limitations. Firstly, as the sample of participants comprises teachers from primary education and secondary education in the context of Spain, the conclusions can only be extrapolated to similar contexts. Furthermore, teachers report opinions based on their perceptions of a specific term. This does not offer an objective vision of what they really believe, and bias could be introduced by a wish to give socially desirable responses. Similarly, the use of a single open question in the questionnaire offers an initial overview of teachers' conceptions of formative assessment, but it limits the depth of their analysis. Future research should examine the topic in more depth through interviews or discussion groups to provide a more detailed understanding and consider in more depth how teachers' ideas of assessment can influence their teaching practice and their responses to institutional reforms. This could be complemented by analysing how sociodemographic variables, such as gender, place of work, age, or the educational level respondents teach at, influence their perceptions of formative assessment. It would also be essential to observe the real classroom context and the different options teachers have for implementing this type of process in their everyday practice.

Authors' contributions

Maite Zubillaga-Olague: Conceptualisation; Data curation; Writing (original draft).

Laura Cañadas: Writing (review and editing).

Jesús Manso: Visualisation; Writing (review and editing).

Artificial Intelligence (AI) Policy

The authors do not claim to have made use of Artificial Intelligence (AI) in the preparation of their articles.

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Book reviews

Ruiz-Corbella, M. & García-Gutiérrez, J. (Eds.) (2023).
Aprendizaje-servicio: escenarios de aprendizajes éticos y cívicos [Service learning: Scenarios for ethical and civic learning]
(Paula Álvarez-Urda)

Gairín-Sallán, J. (Coord.) (2024).
Dirección y liderazgo de los centros educativos. Naturaleza, desarrollo y práctica professional [Management and leadership in educational centres. Nature, development, and professional practice]
(Sheila García Martín)

Meirieu, P. (2022).
Lo que la escuela puede hacer todavía por la democracia. Dos o tres cosas que sé (quizás) sobre educación y pedagogía [What the school can still do for democracy: Two or three things I (maybe) know about education and pedagogy]
(José García Molina & Roberto Moreno López)

In memoriam
Richard Pring (1938-2024): A realistic and profound philosophy of education
(María G. Amilburu)

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Book reviews

Ruiz-Corbella, M. & García-Gutiérrez, J. (Eds.) (2023).

Aprendizaje-servicio: escenarios de aprendizajes éticos y cívicos [Service learning: Scenarios for ethical and civic learning].

Narcea. 239 pp.

The university of the 21st century must adapt to changing times and bolster its impact on and commitment to all levels of life. Achieving this requires the effective introduction of teaching innovation methodologies that offer accessible, profitable, ongoing learning opportunities that are put into practice in the social sphere. It is on this point that service learning (SL) comes into play, an educational focus in which knowledge is exchanged that acquired through its direct application in specific projects with the aim of offering a positive service to a particular community. It is a clearly engaged methodology, and its implementation appears to be more than appropriate for modernising the function of the university towards a more digital and globalised society, which faces many challenges. The book *Aprendizaje-servicio: escenarios de aprendizaje éticos y cívicos*, edited by Ruiz-Corbella and García-Gutiérrez, sets out numerous applications, possibilities, resources, and factors to take into account in order to ensure that SL has a positive social impact.

This book has twelve chapters, equally divided into three sections. More than thirty authors from universities all over Spain were involved in writing it. Furthermore, before the themed sections, the editors provide introductions that describe the key points of the book, giving a clear context and identifying multiple possibilities for SL in the university sphere as well as its social impact. The first section sets out the definition and aims of SL from an ethical and reflexive focus. The second section focuses on the didactic possibilities for ethical and civic values through SL, as well as questioning its viability, challenges, and limits. Finally, the third section addresses methodological scenarios centred on SL considering other approaches, skills, branches of knowledge, and technological resources.

The first chapter notes the important role of the university for training future professionals in civic values that are participatory and committed to social well-being. This role must be manifest in the academic pathway, and implementing SL is fundamental for doing so. This is because it is a methodology that allows direct collaboration with the community through learning and the constant interchange of experiences, and it also favours the capacity to solve problems, creativity, and interdisciplinarity through participating actively with different people. Therefore, this shows that SL offers unrivalled opportunities for developing an ethical conscience in university students, the impact of which is reflected in their future professional and social choices.

The second chapter underlines the transformative power of SL, bolstered by a clear reflexive component that results from putting this methodology into practice in real social scenarios. The inclusion of a range of aspects that enable empathic, evaluative, and transversal reflection is considered indispensable when implementing SL projects. The first is tutorial action, comprising proper guidance for university students. The next aspect is the need to provide spaces that allow individual reflection according to people's lived experiences. This is accompanied by collective reflection between peers to reinforce the epistemological and emotional component derived from its implementation. Finally, it is important to mention reflection with other groups of participants who are not usually present in other methodologies, such as for example the members of the specific community with which the project has been carried out, as a means of guaranteeing a negotiated, critical, committed, and above all reflexive, practice.

The third chapter addresses ethics seen from care and emphasises the prevailing need in SL to provide the proper treatment for the specific community in which it is applied. This chapter examines in depth clear experiences and cases that show the importance of considering care when implementing SL for its efficacy, quality, and better comprehension of the context. Consequently, SL goes beyond creating spaces that foster knowledge exchange to favour a particular community, as it also allows the presence of attitudes that regard care as a foundational support to consider.

Chapter four focuses on synthesising some of the challenges that concern the citizens of the 21st century, such as climate change and social exclusion. Implementing SL is essential to address them, especially in the university domain. This methodology allows students to reflect their social commitment in different dimensions and moments in their lives through ethics, reflection, and innovation. Therefore, SL must be a key factor for reinforcing the functions of the university and a civic education linked to scenarios that favour solutions to contemporary social problems.

In the second section, chapter five centres on guaranteeing respect as a cornerstone of any possible implementation of SL. It is vital to consider all of the social variables at play in each context, given that some of the participants can feel morally harmed by particular situations deriving from SL owing to their beliefs, circumstances, or vulnerability. In any case, it is also apparent that carrying out such a precise analysis of the variables at play is difficult owing to the lack of available time, which is limited by the structure of most university programmes. Consequently, SL must guarantee respect for all of the participants, but so doing requires the university to act in a socially and morally responsible way.

Chapter six considers SL as a methodology that must be applied and guided successfully through dialogue between the different agents involved. As such, the aim of creating ethical principles in students is met by a methodology that allows for an easy link with politics, the community of practice, the space for dialogue, interdisciplinarity, and changes in the role of the teacher. That is to say, dialogue is a key element in the implementation of SL owing to SL's multicultural, reflexive, and socially committed nature, and so its absence results in a poor and inappropriate implementation.

Chapter seven sets out the need to elaborate a code of ethics for common action for all university actors who attempt to implement SL in their professional practice. This not only achieves greater coherence and synchronicity, but it also resolves the ethical-pedagogical problems of SL. These cases are linked to the activist (and not educational) inclination, innovative conceptions of it (instead of prioritising its basic elements), and the divide between theory and practice. Therefore, creating an ethical code as a reference point is vital to resolve these problems and reinforce civic engagement linked to university students.

Chapter eight identifies situations in which there are deficiencies in ethical and civic principles when organising an SL project, which could be detrimental for university students who do not have prior training in certain aspects. It underlines that the ethical foundation is the fundamental element in the implementation of any SL project. In this case, teachers play a leading role when developing the proposal that the students will then put into practice.

Therefore, once the teaching foundation has been correctly laid, good actions and intentions will lead the SL methodology to a good end.

Chapter nine links SL to another complementary methodology at a university level: the living lab. While the aims of the former relate to offering a social service, the latter is linked to research. Therefore, implementing both approaches at the university level favours students' commitment to research projects that consider the social sphere in greater depth from an ethical, just, and participatory perspective. Furthermore, this merging favours the development of skills such as building solutions and a moral conscience, aimed at facing the challenges of the 21st century.

Chapter ten describes an experience linked to the application of SL at the Universidad Jaume I. As a result, it argues that SL is an undisputed methodology that acts as a springboard for developing civic skills to achieve a fairer society. However, its application is often limited by shortcomings and weaknesses in the institutional and legislative framework. In consequence, it is vital to reconfigure the university to favour the implementation of SL and take advantage of all of the social advantages that it offers.

Chapter eleven sets out a clear evolution in the inclusion of SL for developing soft skills and transdisciplinarity through humanistic thinking, which derives from applying this methodology in qualifications aimed at scientific fields, such as engineering. This pathway is set out in three periods: one before the Bologna Plan; another after it; and a third in which SL is of special relevance. This application has benefited students on science programmes in various areas, from personal and moral growth to linking their applied knowledge to social improvement.

Finally, chapter twelve considers the possibility of integrating emerging technologies to improve the capacities of SL. The recent growth of artificial intelligence (AI) poses many challenges and questions for this methodology, but this does not mean that using it is inappropriate. On the contrary, this chapter argues that AI is a resource that facilitates personalised, transformational, evaluative, and participatory strategies. In any case, more research is needed that considers the possible advantages of pairing SL and technology to achieve the critical, transformational, and reflexive development of a more just and civic society.

This is a book that undoubtedly encompasses multiple dimensions and applications of SL, through a reflective and critical analysis that seeks to inform the reader of the need for it to be included in all university and professional settings. This way, universities will modernise their functions and strengthen their social commitment, adapting to the challenges and demands that characterise a more intercultural, globalised, and digital world. The book does this through complementary chapters that are correctly articulated, argued, and guided, with a clear and comprehensible language aimed at all readers interested in the applications of SL in the university setting. It is, therefore, an especially recommendable text for social educators, university teachers, students, and any professionals who seek ways to implement active methodologies for social improvement.

Paula Álvarez-Urda

Gairín-Sallán, J. (Coord.) (2024).

Dirección y liderazgo de los centros educativos. Naturaleza, desarrollo y práctica profesional [Management and leadership in educational centres. Nature, development, and professional practice].

Narcea. 302 pp.

School management is one of the most important factors in the quality of educational centres as the management is responsible for ensuring that the organisation functions correctly and fully meets the demands of people and of the society of which the centre is a

part. The debate about the desired management model for school settings and how it relates to leadership are topics that still await political and professional decisions, although it could be said that management centres more on the tasks to be performed while leadership relates to how to ensure that people get involved in carrying them out.

The work reviewed here upholds the need to maintain and foster models for studying the leading managers, making known the strengths and weaknesses of the proposals relating to the managerial role and leadership. It considers the impact of managers on the functioning of the institution on the basis of the projects that they implement, the relations they promote, and the stability that they give to the institution's project.

This publication comprises ten chapters, arranged in three sections, with the involvement of thirteen authors of recognised standing in Spain. The first section, with the title "Nature and meaning of managers as institutional authorities", comprises the first three chapters. In the first chapter, "Management and leadership: two faces of the same coin?", the coordinator of the publication, Gairín Sallán, examines in depth the link between management and leadership and considers the possibilities that present themselves in organisational practice, arguing that while this approach is no easy task, it is a necessary one in an international context in which traditions and languages with overlapping meanings cross.

In the second chapter, "The managerial role in the national and international context", López Rupérez analyses a significant part of the empirical evidence for the impact of school management on student performance, considering the professionalisation of the managerial role from an international perspective as an essential aspect of policies centred on school management, and presenting a systematic analysis of the evolution of the Spanish school management model in the different laws that have regulated it since the return to democracy. In chapter three, "Evolution of leadership in the national and international context", Tintoré-Espuny and Gairín-Sallán offer an analysis of recent studies on educational leadership and their most important contributions at a national and international level, centring on the principal reports and research groups referring to what has been happening in Spain.

Section two, "The professional development of managers", contains chapters four, five, and six. In chapter four, "The initial training of school management in Spain", Álvarez-Fernández and Villa-Sánchez consider entry requirements, merit-based competition, competences, and experience in management and leadership, training before and during the selection process, the managerial body, and the professionalisation of school management, reflecting on the importance of and need for competent managers who perform the role of leadership with experience, training, and knowledge. To do so, they suggest possible proposals and realistic options aimed at improving the exercise of an ever more necessary and essential leadership, taking into account the level of complexity and need for change that society demands. For her part, Tintoré-Espuny, in chapter five, "The continuous training of managers", considers the continuous training of school leaders in depth, focussing on strategies of support, retention, motivation, and intensification, and noting how training should be approached if its aim is to build loyalty in people who are key to improving education systems.

In chapter six, "Handover and transition in the management of schools", Antúnez-Marcos and Silva-García reflect on management succession in educational centres. They see the transition as a critical period in the life of the institution, and they emphasise the need to be fully aware of the consequences for those who receive the position, who must undertake and fully and properly handle a change of professional role, and for those who leave it, who must also be aware of the responsibilities that they take on to ensure that the transitional period is satisfactory and efficient.

Section three, with the title "The professional practice of managers", contains the last four chapters. In chapter seven, "Managers in vulnerable settings", Murillo-Torrecilla and Azorín-Abellán address the decisive role of school management for students' integral development and for the quality of the teachers and schools located in vulnerable settings. These settings require a different perspective, not just focussed on learning and high-quality teaching but also on equity and social justice.

In chapter eight, "Managing professional training", Espinós-Espinós and Andrés-Villena condense the distinguishing aspects, from the point of view of management and organisation, of an educational centre that provides professional training (PT). They first contextualise current PT on the basis of the recent publication of the professional training act and of the royal decree approving the regulations that implement it. They then reflect on the future prospects of this training pathway. In chapter nine, "Managing rural centres. Specific features of management in these settings", Cantón-Mayo presents a general overview of rural education, before addressing the particular features of the management of rural centres. He reviews the entry requirements and the lack of competition in applications for the post of head and ends with a ten-point plan for the improvement of the functioning of rural management, in which two questions stand out: enthusiasm and commitment on the one hand, and connection with the surrounding context on the other, to generate satisfaction as a general indicator of educational quality in this way.

Finally, in chapter ten, "Networks of managers for improvement", Gairín-Sallán, Galdames-Calderón, and López-Crespo address online work, recognising that networks favour change, offer a medium for improving the exercise of management, leadership, and shared responsibility, and informing about the known networks of educational managers and leaders that must act as a reference for leading managers to be able to project their work and concerns beyond their everyday activity.

All of this is collected in an interesting work aimed at managers, academics and researchers, assessors, teachers, and people in charge of education systems. A work that seeks to disseminate the existing knowledge, providing theoretical and practical frameworks that support their intervention in education centres. It asserts the need to encourage and maintain models for studying managers and leaders that go beyond mere structural analysis and advance in the description and knowledge of the complex human dynamics on which they act. It also presents advances in this topic, extending to models of distributed management with transformative leaders, centred on learning processes and able to promote more efficient, inclusive, safe, healthy, sustainable, and personally and socially useful educational centres.

Sheila García Martín

Meirieu, P. (2022).

Lo que la escuela puede hacer todavía por la democracia. Dos o tres cosas que sé (quizás) sobre educación y pedagogía [What the school can still do for democracy: Two or three things I (maybe) know about education and pedagogy].

Editorial Popular. 210 pp.

In this book, Philippe Meirieu dedicates himself to an exercise akin to that of the classic *confessions*, so in vogue among thinkers from earlier centuries. It is, of course, an eminently pedagogical confession. And yet it would not be an exaggeration to say that the text also has much of the style of *memoirs*, exercises in writing dedicated to setting out in black and white a synthesis, a journey's end, even an *intellectual testament*. Through simple, clear, and deft writing, which uses his own experience as a student, pedagogue, and educator as a narrative thread, Meirieu's book drops a plumb line onto the surface of the world and the time in which we live with the aim of, on the one hand, diagnosing their hegemonic rationales and, on the other, exploring the possibilities and limits of pedagogical thought and educational practice. Both of these intentions can be seen in the long but declarative title of the book, *What the school can still do for democracy*, but also in the intentionally modest subtitle, *Two or three things I (maybe) know about education and pedagogy*. In this case there is no possible *maybe*; Meirieu possesses, and supports with conviction and good arguments, a pedagogical and political knowledge accumulated through extensive practice.

The book starts with a precise diagnosis of the world we inhabit. This process of mapping is necessary as an exercise in anticipation and justification of what, towards the end he will

propose as the place and role that the school and education can still occupy in this world. Necessary, yes, but also very obvious. However, we do not see this exercise in the obvious as a demerit of the author. What happens is that the contemporary rationales of immediacy and hyperstimulation, the capricious habits that are confused with freedom, and the irreflexive automatisms spurred by advertising, the media and social networks are so evident that they leave little room for doubt for anyone who pays the most minimal attention to what is happening to us. Everyone will feel identified with the description of the world that unfolds throughout this book.

After this diagnosis, which is both concerned and concerning, Meirieu strives to send a message, as he has previously done in other texts, to those of us who still devote ourselves to the task of pedagogy. Messages in bottles or capsules thrown into a tempestuous sea containing brief reflections that sometimes seem like cries for help or, at least, for attention. Messages that alert us and invite us to stay attentive and to ready ourselves to be in a position to confront the many obstacles and dangers that today stalk pedagogical thought and educational praxis. What would these obstacles be? Some are all too well-known, they are already classics; others appear to gain ground in our present day: the fatalism or determinism characteristic of certain sociological or psychological languages, the technification and protocolisation of life and education, rampant individualism and self-absorption, the decline of thinking in favour of recipe books, the abandonment of creative effort for the passive ease of applying a formula, and so on. Meirieu portrays a time in which the social and educational sciences have become embroiled in the quasi-entomological classification and labelling of problems, of deficiencies and of disorders that would seem to attest to a need for standardised treatments and predisposed responses, but which appear to forget that (unlike therapeutic treatment),

> the pedagogical focus does not systematically seek to base its proposal on what it finds in the child's past, but rather to propose over and over the items from teachers' methodological arsenals that can help them project themselves forwards and so overcome the obstacles that it finds. (pp. 64–65)

Therapy looks back: pedagogy looks forwards.

It is fair to note that the systematic nature and insistence of Meirieu's thought is not based on any revealed certainty or demonstrated truth, nor even on a verifiable truth. Its centre of gravity is a hypothesis that is at the very least paradoxical and particular insofar as it is at the same time as undemonstrable as it is irrefutable: the *educability* of all people. Educability is scientifically undemonstrable because, "however far we go with brain imaging, we will never be able to decipher, formalise, and reduce to a handful of formulas the extraordinary variety of our desires ... [nor the desire of or the refusal to learn]" (p. 83). And it is with regard to this primal intellectual and ethical approach that Meirieu recovers and puts on the table the work of pedagogues, educators, who made the premise of the educability of all people their pedagogical and ethical principle. The projects and practices of Pestalozzi, Jacotot, Don Bosco, Makarenko, Montessori, Ferrer, Tolstoy, Oury, Korczak, and Freinet parade through the text, along with a great cast of thinkers and actors involved in the right for, necessity of, and potencies of education. All of them share a conviction that does not ignore the particularities of the social and personal situations of each individual but which does not turn limits and obstacles into an alibi for educational inaction or an excuse for failure. Meirieu formulates and synthesises the idea that inspires his educational projects in a phrase that should be written over the doors of institutions and in the minds of educators: "predispositions are not predestinations" (p. 69).

The assumption of and confidence in the educability of all people do not lead Meirieu to argue that absolutely anything is possible and/or feasible. Returning to the central idea of one of his best texts, *Frankenstein educador*, the author notes the need for caution in the face of any fantasy or delusion of educational omnipotence. Educability cannot ignore and must not deny the negativity and limits of education and, in first place, the need for desire, commitment, and participation from the person who is to learn. There is no will, formula, technique, or protocol

that can dispense with the freedom of individuals who consent and are committed to their own educational process, or ones who do not. When it is a case of educating and of learning, there is no way to start anything on behalf of another, of obliging another to learn and to grow. Educators have the responsibility to create all types of conditions for learning (Meirieu writes fine pages on the institution, the "fertile imposition" that becomes a resource, time...); this is our share of responsibility. However, we cannot learn for others, save them from following their own path, break for them the circle of what is previously established and enables the leap from not knowing to wanting to know.

The spirit of our age, as Meirieu knows, seems too much like a strong tide, even a violent tempest, that brings the messages sent out in that bottle back to the same shore time and again. Maybe very few people will find them, be able to read them and meditate on them. But anyone who delves into reading this book will find that Meirieu's wake-up call, from the humility of a mature and serene thought, contains markers of fruitful paths that we would do well to continue to explore. If only, as he himself advises, not to fall into the temptation of misanthropy. Moreover, is exploration not another of the possible names for this adventure that we continue to call education?

José García Molina
Roberto Moreno López

In memoriam

Richard Pring (1938-2024): A realistic and profound philosophy of education

Richard Pring was born in Sheffield on 20 April 1938 and passed away peacefully on 6 October 2024 at his home in Oxford, surrounded by his loving family.

A fellow of Green Templeton College, he was head of the Department of Education at the University of Oxford for fourteen years until his retirement in May 2003; editor of the *British Journal of Educational Studies* (1986-2001); doctor honoris causa from the University of Kent (1984) and from the Institute of Education at University College London (2015); and recipient of the award of distinction from the Aga Khan University, Karachi (2008).

Over his long academic career, he wrote some twenty books and numerous articles; he wrote reports and gave talks and lectures to very varied social sectors in many locations; he taught; he supervised 40 doctoral theses and other research work, and he advised countless groups of students and academics from all over the world.

After his retirement, he completed three important research projects: the "Nuffield review of 14-19 education and training" over six years, funded by the Nuffield Foundation; the "Evaluation of the Oxford bursary scheme", funded by Atlantic Philanthropies; and the "Evaluation of quality assurance in 11 Arab universities", funded by the United Nations Development Programme (UNDP).

The editors of the book in honour of him, entitled *Thinking philosophically about education: Selected works of Richard Pring*, published by Routledge in 2018, introduced the collection as a "selection [that] displays the knowledge and rigor that has made Richard Pring one of the world's most respected and eminent scholars of the field of philosophy and education". They were not exaggerating.

After completing his initial studies in Nottingham, he read for a BA in Philosophy at the English College and Gregorian University in Rome (1955-1958). These years of study in Italy left a deep impression on his thought and his way of life, and allowed him to familiarise himself with the Greco-Roman tradition and *continental philosophy*, as it is known in Britain. On his return to the United Kingdom, he continued his philosophical studies with A. J. Ayer at the University College London.

The philosophical thought of Richard Pring combined both traditions (the continental and the analytic) in an original and fruitful way because, as he himself observed, he abhorred the (often false) dichotomies that were established, for example, between empiricism and rationalism, idealism and realism, professional education and liberal education, etc.

His dedication to teaching was not his first professional choice, but he discovered his vocation while working with Derek Morrel to create and launch the Schools Council (1962-1965). There he realised that for the education system to fulfil its role well, politicians must (and this is no small thing) limit themselves to funding it. It is families that should determine its aims, that is to say, the type of education they want for their children. And teachers, as experts in the field of education, must be able to dedicate themselves to doing their work (educating people) without pressures from areas outside this undertaking.

He started work as a teacher in a London comprehensive school and at Goldsmiths from 1965, while working on his doctoral thesis (supervised by Richard S. Peters) at the Institute of Education at the University of London. In 1971 he moved to Cambridge, and in 1974 he returned to the Institute of Education at the University of London to lead the area of philosophy and to set up the area of curriculum studies alongside Lawton (sociology), Gibby and Ing (psychology), and Gardon (history).

In 1979 he joined the academic staff of the University of Exeter, and from 1989 what was then the Department of Educational Studies (now the Department of Education) at the University of Oxford, where he held the first chair in education created by that university. While working as head of the department, he wanted to combine his academic work with teaching, one day a week, at a nearby comprehensive school, to *keep his feet on the ground*, and so avoid the excessive intellectualism into which the philosophy of education can fall.

* * *

Richard Pring devoted himself for more than 50 years to the study and practical implementation of philosophical questions that are fundamental to the good development of education: clarifying the goals of this task with a special focus on promoting democratic coexistence; defending critical realism; studying the role of teachers as experts in the field of education, simultaneously educators and researchers; the need for philosophical reflection when taking prudent decisions regarding educational policy, etc. In recent decades (conscious of the increasing pace of social change), he identified and fought the risk represented by introducing ideas, terms and procedures characteristic of an entrepreneurial business mentality into educational language, and he underlined the need to refocus the educational task so that it can fulfil its objectives.

Richard Pring's thought daringly asks questions about what it means to be an educated person in the twenty-first century; the possibility of providing a vocational education that simultaneously has a humanistic, liberal character; establishing the content and curriculum design; and the need to develop a philosophy of education that *studies educational reality* to influence *action* effectively, enhancing teacher training and the development of *educational policies* that respect its nature without being motivated, or at least not exclusively, by economic or partisan criteria.

He was highly knowledgeable about John Dewey's thought and the discussion about the *Common School* and its suitability for creating a *common culture in democratic society* was one of the topics that accompanied his intellectual journey. In the last decade (coinciding on this point with the proposals of T. H. McLaughlin and J. Sacks), he championed the need to establish a third way: a common school system that envisages the existence of educational centres with their own ethos, promoted by different family, civil or religious institutions. He was an advocate of maintaining different voices deriving from traditions that have rational roots, wisdom, and ethos, within the increasingly multicultural contemporary society.

* * *

Richard Pring was a philosopher of education who enjoyed rightful international renown and has left a decisive mark in this academic field. But in addition, and above all (and this is confirmed unanimously by his colleagues, his students, and so many others who had the privilege of interacting with him and enjoying his friendship), he was an excellent person. Generous with his time and his knowledge, he worked selflessly in favour of education, the family, and social justice. Among other aspects, his humble affability stands out: he never gave himself airs, even when his fame preceded him. He was a friendly, kind, hospitable person, a good friend to his friends, an excellent conversationalist, with a sharp and intelligent sense of humour.

He loved the university and the city of Oxford. And it was common to see him cycling between his home on Banbury Road; the emeritus professors' room in the Department of Education, which Pring jokingly called the *geriatrics' room*; the vegetable patch he tended with Faye in Port Meadow; his local pub The Rose & Crown on North Parade, which saw so many moments of joyful philosophical conversation; and the church of Saint Aloysius on Woodstock Road, which he attended at least weekly.

He took part in 27 marathons, and his family and friends will not forget the celebration for his 70th birthday after running the London Marathon in 2008. A tireless worker, he stayed fit and active until he started to experience mobility problems and his memory started to fail him a few months before his passing.

He was an excellent academic host and enjoyed inviting those of us who were staying in Oxford to formal dinners at Green College, because he knew that we enjoyed this experience of the university. And he enjoyed sharing the produce from his garden at more familiar dinners in his home, after a glass from the bottle of Tío Pepe that I brought from Madrid following a little tradition that emerged spontaneously.

I am not the only person who laments having lost someone who was a point of reference in his field, an interlocutor, and a good friend on this Earth. But, for those of us, like Richard, who are convinced that the story does not end here, this is not farewell but only "Many thanks, Richard, and until we meet again!".

Works by Richard Pring

- *Education, social reform and philosophical development: Evidence from the past, principles for the future*. Routledge, 2021.
- *Challenges for religious education: Is there a disconnect between faith and reason?* Routledge, 2020.
- *The future of publicly funded faith schools. A critical perspective.* Routledge, 2018.
- *Una filosofía de la educación políticamente incómoda* (edited and translated by M. G. Amilburu). Narcea, 2016.
- *The life and death of secondary education for all.* Routledge, 2013.
- *Education for all: The future of education and training for 14–19 year-olds in England and Wales.* Routledge, 2009.
- *Common school and the comprehensive ideal: A defense by Richard Pring with complementary essays* (edited with M. Halstead & G. Haydon). Wiley-Blackwell, 2008.
- *John Dewey: The philosopher of education for the 21st century?* Continuum, 2007.
- *Comprehensive education: Evolution, achievement & new direction* (edited with M. Hewlett & M. Tulloch). The University of Northampton, 2006.
- *Evidence based practice in education* (edited with G. Thomas). Open University Press, 2004.
- *Philosophy of education: Aims, theory, common sense and research.* Continuum, 2004.
- *Philosophy of educational research*. Continuum, 2000 (3rd edition, 2015).
- *Affirming the comprehensive ideal* (edited with G. Walford). Falmer Press, 1997.

- *Closing the gap: Liberal education and vocational preparation*. Hodder & Stoughton, 1995.
- *Academic respectability and professional relevance: An inaugural lecture delivered before the University of Oxford on 8 May 1991*. Clarendon Press, 1991.
- *The new curriculum.* Continuum, 1989.
- *Personal and social education in the curriculum*. Hodder & Stoughton , 1984.
- *Knowledge and schooling*. Open Books, 1976.
- *Social education and social education* (edited with J. Elliott). UCL Press, 1975.

Books in honour of Richard Pring

- *Thinking philosophically about education: The selected works of Richard Pring*. Routledge, 2018.
- *Education, ethics and experience* (edited by M. Hand & R. Davies). Routledge, 2016.

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Revista Española de Pedagogía

Revista Española de Pedagogía (REP)
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Instructions for authors

A. Purpose of the journal

Revista Española de Pedagogía was created in 1943 and its search for excellence has always distinguished itself. It has been the first journal of pedagogical research in Spanish that has been indexed in the most relevant international databases. It accepts only original, high quality submissions from anywhere in the world that help advance pedagogical knowledge, avoid mere opinion polls, and are of general interest. Articles must follow commonly accepted ethical criteria; in particular, in cases of plagiarism and falsification of data, the author will be penalized by the rejection of their submissions. Articles with more than three authors will only be accepted if a reasoned explanation is provided, and in any case, the intellectual collaboration of all the signatories must be certified, not just data collection. Three issues a year are published.

B. Languages used in the journal

REP publishes all scientific articles and bibliographic reviews in Spanish and English.

When an article is accepted for publication and in order to guarantee the use of correct academic language in both languages, an agreement will be reached with the authors for the translation of their article into English or Spanish. If necessary, the translation will be made by professional experts who are native speakers of each language according to the conditions described in **H. Article Processing Charges (APCs)**. All contents of the original article, including tables and graphs, must be translated.

Texts cited in the article that were originally published in Spanish, even if they were later published in an English translation, must also be included in their original language. In this way, translators will not have to translate these texts again. In particular, it is preferable for a classic text to be cited with both versions: that of its original and that of the printed translation.

C. Requirements of originals

C.1. The publication of research articles must be in accordance with the *Publication Manual of the American Psychological Association* 7th Edition, 2020, (www.apastyle.org). Here are some basic points which must be strictly followed by the authors.

1) The length of the contributions, including all sections, will be between 6000 and 7500 words, using the Times New Roman font.
2) Articles should be submitted following the structure and formats indicated in the template that can be found on the journal's website (https://www.revistadepedagogia.org/rep/plantilla_articulo_eng.docx).
3) In cases where authors have compound names or use more than one last name, such as Hispanic authors, they should be connected with a hyphen. Example: María-Teresa Calle-Molina.

4) The authors must indicate the role of each one using **CREDIT taxonomy** (example available in the template).
5) 6 to 8 keywords should be included.
6) Following the APA model, the References list will be at the end of the article, in alphabetical order by surname, naming all the authors up to a maximum of twenty, with the second line indented.

The translation into English or Spanish should be included in square brackets next to the original title of the publications, since in the Spanish version of the article, the Spanish translations of the titles of the works published in English will be provided. **DOI of publications should be always included whenever possible.**

Some examples are given below:

• **Books:**

Genise, N., Crocamo, L., & Genise, G. (2019). *Manual de psicoterapia y psicopatología de niños y adolescentes [Manual of Psychotherapy and Psychopathology of Children and Adolescents]*. Editorial Akadia.

• **Journal articles:**

Siegel, H. (2002). Philosophy of education and the Deweyan legacy. *Educational Theory, 52* (3), 273-280. https://doi.org/10.1111/j.1741-5446.2002.00273.x

• **Chapters in multiauthor books:**

Mendley, D. M. (2005). The research context and the goals of teacher education. In M. Mohan & R. E. Hull (Eds.), *Teaching Effectiveness* (pp. 42-76). Educational Technology Publications.

• **References to web page:**

Guarino, B. (2019, January 3). How will humanity react to alien life? Psychologists have some predictions. *The Washington Post*. https://www.washingtonpost.com/news/speaking-of-science/wp/2017/12/04/how-will-humanity-react-to-alien-lifepsychologists-have-some-predictions

U.S. Census Bureau. (n.d.). *U.S. and world populatíon dock. U.S*. Department of Commerce. Retrieved July 3, 2019, from https://www.census.gov/popclock/

7) References in the body of the article are written in an abbreviated way that differs from what is used in the Reference list. Specifically, if the reference is a direct quotation, the text must be enclosed in quotation marks and, usually at the end, the author's last name, year and page number are placed in parentheses: "(Taylor, 1994, p. 93)". If it is not a direct quotation, and so is not enclosed in quotation marks, the page number will be omitted: (Taylor, 1994). When the author's name is given in the text he/she will not be included in the parenthesis: "According to Taylor (1994, p. 93), culture ..." When an idea is supported by several authors, they will be separated by semicolons: "(Taylor, 1994; Nussbaum, 2012)".

To quote several works by one author, only the years will be added after the author, with letters added if it is necessary to distinguish between publications from the same year: "(Taylor, 1994, 1996a, 1996b)".

When citing works by 3 or more authors, only the first one is cited followed by "et al".

Textual quotes will be written in-line if they have fewer than 40 words. If the quotation has 40 words or more, it will be placed in a separate paragraph, without quotation marks, indented by 0.5 cm and in the body text style in a typeface one point smaller. Following the quotation, the author, the year and the page are added in parentheses. The material quoted is reproduced textually, including spelling and punctuation.

Other authors' texts will be quoted following the criterion of consulting the originals that are written in those languages and using their official translation when such text has also been

edited in the other language. If this official translation is not available, the quoted text will be offered to the readers translated by the author of the article (noting that the translation belongs to the author of the article), or by the sworn translator hired by the journal.

The use of endnotes will be limited. They must have correlative numbering, using the automatic system in Word and they will be placed after the body of the article and before the References that list everything cited in the text.

8) To highlight a word, italics will be used. Underlining or bold should not be used.
9) The number of lists, diagrams, tables and figures in the text should be limited. These will be called Tables or Figures. In any case, they must be where they should be in the article. In tables, columns should be aligned using tabs (only one tab per column). When quoted in the text (e.g., "as we see in Figure 1 on core subjects"), only the first letter will be capitalized, while at the top of the Table or Figure the whole word will be in small caps, in 12 point capital with Arabic numerals, followed by a point, writing the title in normal text.

The text within the table will be written in the same typeface as the normal text and in 9 point. The source of the table or figure will be placed below it, without a space of separation, stating the Source, colon, surnames, comma and year.

Graphs and tables, in addition to appearing where they should in the article, have to be sent in their original editable format whenever possible. Images should always be sent in high resolution (300 dpi).

10) Equations will be centered, separated from the main text by two lines. They should be referenced in the text, stating the number of the equation; therefore, they will be accompanied by Arabic numerals, aligned to the right and in parentheses in the same line.
11) The article will conclude with a list of the bibliographical references of all the works cited, except for the works cited whose authors include one of the authors of the article. In these cases, these works will be listed in the version with names of the authors, while in the anonymous ones they will not be included in the references, although they will appear in the text, where they will appear as follows: "(Author, 2022, p. 39)". Citation of publications belonging to journals or publishers considered "predatory", i.e., those that lack a rigorous and quality scientific evaluation system (e.g., double-blind peer review) and whose main purpose is not to disseminate knowledge but to obtain an economic profit by charging publication fees to authors. Lists of predatory publishers and journals can be consulted at: https://beallslist.net/
12) Finally, a brief biography of the authors should be included, of a maximum of ten to fifteen lines, which should mention their ORCID and the main aspects of their academic career, current academic situation and the university where they obtained their higher academic degree.
13) Authors of published works that have been carried out with research data including the sex variable are encouraged to report whether the conclusions have taken into account possible differences between sexes.

C.2. In addition to research articles, the **Revista Española de Pedagogía** wishes to keep up to date by publishing, in various formats, other works and relevant information in pedagogical science. For this reason, it publishes reviews of books, current news, brief commentaries on educational problems, readers' comments on articles published in the last year, etc. The reviews, always on recent books from relevant publishers, will be between 1200 and 1700 words. They will be headed by the book's details as follows:

Villardón-Gallego, L. (Coord.) (2015). *Competencias genéricas en educación superior [Generic competences in higher education]*. Narcea. 190 pp.

Commentaries will be of moderate length. The analysis of published articles will be sent, from the journal, to the author of the analysed article, so that he/she can prepare a response.

D. Policy on the use of artificial intelligence (AI) in articles

Authors must follow the AI use policy established by Revista Española de Pedagogía and declare compliance with the following sections before submitting their articles.

1) Authorship of the article:
   - Author(s) cannot cite AI as the author or co-author of the submitted articles.
2) Use of AI in the writing process:
   - The authors may only use generative AI or AI-assisted technologies to improve the language and readability of this article.
   - If AI is used, authors must cite it in the References section according to the use of APA standards in force in the journal.
3) Use of Language Multimodal Model (LMM) or Large Language Model (LLM) in the development of the article:
   - The authors are responsible for reviewing and validating the AI-generated information.
   - The authors should indicate and document the use of LLM or LMM in the Methods section.
4) Use of AI-generated images and videos in the article:
   - The use of AI-generated images and videos in articles is not permitted.
5) IA Policy Compliance:
   - In the case of non-compliance with the IA policy, the journal may reject (pre-publication), retract (post-publication), or publish an editorial notice on the article.

The acceptance of **this declaration is mandatory** if the authors wish to publish it in the journal.

E. Submissions

Submission of papers is open on a permanent basis. Special deadlines will be established for publicly announced monographic issues.

All papers must be submitted through the journal's web platform by clicking on the following link: Enviar artículo | Submit Article

After creating the user, the system will guide you through a series of pages in which you will be asked to accept the Submission agreement, the journal's policies, the requirements for papers submitted to the journal, and to enter the data related to the authors and the submitted article. Only papers that comply with these policies and journal requirements will be considered for evaluation.

The system accepts Word or RTF files. The system will automatically generate a PDF for you. Images or graphics should be placed in the article in their proper place in the highest possible quality. If the images are not of sufficient quality (300 dpi), they will be requested again from the authors once their article has been accepted for publication. Tables should be placed in the article in the appropriate place and be editable.

The corresponding author will receive an automatic notification confirming receipt of the article. This notification will indicate the link through which you will be able to access your article on the journal's web platform and make any modifications or send new files that may be necessary during all the evaluation and editing process of the article.

F. Submissions evaluation and editorial processing times

The editors will make an initial assessment of the article based on the suitability of the proposals to the editorial criteria of the **REP**. Authors can consult more information on the type of articles accepted by the journal at the following link: Scope. The result of this assessment will be notified within a maximum period of one month. If a positive first evaluation is received, the paper will be peer-reviewed. Authors will receive the result of the second evaluation within approximately three months.

Each article submitted will be subject to the journal's editorial decision process. The journal is under no obligation to publish the article.

The deadline established for the completion of the evaluation process is four months, counting from the notification of receipt of the article. At the end of this period, the author will normally be informed of the final result of the evaluation. Authors can consult more information on the evaluation procedures followed by the journal at the following link: Submissions evaluation and editorial processing times. An author whose article has not been selected may resubmit other papers at a later date.

Accepted articles will begin the editing process (translation, style correction, layout, etc.), to be subsequently included in the corresponding issue, according to the decision of the editorial direction. Once the editorial process has been completed, the preliminary layout of the text will be sent to the authors for final revision and approval. The editing process usually takes a maximum of two months.

The average time between the receipt of an article and its publication is six months.

Publication of articles does not entitle the author to any remuneration.

G. Publication costs

REP provides diamond open access. Publication is free and open with no costs to authors or readers.

H. Article Processing Charges (APCs)

In order to guarantee the quality of published scientific articles, we follow a policy of only accepting professional translations from accredited translators or translations from authors whose mother tongue is Spanish or English or who have a high level of proficiency in these languages.

Once an article has been approved for publication in the **REP**, in cases where a professional translation into English or Spanish is required, authors must pay for the translation under the following conditions:

- If it is an article supported by a research grant, or similar, the invoice will be paid in full by the body supporting the research. The total cost will generally depend on the number of words translated. If this institution has an accredited professional translation service, translations carried out by the funding body will also be accepted.
- In the case of an article without research or publication support, the author will pay the maximum amount of 400 euros (including 21% VAT), and the journal will be responsible for the rest of the quoted translation costs, which will depend on the number of words translated.

The costs of translating bibliographical reviews or other non-scientific content published in the journal in Spanish and English will be fully covered by the journal.

I. Dissemination of published papers

Once the papers have been published in the **Revista Española de Pedagogía**, authors can contribute to dissemination tasks, both by supporting the ones that the journal itself carries out and by their own initiative.

The **Revista Española de Pedagogía** has profiles on the main social networks (Facebook, Twitter and LinkedIn), where it disseminates the papers it publishes, consequently we recommend that authors follow the journal on these networks and share their publications.

https://www.facebook.com/revistadepedagogia

https://twitter.com/REPedagogia

https://www.linkedin.com/company/revista-espanola-de-pedagogia

To assist in the dissemination of their articles, once approved for publication, authors will be asked to send:

- Two key summary sentences of their article of a maximum of 180 characters for use on social network X.
- A summary of your article of about 90 words for use on Facebook and Linkedin.
- A video of approximately 1 minute in length, in horizontal format, summarizing the main ideas developed in the article for use on our social networks would also be appreciated.
- Our journal is also part of the academic blog Aula Magna 2.0 (http://cuedespyd.hypotheses.org/), where entries on topics of interest for educational research are published periodically, as well as reviews of articles, which contribute to its dissemination. Aula Magna 2.0 publishes an entry dedicated to an article of the **REP** for each published issue, for which the authors will be asked to provide a longer summary, of between 600 and 1500 words, in a language accessible to the general public and a high-resolution photograph.

Authors are also encouraged to deposit or disseminate accepted articles in:

- Institutional repository of their university and public repositories (SSRN, Zenodo, etc.).
- Google Scholar, ORCID, Dimensions, PlumX, etc.
- Scientific social networks.
- Social networks (Facebook, Twitter, LinkedIn, etc.).
- Personal or institutional website, blog, etc.

It is required that all the bibliographic data of the published work be detailed in these publications.

Each author should consider using the most effective means of disseminating their article, obtaining citations and contributing to the advancement of pedagogical knowledge.

Databases and bibliographic directories

Social Sciences Citation Index, Scopus, Cabell's International, Catálogo Latindex, Contents Pages in Education, Dialnet, Dulcinea, EBSCO Academic Search Complete, EBSCO Academic Search Elite, EBSCO Academic Search Premier, EBSCO Academic Search Ultimate, EBSCO Education Full Text, EBSCO Education Research Complete, EBSCO Education Source, EBSCO Education Source Ultimate, EBSCO Serials Directory, Educational Research Abstracts Online (ERA), Fuente Académica, Fuente Académica Plus, Fuente Académica Premier, Google Scholar, IBR Online Internationale Bibliographie der Rezensionen geistes- und sozialwissenschaftlicher Literatur, IBZ Online Internationale Bibliographie der geistes- und sozialwissenschaftlichen Zeitschriftenliteratur, IRESIE. Base de datos sobre Educación, JSTOR, Matriz de Información para el Análisis de Revistas (MIAR), MLA International Bibliography, Periodicals Index Online (PIO), Psicodoc, Redined – Red de información educativa, Social SCIsearch,
Ulrich's Periodicals Directory.

Classifications and rankings

Journal Citation Reports (JCR), Scimago Journal & Country Rank (SJR), Scopus Sources, Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca (ANVUR), Clasificación Integrada de Revistas Científicas (CIRC), Dialnet Métricas, European Reference Index for the Humanities (ERIH).

Library catalogs

Catálogo Colectivo de la Red de Bibliotecas Universitarias Españolas (REBIUN), Catálogo Colectivo de Publicaciones Periódicas (Biblioteca Nacional), Catálogo Colectivo del CSIC, Catálogo de la Biblioteca de Educación (Ministerio de Educación y Formación Profesional), Catalogue Collectif de France (CCFr), Catalogue SUDOC (Francia), Library Hub Discover (Reino Unido), The British Library Current Serials Received, Worldcat (OCLC).

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