

Teacher education for sustainability: Current practice and outstanding challenges

Formación docente para la sostenibilidad: práctica actual y desafíos pendientes

Ingrid Mulà @ ¹, Daniella Tilbury @ ^{1,2}

¹ Universitat de Girona (Spain)

² University of Cambridge (UK)

Abstract ∞ The move to a sustainable future requires that we all learn to live, work and engage with our planet differently. Teacher education has been recognised as one of the most significant catalysts for bringing innovation and sustainability into education and thus supporting learners to contribute to the green transition. This theoretical paper seeks to provide an understanding of the need for, and challenge of, mainstreaming Education for Sustainable Development (ESD) and describes the critical role of teacher education in advancing sustainable development. Drawing on findings of a literature review and case study collection commissioned by the European Commission, the authors identify key challenges and lessons learned to enhance teachers' professional learning in ESD. Future practice is identified to support efforts in this area and help teachers and teacher educators, including mathematics educators, to build competences that better allow them to connect their work and expertise with the sustainability imperative.

Keywords ∞ Teacher education; Sustainable Development; Education for Sustainable Development; Initial teacher education; Professional development

Resumen ∞ El paso a un futuro sostenible requiere que todos aprendamos a vivir, trabajar y relacionarnos con nuestro planeta de manera diferente. La formación del profesorado ha sido reconocida como uno de los catalizadores más importantes para llevar la innovación y la sostenibilidad a la educación y, por lo tanto, apoyar al alumnado para que contribuya a la transición verde. Este artículo resalta la necesidad de abordar la Educación para el Desarrollo Sostenible (EDS) y describe el papel fundamental de la formación docente en el avance del desarrollo sostenible. Basándose en un estudio encargado por la Comisión Europea, las autoras identifican los desafíos clave y las lecciones aprendidas para mejorar el aprendizaje profesional de los docentes en EDS y proponen acciones para ayudar a los docentes y formadores de docentes, incluidos los docentes de matemáticas, a desarrollar competencias que les permitan conectar mejor su trabajo y experiencia con el imperativo de la sostenibilidad.

Palabras clave ∞ Formación del Profesorado; Desarrollo Sostenible; Educación para el Desarrollo Sostenible; Formación Inicial de Maestros/as; Formación Continuada

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1. INTRODUCTION

The world has been shaped by unsustainable thinking and practices and this has led us to a state of climate emergency and systemic global dysfunction. Recently, there has been a significant push for changing this outlook with renewed energy stemming from Agenda 2030 for Sustainable Development and its Sustainable Development Goals (SDGs) (UNGA, 2015). Although not legally binding, the SDGs seek action in areas of critical importance to the future of people and the planet. The EU Green Deal is also an example of the ambitious efforts taken internationally to fight climate change and environmental degradation (European Commission, 2020). These interconnected global responses seek to transform every aspect of society and the economy and recognise that the move to a sustainable future requires that we all learn to live, work and engage with the planet differently.

The Berlin Declaration on Education for Sustainable Development (UNESCO, 2021a) acknowledges that education and learning are central not only to attaining SDG 4 (Quality Education), but also to the rest of the SDGs. Authoritative documentation attests to the contribution of education to equipping learners with sustainability competences (UNECE, 2022; UNGA, 2020). Efforts to transform our societies must thus prioritise teacher education – developing teachers' understanding of Education for Sustainable Development (ESD) and their ability to transform learning experiences and opportunities have been identified as key levers to the sustainability transition (UNESCO, 2020).

In this paper, the authors draw on lessons learned from their research and engagement in informing policy frameworks and practices in teacher education for sustainability for over three decades. Building on findings from a recent study (see Mulà & Tilbury, 2023) and case study collection (see Tilbury & Mulà, 2023) commissioned by European Commission, this article seeks to provide a better understanding of the need for and challenge of mainstreaming ESD in teacher education.

As a context to this paper, it is important to recognise that mathematics, teacher education and ESD are rarely spoken of in the same sentence. Ningsih & Juandi (2019) make the case for establishing these connections arguing that this association could help mathematics education address 21st Century learning needs. Recently, some authors have engaged in these dialogues bringing these concerns together and have provided examples of how mathematics education for sustainable development looks like in practice (see Alsina, 2022; Alsina & Calabuig, 2019; Vásquez & Alsina, 2021). This work can help teachers and teacher educators understand the type of competences that better allow them to connect their work and expertise with the sustainability imperative.

2. WHAT WE MEAN BY EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

ESD encompasses a new vision of education and learning which unlike other forms of adjectival education – such as citizenship, health or peace education – calls for a reorientation of educational frames and systems (Sterling, 2001). ESD empowers people of all ages to assume responsibility for creating a sustainable future, seeking

alternative scenarios where well-being, social justice, cultural diversity, human development, and the health of our planet are interlinked.

Embedding ESD in education and learning is not about adding sustainability themes to the curriculum or questioning educational practices. ESD provides a different lens to view and transform learning objectives, content, methods, contexts, and assessment (UNESCO, 2020). It uses emancipatory learning approaches, such as systems thinking, critically reflective thinking, participatory learning, and interdisciplinary learning, but also more disruptive pedagogical strategies, like place-based learning, envisioning, community learning, and transformative learning (Sterling, 2012; Tilbury, 2011; Tilbury & Wortman, 2004). These pedagogical approaches are required to help learners develop the competences that are needed to address emerging complex issues such as climate change, social justice, or community resilience. They call on educators to challenge the traditional teacher-student relationship and consider other learning dynamics that favour dialogue, empowerment and student responsibility over the learning process. Reid et al. (2021) remind us that there has been little progress on this across the globe.

ESD is best practised through the adoption of a whole-institutional/school approach (Mogren et al., 2019), as it invites all stakeholders to reflect critically and take joint actions that are systemic and creative (Mathie & Wals, 2022). A whole-school approach helps link student learning with school management, operations, and outreach (Tilbury, 2022). It also engages students in taking decisions concerning their school, participating in community projects, and getting involved in global initiatives (Henderson & Tilbury, 2004). Inquiry- and place-based learning as well as envisioning strategies that engage students in imagining alternative scenarios and embracing system thinking – and not just problem solving – can support this type of approach.

3. TEACHER EDUCATION FOR SUSTAINABLE DEVELOPMENT – ‘THE PRIORITY OF PRIORITIES’

The evidence available suggests that teacher education is the most important catalyst for leveraging innovation and redesigning learning opportunities across the education system (Ferreira et al., 2009; Fischer et al., 2022; UNGA, 2020). The literature confirms that teacher education has positive effects on supporting students in their learning journeys towards sustainability (Andersson, 2017; Kadji-Beltran et al., 2014; Kostoulas-Makrakis, 2010). Andersson et al. (2013) also point to the efficacy of teacher education in increasing the motivation of teachers to consider sustainability in their classrooms. Thus, it is more likely that teachers consider sustainability principles if they have experienced or learned about it during their training. This implies reorganising teacher education so that students can live and learn sustainability throughout their learning journeys. This leads to challenging disciplinary silos and student-educator power relationships, connecting learning experiences to what is practiced institutionally, supporting meaningful interactions with community stakeholders, and providing opportunities for students to do their placements in sustainable schools, etc. This will not occur without challenges, including resistance to change.

For all these reasons and because effective teacher education in the area of sustainability has a direct impact on citizens' sustainability capabilities, it has been identified by key ESD players as the 'priority of priorities' (UNESCO-UNEP, 1990). This is consistently reflected in international policy and frameworks; for example, teacher education is explicitly included in one of the action priorities of the UNESCO Strategy on ESD for 2030 (UNGA, 2020) and is widely supported by the recently adopted EU Council Recommendation on learning for the green transition and sustainable development (Council of the EU, 2022).

At the practice level, there is a wide perception that the ESD discourse has progressively been accepted by teacher education stakeholders and institutions (Bourn et al., 2017; UNESCO, 2016). McKeown & Hopkins (2014) report on the findings of an international survey completed by members of the International Network of Teacher Education Institutions (INTEI). The results show that teacher education institutions engaged in the network undertook many types of initiatives that influenced programmes and policies within their organisations in locally relevant and culturally appropriate ways. Also, a recent systematic literature review reveals that there is a rise in published research in the area of teacher education for sustainability which reflects increasing practice within this sector (Fischer et al., 2022).

Although progress has been documented, there are still many commentators that criticise the extent and approaches to which ESD has been integrated into teacher education, claiming that it remains an aspiration (Ferreira et al., 2009; Wals, 2009). Whereas McKeown & Hopkins (2015) urge the international community to position ESD away from the margins, Ferreira et al. (2007) and Ferreira & Ryan (2012) remind us about the need to support actions that go beyond the simple inclusion of ESD into the teacher education curriculum. A whole-of-system approach is needed so that ESD gets to the core of institutional and school policies, curriculum, and day-to-day activities. In the next two sections, the authors provide a snapshot of current challenges and apply learnings from their research experience to enhance teachers' professional learning in this area.

4. CURRENT ESD STATUS AND CHALLENGES IN TEACHER EDUCATION

4.1. The lack of status of ESD in school and teacher education curricula hinders its mainstreaming process

A recent study analysing national curricula of 78 countries has found that the 90% of the frameworks contain ESD themes (IBE-UNESCO, 2016). Although ESD coverage and depth at schools have significantly increased in the past years (Mulvik et al., 2021), it continues to be a non-mandated component in teacher education in most places (UNESCO, 2014). Different scholars alert us that this can lead to easily overlooking the role of teacher education in the sustainability transition, creating uncoordinated thinking and actions across the education system (Evans et al., 2017). School teachers and leaders are required to embed ESD in their schools and classrooms, but do not have the support and professional learning needed to be able to create relevant, exciting and quality opportunities for their students.

4.2. Teachers do not feel ready to teach for sustainability and are rarely requested to engage in professional development in this area

A large study that surveyed over 58,000 educators demonstrates that although teachers are aware of the importance of teaching sustainability, 25% do not feel ready to take on this challenge (UNESCO & Education International, 2021). Similarly, a piece of research focused on pre-service teachers confirmed that most of the 578 students surveyed expressed concerns about their competences in sustainability teaching (Dahl, 2019). The reality is that teachers are rarely requested to engage in professional development in ESD. Where this is mandatory, research tells us that the training in which they are involved tends to be superficial, leaving more in-depth preparation as a personal choice (Mulvik et al., 2021). There are a few exceptions in countries, such as Scotland and Hungary, where ESD is included in competence frameworks and national standards for teaching and offer professional development opportunities aligned with national expectations (see GTCS, 2021).

4.3. ESD efforts in teacher education are fragmented and isolated

The literature consistently reports that ESD efforts in teacher education tend to be fragmented and isolated, rather than embedded into existing teachers' professional development programmes or day-to-day training (Evans et al., 2017). On one hand, in pre-service teacher education, ESD is characterised as taking place as individual curriculum development initiatives and included in specific (elective) courses (Evans, 2017). Progress is usually made by discipline champions who are personally committed or feel a moral duty to provide students with the opportunity to understand how they can contribute to sustainability through their professional careers (Bronwyn et al., 2016). On the other hand, in in-service teacher education, ESD takes place in a patchy way and usually takes the form of one-off theoretical sessions targeting individual teachers who seek to improve their teaching practice (Boeve-de Pauw et al., 2022). The literature on teacher education demonstrates that this kind of professional learning has little or no impact on teaching improvement or student outcomes (Darling-Hammond et al., 2009, 2017).

4.4. The structuring of curricula around single subjects is an obstacle to embedding ESD through whole-school and interdisciplinary approaches

As a general tendency, national curricula tend to favour a cross-curricular and interdisciplinary approach to ESD in primary and secondary education. In contrast, at the practice level, the structuring of curricula around subjects, especially in secondary education, has been identified as a key barrier to tackling ESD through an interdisciplinary perspective (Annan-Diab & Molinari, 2017). Regularly, sustainability is introduced in geography or natural science subjects, but in an increasing number of countries, it is included in citizenship, ethics or outdoor studies (UNESCO, 2021b). In addition, only a few countries view the curriculum as a key component of a whole-school approach to sustainability (Mulvik et al., 2021).

Mirroring the school sector, ESD in initial training is fundamentally integrated into disciplines associated with geography and natural sciences. Very rarely, courses concerned with the didactics of language, arts or mathematics have considered sustainability, but fewer courses focused on leadership, organisational learning, or sociology of education (Tilbury, 2022). There are only a few teacher education institutions that have engaged in developing a whole-institutional approach to sustainability allowing candidates to live and learn sustainability on campus and understand how it can take place at the school level (Timm & Barth, 2020). In in-service learning, specific training programmes might emphasise the need to connect sustainability in different subject areas and school management, but practical opportunities to understand how this approach looks like in practice and how it depends on the quality of teacher and other non-teaching staff collaboration are hardly provided (Nórden, 2016).

4.5. There is a need for more transformative learning approaches and experiences

As previously mentioned, ESD promotes learner-centred and action-focused learning opportunities. This is important to connect students with real-life issues and understand the impact of different types of actions in the community (Concina, 2019). However, these approaches are not often practised in schools or teacher education institutions. Findings from different reviews attest that the cognitive domain of sustainability receives a greater focus in comparison to socio-emotional and action ones (UNESCO, 2019, 2021b). Many authors have alerted us that learning processes that are centred on raising awareness about sustainable development issues or on understanding concepts associated with it are not effective to engage the learner (Scott & Gough, 2003). They point to how problem-oriented learning can lead to negative psychological impacts on students, including eco-anxiety or apathy for change (Hoffman, 2021). Currently, only teachers who have been championing this agenda for a long time are considering more transformative learning approaches that engage students in action and emotional learning. This is no surprise since teacher education is not contributing to supporting teachers and teacher candidates to design and facilitate learning experiences of this transformative nature (Bourn & Soysal, 2021). Additionally, many novice teachers, do not have the experience of creating ESD opportunities in practice during school placements, given the lack of mentors with ESD expertise (Robertson et al., 2020).

4.6. Effective teacher education requires head teachers and teacher educators who have been trained in ESD

Teachers are critical agents in transforming society towards sustainability (Ferguson et al., 2021), and if they are to play this catalytic role effectively, quality training is a key requirement (Boeve-de Pauw, 2022; UNESCO, 2018). However, while efforts are centred on the professional learning of individual teachers, the training of head teachers and teacher educators is overlooked. On the one hand, head teachers have an important impact on teachers' training as they are responsible for creating and nurturing a school sustainability vision and developing teacher professional

development plans (Kadji-Beltran et al., 2012, 2016; Mogren & Gericke, 2019). On the other hand, teacher educators guide teachers at all stages of their careers, model good practice and engage in research that helps better understand and practice teaching and learning (European Commission, 2013). It is important to involve teacher educators who see sustainability and interdisciplinary learning a threat to disciplinary knowledge more meaningfully. To deepen their engagement, efforts that articulate the wider value of ESD in education and to learners, beyond immediate concerns with the environment and sustainability, may prove to be effective. New incentives to explore an experiment with more interdisciplinary approaches should also be provided, as well as opportunities to network and participate in action research projects.

5. ENHANCING TEACHERS' PROFESSIONAL LEARNING IN ESD

5.1. ESD teacher competence frameworks can stimulate changes in teacher education

Different ESD competence frameworks have been developed in the past years and many guide the professional development of teachers (Bürgener and Barth, 2018). These models support the idea that teachers are not only the designers of educational processes and classroom facilitators, but are also agents of change within their institutions and the education system itself (Barth & Kater-Wettstädt, 2021). Designing teachers' professional learning with ESD competences in mind can be a good starting point to leverage pedagogical transformation and spark dialogue among key stakeholders (Sterling et al., 2017).

5.2. ESD must be embedded in the continuum of teacher education

For for teachers to develop these competences, ESD must be embedded in the continuum of teacher education. Leadership is required to establish learning structures and conditions for teachers to continue to learn and grow as ESD practitioners from their initial training to the first days in school and throughout their entire careers. In initial training, teachers should develop a good base of the knowledge and skills that they will need to put ESD into practice and should start developing their professional identity in this area (Qi et al., 2021). Later, professional development will become vital for teachers to share good practice and broaden perspectives, as well as keep up to date on a fairly new and changing field such as ESD.

5.3. The development of ESD competences is a long-term practice

Research has recognised that teachers need time to develop ESD competences and engage in transformative practices. Professional development should consider different contexts where teachers learn: the school, the local community, the professional community (Réti, 2022). Teachers' learning is not a linear process and the different needs and motivations at different stages of their careers should be considered. As Darling-Hammond et al. (2009, 2017) state, effective professional learning should involve considerable contact hours over a long period, is content focused, uses active learning, supports collaboration, is school-based, uses

modelling of effective practice, provides mentoring support, and offers opportunities for feedback and reflection.

5.4. Teachers must be capable of facilitating change for sustainability

A lack of progress in mainstreaming ESD in schools and teacher education could be attributed to the lack of experience teachers and teacher educators have in implementing change for sustainability (Ryan & Tilbury, 2013). ESD requires teachers to challenge learning dynamics and influence education practices beyond the classroom. Building competences for change and leadership in educators is important. Thus, initiatives such as participatory action research can enable educators to come together to co-create and map strategies for change that can have positive impacts on the mainstreaming process (for example, Ferreira et al., 2007).

5.5. Quality resources are needed to support teachers in this area

A critical need identified in the literature is the availability and assessment of quality pedagogical resources in ESD (UNESCO & Education International, 2021). Although there are many resources and materials available online, support to schools and teachers is needed to assess and identify those materials that can influence ESD and quality learning outcomes (McKeown, 2014). Teacher professional development is needed as these resources, which are mostly content-rich, are unlikely to have an impact on school practice. Resources that support teachers to embrace whole school approaches and pedagogical strategies that connect students with real sustainability contexts are important.

6. FINAL REMARKS

The direction of global frameworks, dialogues and plans for ESD is an important strategic focus for teacher education worldwide. School and higher education students are also providing important contexts to frame and focus the kind of professional learning required for our teachers of tomorrow. Further research is needed to identify the type of teacher education that contributes to changing teaching and learning cultures at schools, and more scholarly work is required to understand how teachers develop ESD competences and use these to create and facilitate learning experiences and processes that lead to change.

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Ingrid Mulà

Universitat de Girona (Spain)

ingrid.mula@udg.edu | <https://orcid.org/0000-0002-5691-1159>

Daniella Tilbury

University of Cambridge (UK), University of Girona (Spain)

daniella_cam@hotmail.com | <https://orcid.org/0000-0002-4290-0651>

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Formación docente para la sostenibilidad: práctica actual y desafíos pendientes

Ingrid Mulà @ ¹, Daniella Tilbury @ ^{1,2}

¹ Universitat de Girona (Spain)

² University of Cambridge (UK)

Para avanzar hacia un futuro sostenible, es esencial que todos aprendamos a interactuar con nuestro planeta de manera diferente, tanto en lo referente a la vida como al trabajo. Diferentes marcos y documentación internacional atestiguan la contribución de la Educación para el Desarrollo Sostenible (EDS) para equipar a las personas con competencias de sostenibilidad. Por lo tanto, es necesario priorizar la formación de los docentes, dado que es uno de los elementos más influyentes para lograr la innovación e integrar la sostenibilidad en los sistemas educativos, permitiendo al alumnado involucrarse en la construcción de un futuro sostenible.

La EDS promueve una nueva visión del aprendizaje que, a diferencia de otras formas de educación —como la educación para la ciudadanía, la salud o la paz—, exige una reorientación de los marcos y los sistemas educativos. La EDS capacita a personas de todas las edades para asumir la responsabilidad de crear un futuro sostenible, buscando escenarios alternativos en los que el bienestar, la justicia social, la diversidad cultural, el desarrollo humano y la salud de nuestro planeta estén interconectados.

Este artículo tiene como objetivo destacar la necesidad y la dificultad de hacer de la EDS una práctica común, así como explicar la parte crítica que desempeña la formación de profesorado en la promoción del desarrollo sostenible. Utilizando los resultados de un proyecto de investigación realizado para la Comisión Europea donde se realizó una revisión bibliográfica y una selección de estudios de caso, las autoras identifican los principales desafíos y lecciones aprendidas para mejorar la formación de los docentes en EDS. Se identifican acciones futuras para apoyar los esfuerzos en esta área y ayudar al profesorado y formadores del profesorado, incluidos los docentes de matemáticas, a desarrollar competencias que les permitan conectar mejor su trabajo y experiencia con el imperativo de la sostenibilidad.