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REVIEW AND SYNTHESIS

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Collaborative learning, cooperative learning and reflective learning to foster sustainable development: A scoping review

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Abstract

Education for Sustainable Development (ESD) plays a key role in addressing global challenges. This study highlights the key role of collaborative, cooperative and reflective learning in enhancing students' ability to promote sustainable development. In this study, narrative analysis techniques were used to analyse 172 manuscripts with the core keywords 'reflective learning' or 'cooperative learning' or 'collaborative learning' and 'sustainability' or 'sustainable development' and 'education' that resulted from the search in SCOPUS and Web of Science for the period 1994 to 2023 and the paper selection process. These articles provide a comprehensive overview of collaborative and reflective learning in the context of sustainable development. This study demonstrates how critical it is to identify and deal with students' limits in terms of reflection and cooperation. To genuinely contribute to sustainable development, students must not only possess the necessary knowledge, but also embody values and global awareness, thus enabling them to reflect on and evaluate their practical experiences within complex contexts. Despite potential obstacles of individual differences and cooperation challenges, the review emphasises the importance of innovative pedagogical strategies in providing students with engaging educational opportunities that inspire a commitment to advocating for sustainable development. This study highlights the potential of diverse pedagogical

programmes in cultivating sustainable competencies and underscores the significance of recognising and overcoming constraints for the effective implementation of education in sustainable development.

KEYWORDS
collaborative learning, competencies, cooperative learning, reflective learning, sustainable development

Context and implications

Rationale for this study: This literature study was conducted to examine the evidence for collaborative, cooperative, and reflective learnings for competency-based sustainable development.

Why the new findings matter: This review demonstrates that innovative teaching approaches can provide students with the ability to generate sustainable development education. It focuses on pupils merging academic knowledge with real-world challenging environmental situations.

Implications for researchers and educational institutions: Implications for practice relate to the importance of how students acquire knowledge, values and attitudes, and contribute to the process of accumulating sustainability as a phenomenon. The impact of collaboration and reflection on fostering students' sense of responsibility and their ability to address complex problems to pursue and develop values such as equity, democracy and quality of life is needed to promote ethics in education. Implications for teachers include using cooperation and reflection for students' ability to solve challenging complex problems. Researchers may use this study to reshape educational teaching practices in education to promote a sustainable future.

INTRODUCTION

Collaborative and reflective learning underpins the development of complex competencies and key employability skills (Fang & O'Toole, 2023) that aim to promote sustainable development (Malik, 2018; Svanström et al., 2008). In developing a sustainable future there is still a debate about students' awareness of global sustainability (Ben-Eliyahu, 2021; Mora et al., 2020) and the complex interconnection between the dimensions of sustainable development (Demssie et al., 2023). This will not only present a new challenge, but also an opportunity for educational settings to redefine competencies and curricula that best address the actual challenges for individual, social and ecosystem development, and development of new global perspectives (Fang & O'Toole, 2023).

The development of cooperative learning was deeply grounded in social constructionism and cognitive psychology from the 1950s through the 1970s (Youniss & Damon, 2013). Vygotsky and Piaget laid the groundwork for understanding the nature of cooperative learning and suggested the importance of social interaction for cognitive development (Forman & Cazden, 2013). In the subsequent late 20th century, cooperative learning entered a period of empirical research and modelling, and more studies began to repeatedly verify the effectiveness of cooperative

learning through practice while beginning to focus on the intrinsic motivation of the team members, role allocation and other essential elements (Al-Malki et al., 2022). At the same time, the emergence of different cooperative learning models, such as the 'expert-apprentice model' and the 'mutual teacher-learner model', has provided concrete theoretical support for the practice of cooperative learning (Lipka et al., 2005; Mokhele, 2006). Along with the continuous progress of science and technology, cooperative learning has been combined with computer-supported cooperative learning, especially following COVID-19 (Anand Shankar Raja & Kallarakal, 2021). The emergence of various online collaborative tools, virtual learning environments and social media has provided students with a wider range of learning and practicing opportunities, as well as promoting the research and practice of computer-supported cooperative learning (Nortvig & Christiansen, 2017). This study will explore the application of this theory to ESD. Social constructionism, the main theoretical framework for cooperative learning, emphasises that knowledge is constructed in social interaction and cooperation (Oxford, 1997). Students engage in a cooperative learning model by working in groups or teams centred on specific projects or challenges, and emphasises a process through which students construct knowledge in solving real-world problems and collaborative solutions (Johnson et al., 1984).

The trend of globalisation and modes of cultural cooperation in formal and non-formal institutions has continued to drive the importance of cooperative learning and has been validated in different countries and cultures around the globe (Akçay, 2016; GP et al., 2020; Nguyen et al., 2009). At the same time, global formative cooperation and cross-cultural team learning have become the new trend of cooperative learning, which has the important purpose of fostering students' international perspective and global citizenship, and promoting global development (Spires et al., 2019; Wihlborg et al., 2018). With the in-depth study of socio-cultural theories, the development of technology and the acceleration of the trend of globalisation, the influence and application of cooperative learning in education have been expanding. In the future, integrating collaborative learning into the new educational paradigm will be inevitable, thus offering more possibilities to develop students' teamwork, critical thinking, and innovation skills. Currently, sustainability research is being conducted on different levels, including the global sustainable development goals at the macro level and organisational and community practices at the micro level (ElAlfy et al., 2020). In order to maintain the balance between the social, economic and environmental dimensions as much as possible, more attention is paid to social justice and human rights, while economic sustainability considers economic growth and the rational distribution of wealth, and environmental sustainability emphasises the health of the entire ecosystem and the renewability of resources (Dieleman, 2017). In particular, there is a commitment in education to help students develop the ability to think and practice sustainability (Rieckmann, 2018) and to expose them to complex real-world systems to facilitate meaningful engagement and motivation to learn (Demssie et al., 2023). The expansion of sustainability education has led to the development of educational models, policies and methods that have helped to promote the integration of sustainability concepts into education (Pavlova, 2013).

Cooperative learning and collaborative learning are two distinct teaching methods in education, both emphasising the significance of student collaboration, yet differing in philosophy and application (Dyson & Casey, 2012). Cooperative learning emphasises organising students into heterogeneous small groups, fostering collective participation in learning activities, collaborative problem-solving, and mutual support within the group (Bjørke & Mordal Moen, 2020). In education, this approach may involve group participation in various sports activities, promoting shared responsibility, achieving common goals, and facilitating the exchange of knowledge and skills among group members (Casey et al., 2009; Dyson & Casey, 2012). Conversely, collaborative learning underscores students working together to achieve shared goals, with a focus on the success of the entire team (Keay, 2006). In education, collaborative learning may involve teamwork to enhance overall team performance, jointly address related issues, and promote collective improvement through shared discussions and reflections among team

members. The emphasis is on effective communication and team spirit, encouraging students to share skills and knowledge (Duncombe & Armour, 2004).

Both cooperative and collaborative learning are advocated teaching methods in education, emphasising teamwork and shared learning (Dyson & Casey, 2012; Keay, 2006). While cooperative learning emphasises interaction and support within small groups, collaborative learning focuses on the overall success and common goals of the entire team. These approaches contribute to the development of students' collaborative skills, communication abilities, and a spirit of teamwork, thus fostering comprehensive growth within education.

Sustainability has become an important educational goal in the field of education (Annan-Diab & Molinari, 2017). Through cooperative learning, students can gain a deeper understanding of the concept of sustainability and work in teams to solve sustainability-related problems. Operating within a cooperative learning environment enables students to think and act together on sustainability in its social, economic and environmental dimensions (Rieckmann, 2018). Warner and Elser (2015) have examined how sustainability can be integrated into the educational system to develop a sense of sustainability in students. Education, in turn, becomes a key driver and source of energy for achieving the SDGs (Kioupi & Voulvoulis, 2019). Key competencies for sustainable development include collaboration skills, ability and willingness for critical and reflective thinking, creativity, innovativeness and entrepreneurship, as well as ethical reasoning and global contextual analysis (Silva et al., 2018; Takala & Korhonen-Yrjänheikki, 2019). However, some authors also recognise the need for student reflection to support the acquisition of the higher-order thinking skills required to address the complex challenges of sustainability (Colomer et al., 2020; Whalen & Paez, 2021).

This research aims to examine the intricate relationship inherent in the current literature between sustainable development education and active teaching practices for transformative teaching practice (collaborative, cooperative and reflective learning). The literature explicitly indicates that collaborative and cooperative learning contribute significantly to cultivating students' complex abilities and key employability skills, therefore directly aligning with the goals of sustainable development. The research has two primary objectives. First, it aims to demonstrate the importance of teaching practices for students' sustainable development and enhance understanding of the complex interrelationships among the different dimensions of sustainable development; Second, it aims to identify the key factors and challenges in implementing these teaching practices.

METHOD

Scoping and critical literature analysis methods are integrated into the analysis of scientific sources using narrative analysis techniques (Byrne, 2016; Snyder, 2019). In the context of our scoping review, narrative analysis involves systematically examining the content, structure and context of educational practices described in the literature to identify patterns, themes and relationships related to reflective and cooperative/collaborative learning approaches in sustainability education. This technique allowed us not only to describe identified articles but also to analyse conceptual developments and innovations across the field. We applied narrative analysis principles by extracting qualitative data from the literature, organising findings thematically, and synthesising evidence to capture the evolution of pedagogical approaches over time.

This critical review approach involved presenting, analysing and synthesising material from diverse sources to identify, define and structure the literature on reflective, cooperative and collaborative learning within sustainability education. This methodology enabled us to evaluate the quality, relevance and contribution of various studies while maintaining a critical perspective on methodological rigour and practical implications.

Search strategy and process

This study followed a systematic and chronological comprehensive literature search. Relevant literature was analysed using Scopus and the Web of Science. The searches were made for manuscripts with titles, abstracts or keywords, with manuscripts written in either English or Spanish. This manuscript used the key words in combination and beginning with 'reflective learning' OR 'cooperative learning' OR 'collaborative learning' AND 'sustainability' OR 'sustainable development' AND 'education'. Researchers searched for manuscripts in which these terms appeared in the title, abstract, or keywords, limiting themselves to publications in English or Spanish in the past 30 years (with a start date of 1994 and an end date of 2023). For result management, we used the Covidence platform (Systematic Review Software, Veritas Health Innovation, Melbourne, Australia) to import search results from both databases. Covidence automatically identified and removed duplicates appearing in both databases. This initial search yielded more than 500 results before deduplication.

Screening process

Following the PRISMA 2020 guidelines (Page et al., 2021), we implemented a rigorous two-stage screening process. In the title and abstract screening stage, two independent reviewers (both co-authors of this paper) evaluated titles and abstracts against the following inclusion criteria: explicit focus on sustainability or sustainable development, implementation of cooperative, collaborative or reflective learning approaches, educational context, publication in English or Spanish, and publication between 1994 and 2023. For full-text screening, articles that passed the initial screening were subjected to full-text review by the same two reviewers using the same inclusion criteria, but with more detailed evaluation.

Throughout the screening process, we used the Covidence platform to manage article flow, record decisions, and resolve disagreements. Covidence facilitated independent evaluations by each reviewer and enabled systematic identification of screening conflicts.

Data extraction and coding

Following the screening process, we conducted systematic data extraction and coding. We developed a structured data extraction form within the Covidence platform to systematically collect relevant information. Two independent data extractors (also co-authors) extracted the following information: general study information (design, purpose, year, country), evaluation context (intervention outcomes, curriculum integration, programme details), educational modality (case study, retrospective analysis, experimental study), competency focus (collaboration, cooperation, reflection), target population characteristics, and educational level. Using the extracted data, we employed thematic coding to identify patterns and themes across studies. This coding process was distinct from screening and involved interpretive analysis of the extracted data to identify emerging concepts and relationships within the literature.

Quality assurance and reliability

To ensure methodological rigour, we implemented several quality assurance measures. All screening and data extraction processes were conducted independently by two reviewers.

A review panel consisting of the two initial screeners and an additional arbitration reviewer (a senior co-author) resolved all disagreements through discussion until consensus was reached. We calculated a mutual confidence level of 98.6% for screening decisions, representing the percentage of initial agreement between reviewers before conflict resolution. This calculation employed the simple percent agreement formula (number of agreements divided by total number of screening decisions) as recommended in systematic review methodology literature (Belur et al., 2021; McHugh, 2012). Additionally, to account for the possibility of chance agreement, we calculated Cohen's Kappa coefficient ($\kappa = 0.986$), indicating almost perfect agreement between reviewers (Landis & Koch, 1977).

This review process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021), the PRISMA extension for scoping reviews (Tricco et al., 2018), and the Joanna Briggs Institute methodology for scoping reviews (Peters et al., 2020). The complete screening process resulted in a final inclusion of 172 papers for comprehensive analysis, as detailed in Figure 1, which presents the PRISMA flow diagram showing the article selection process from identification through screening to final inclusion.

RESULTS AND DISCUSSION

Reflection as a sustainable competency for sustainable development

In the context of sustainable development, the concept of competency often refers to a holistic and interconnected set of knowledge, skills, values and attitudes that aim to improve the quality of action and the effectiveness of problem-solving to address real-world sustainability challenges in a global world context (Brundiers et al., 2020; Cebrián, Junyent, et al., 2020; Glasser & Hirsh, 2016; Rieckmann, 2012; Thomas & Day, 2014). There is a wide theoretical and empirical discourse on reflection competency for sustainable development and the competencies and skills it comprises. Competency of reflection is understood as part of a set of competencies and their constituent skills. This decision was influenced by the studies of researchers such as Moon (1999, 2004), Rogers (2001); Osterman and Kottkamp (2004), Correia and Bleicher (2008) and Yip (2006) who emphasised the central role of the ability to analyse and learn from experience in the structure of reflection competency to improve one's own performance and to develop oneself. Also recognised is the ability to analyse, use and learn from both one's own experience and that of others, at different stages of the process (Cowan, 1998; Schön, 1991): reflection-for-action, reflection-in-action and reflection-on-action. All these forms of reflection are linked to lifelong learning and considered to be one of the most essential prerequisites for learning to learn, being aware of one's own experience, and detaching oneself from everyday events and the ordinary reality of things.

Interpretative approaches to reflection competence

The relevance and importance of reflection as a sustainability competency is not contentious, but it is rather difficult to justify its uniqueness and autonomy in a sustainable development context due to the uncertainty of its place and the possible predictability that it exists or that it is part of other competencies. The selection and analysis of scientific sources has led to a number of possible interpretative approaches to reflection as a competency for sustainable development (see Figure 2).

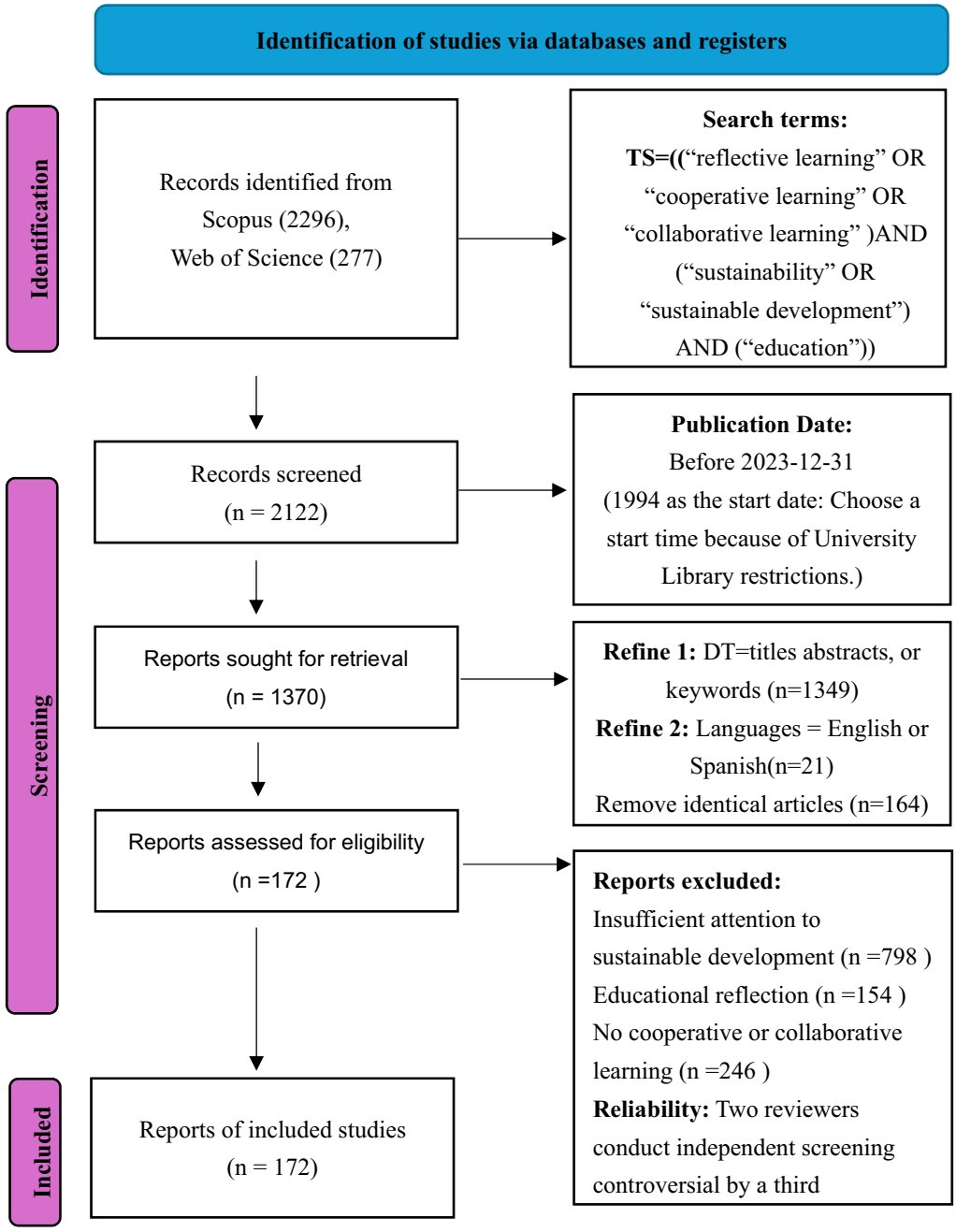

FIGURE 1 Literature screening process.

Education for sustainable development (ESD)

The first position is evident in the majority of scientific sources, pointing out that the ideas of sustainable development in relation to reflection are analysed in the field of education for sustainable development, in the context of educational solutions for the training of professionals

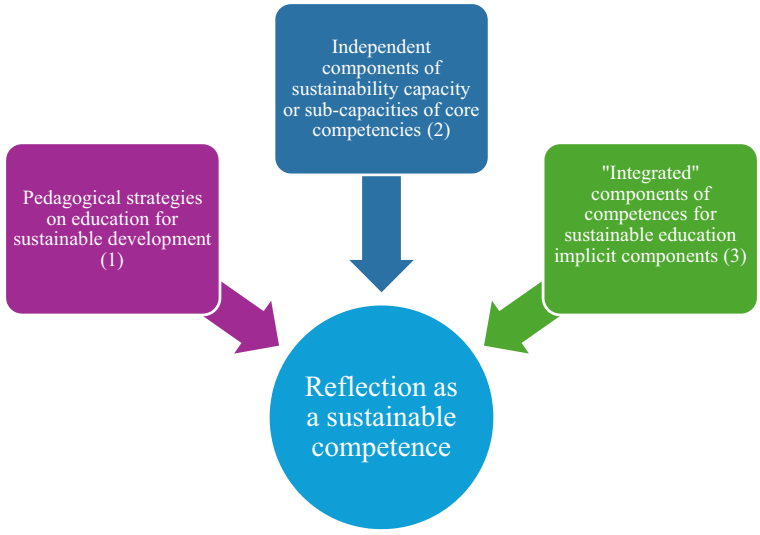

FIGURE 2 The central role of reflection in sustainable education capacity development.

in different fields, and in cultivating their competency for sustainable development (Barth et al., 2007; Barth & Rieckmann, 2012; Brundiers et al., 2020; Eizaguirre et al., 2019; García-Feijoo et al., 2020; Gouwy, 2014; Pauw et al., 2015; Rieckmann, 2012; Trad, 2019; Wiek et al., 2011, 2015). Sustainable development education's purpose is twofold: on the one hand to develop competencies that enable individuals to reflect on their actions in the light of current and future social, cultural, economic and environmental impacts, locally and globally (UNESCO, 2017), and on the other hand, to describes a process of curriculum development that encompasses the subject content and pedagogy required to support sustainable development in order to address the key sustainable development goals (SDGs) and challenges by 2030. Education for sustainable development must equip individuals with the critical thinking skills required to reflect on personal values, attitudes and behaviours, as well as help them make conscious lifestyle choices. It is argued that reflection helps to experience something again or make sense of it, which can reinforce learning and overall personal and professional effectiveness, and that the analysis of experience must therefore be one of the main aims of education (Howell, 2021).

Dewey (1933, 1938), a pioneer of the concept of reflective learning, describes reflection as a dialectical process that integrates experience and ideas, observation and action. 'Routine action' is contrasted with 'reflective action'; the latter involves a disposition to continuously evaluate and improve oneself, whereas 'routine action' is static and unresponsive to changing priorities and circumstances. Learning focuses not only on the mechanical development of skills, but also on values and knowledge, bridging the gap between theory and practice (Bassachs et al., 2020).

Schön (1991) builds on Dewey's idea and emphasises reflection, which is seen as an active cognitive process involving a sequence of interrelated ideas, drawing attention to the importance of belief and knowledge on action and doing, which was a new area of research in educational science and the beginning of learning through reflection. Reflection in and on action encompasses an epistemology of professional practice based on cognition and knowing of action. Such tacit knowledge arises from the construction and transformation of professional experience, as opposed to the application of technical or scientific rationality. Thus, reflective learning enables people to take a new perspective on their knowledge and experience and to adjust their actions in the future.

Kitamura and Ito (2022), Ralph (2015) emphasise the potential of reflective-transformative pedagogy, stressing the importance of developing an understanding of the impact of reflection on the development of reflective competency. The use of reflection is a key pedagogical strategy for transformative learning, and outcomes such as critical thinking, self-determination, and the development of reflective skills mean that reflection is seen as an important element of the learning processes and the curriculum (Ayers et al., 2020; Redman et al., 2021). Reflection as one of the main tools, conditions, and education/training methods for the acquisition and development of key competencies for sustainability education is especially based on the context of leadership. A number of researchers believe that reflection provides a number of useful skills for sustainability leadership (Bendell et al., 2017; Ralph, 2015), and those skills such as self-awareness and critical thinking are essential for developing sustainable leadership. Reflection can be used to promote learners' self-awareness and self-development in a way that fosters sustainability leadership development, which requires creating an environment that allows space for a variety of personal reflective learning journeys and provides clear outcomes and accountability (Van den Berg et al., 2022). It recognises the need to develop a new type of leader with a level of self-awareness that provides insights into new ways of working: resilient and sustainable leadership practices that leaders have developed for a new world with the skills to be present, think critically, see clearly, and behave flexibly (Kitamura & Ito, 2022). By integrating reflection into collaborative learning and ESD, we can develop the sort of leaders who can drive sustainable change in the context of globalisation.

Categorising reflection for sustainable development

The second position includes reflection as an autonomous and independent component of the sustainability competency, or as a well-defined sub-competency of the core competency. Some sources identify reflection as a core competency (Howlett et al., 2016; Thomas & Day, 2014), while others identify it as a sub-competency, i.e., as one of the competencies of the core competency (De Haan, 2010). It should be noted that the importance and relevance of this competency is also directly linked to teaching and learning processes in higher education. Howlett et al. (2016) justified the importance of education for sustainable development by pointing out that innovative educational approaches need to facilitate interdisciplinary thinking and be supportive of the development of reflective and critical thinking skills through reflective practice and learning. This practice is a key process in achieving the goals of sustainability education, i.e., the development of critical thinking skills and a commitment to action (Greig & Priddle, 2019).

Life-long learning skills and continuous reflection for sustainability is identified as a key component of sustainability-related competencies (Trad, 2019). Effective sustainability education encourages continuous learning by reflecting on one's assumptions and beliefs in order to change them which, in turn, leads to changes in values, attitudes and behaviours. It focuses on content (information), process (how that information is shared) and reflection (relating that information to oneself). Therefore, the main aspects of sustainability education are anticipating a better future, critical thinking and reflection, systems thinking, participation in decision-making and collaboration for change (Van den Berg et al., 2022). They point out that reflection can awaken an understanding of the sustainability aspects of social change and help to recognise opportunities and constraints in the ideological and institutional context in which learning is or will be relevant for future work and collective critical thinking (Shah et al., 2024). Thomas and Day (2014), in their analysis of graduate opportunities in the context of sustainable education, highlight that the principles of sustainable development should be closely linked and provide learning opportunities where students act as critical

practitioners of sustainable development. Their analysis of sustainability education competencies by different authors showed that competencies related to sustainability education include thinking, collaboration, innovation, reflection (critical reflection) and broad (interdisciplinary) competencies. The authors relate reflection to critical reflection, which is understood as a process of changing personal beliefs and the highest level of reflective learning. Thomas and Day (2014) indicate that employability goes far beyond the simplistic notion of basic skills, and is underpinned by a combination of personal traits and beliefs, understandings, effective practice, and the ability to reflect productively on experience.

Many other sources also refer to reflection as a sustainable competency for sustainable development, highlighting the importance and significance of critical thinking skills in reflection processes (Howlett et al., 2016; Uhrqvist et al., 2021; Wals & Jickling, 2002). In order to integrate basic education for sustainable development competencies into sustainability stories as a didactical tool in ESD and environmental and sustainability education (ESE), Uhrqvist et al. (2021) identify critical reflection as a key competency alongside action, systems perspectives, and student engagement. Critical reflection is a type of competency that includes learning skills such as active engagement, reflecting on information, and evaluating the ethical implications and consequences of different alternatives. The authors refer to the process of critical reflection on one's knowledge and ways of being as a key aspiration in the context of sustainability in order to enable personal and societal change. Critical reflection seeks to identify, evaluate and change the underlying beliefs and assumptions and theories that directly influence action.

Reflection as a sub-competency and an independent component of the core competency is evident in the content analysis of the action competency in sustainable development (Almers, 2013; Mogensen & Schnack, 2010; Olsson et al., 2022; Sass et al., 2020 and etc.). Action competency helps to change unproductive, irrational social structures, to adapt to innovation, to find better and more efficient models or strategies for action, and illustrates an ability to critically assess alternative solutions in action to achieve sustainable future goals (Elo et al., 2022). Reflection, as a component of action competency and as a tool, plays a central role in action research cycles, originates in professional experience, and involves reflective thinking, forming a situation in which a personal system of attitudes and values is built upon, while leaving open the possibility of reframing (Liu et al., 2022). The aim is to combine action and reflection, theory and practice, and working with others to find practical solutions to sustainability problems in situations that people are concerned about (Díaz-Iso et al., 2019).

Reflection as a sustainable competency is perhaps most widely highlighted in scholarly works that draw on Glasser's metaphor (Glasser, 2007; Glasser & Hirsh, 2016) to describe reflection as a process that enables the formation of a new and sustainable way of life (Pacis & VanWynsberghe, 2020). Glasser (2007) analogises the core sustainability competency to a tree, where all parts of the tree interact through certain processes, as happens in nature. The roots (values and commitments) create the foundation for the trunk (knowledge and understanding), which together create the branches and fruit (social skills and agency). Given that a tree is a living organism, no part can be separate, and it manifests itself as a form of life cycle that rarely reaches a fixed end point, so that the branches and fruits can give rise to new seeds, and thus new roots and trunks. The learning cycle can continue through processes of reflection and learning at each 'level' of tree competency. Reflection encompasses this entire cyclical process, and the reconstruction of experience is a central and continuous goal. Critical reflection requires one to look at one's own practice, think about why one is doing it, whether it is working and what personal attitudes and values have led to it. Reflection provides a way of looking at new situations and experiences in order to develop a new approach to adapt to new situations. In this context, self-reflective skills are also important and inevitably become a component of reflection.

Obviously, the relationship of a learner with sustainability goes beyond sustainable or environmentally-friendly action (Gouwy, 2014). A person's view of sustainability interacts and depends on personal realisation and the interplay between personal and impersonal realisation. It is a process of self-reflection that opens up a dialogue between the un-sustainability of the individual's existence and sustainability. Self-reflection and personal evolution have a central place within the process of creating a sustainable atmosphere for creation. Through self-reflection, the person becomes more open to new ideas, more willing to prepare for difficulties, and more self-confident in confusing and unfavourable situations. As Varga et al. (2007) argue, self-reflection as an essential element of collaboration is a key driver for integrating local action into a global context. The use of self-reflection can provide a common framework through which to reflect on behaviour, actions and values. Self-reflective skills such as reflection for sustainable development make an important contribution to the development of sustainable action by rethinking or reorienting value systems to promote sustainability. Self-reflection without direction is an illusion, inadequate for the development of ESD, and dangerous because it can lead to relativistic worldviews where each value is temporary and not worth acting towards a sustainable development goal because it is considered imperfect. For this reason, a sustainable balance needs to be found between self-reflection and values and actions that are locally and culturally appropriate.

Reflection in key sustainability competencies

The third position considers reflection an integral, often tacit, part of the key competencies of sustainable education. The most comprehensive theoretical analysis of key competencies in sustainability and for sustainable development has been carried out by Bianchi (2020), drawing on the work of Wiek et al., (2011, 2015) and Brundiers et al. (2020). This position can be presented in a content analysis of key competencies for sustainability and in education for sustainable development, building on the competencies for SDGs highlighted in the UNESCO (2017) document. It is generally agreed that becoming sustainable requires the following key sustainability competencies: (1) systems thinking; (2) anticipatory; (3) normative; (4) strategic, (5) collaborative; (6) critical thinking; (7) self-awareness and (8) integrated problem-solving competencies. All competencies can be divided into three main groups (Education for Sustainable Development Guidance, 2021), as described in Figure 3.

Ways of thinking

The first group includes ways of thinking: systems and future thinking, and critical thinking competency. In this group of competencies, the role of reflection is particularly evident. Critical reflection and critical thinking are two inseparable and interdependent processes as discussed in the previous sections. Critical reflection involves more complex forms of thinking and reasoning that lead to a change of meaning in a person's thinking structure. Obviously, reflection is not possible without the thinking operations that take place in reflection (Serra et al., 2023). Systems and future thinking also involve reflective skills, whereby individuals critically analyse and change their attitudes and beliefs, structure and restructure their knowledge, and change their attitudes in order to achieve their goals. By critically reflecting on the current situation, they see their practices and solutions in the context of the overall framework and anticipate possible consequences and plan future actions (Serra et al., 2023).

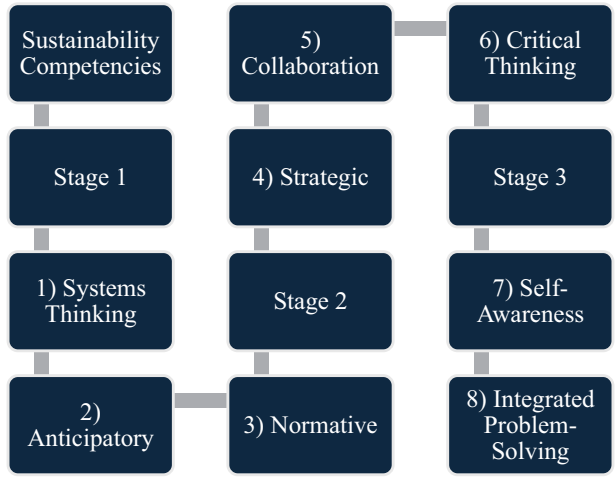

FIGURE 3 Three stages and eight core elements of sustainable capacity development.

Ways of practicing

The second way of practicing includes strategic, collaborative and integrated problem-solving competencies. Reflective action requires active, sustained and attentive reflection on attitudes or on a form of supposed knowledge. The aim of reflection is to unravel a problem or to better understand a confusing situation or problems. The process involves collaboration and learning by working in a team. Peer interaction and collaboration become important as complex problems require an interdisciplinary approach to problem-solving. Reflective thinking and action help to solve problems, allowing for doubt and error until the necessary decision is made. The ability to reflect on one's own values, perceptions and actions and to take a position in the sustainability discourse allows for editing and rewriting the scripts of everyday life, and enables the formation of mental frames of reference and narratives.

Ways of being competent

The third includes ways of being competent: normative competency and self-awareness. Self-awareness is not possible without self-reflection, which is one of the relevant competencies, as has been shown previously, for sustainable development. Reflection is characterised here as a reflexive process of self-awareness and awareness, and at the same time a process of self-assessment, self-analysis, self-observation, and dialogue with oneself. It is the ability to reflect on one's role in the local community and in (global) society, continuously evaluating and further planning one's actions. Reflection emphasises above all the reflection on oneself, on one's own actions, and enables one to understand not only what one has been (retrospection), what one is (introspection), what one could be (anticipation), but also one's relationship with the world in the context of sustainable development. All this enables one to regulate, manage and change by guiding the individuals away from impulsive and routine activities. Reflective action requires an active, continuous and attentive rethinking of attitudes or assumed forms of knowledge.

The structure of the interpretative approaches to reflection as a sustainable competency for sustainable development presented here is conditional, but illustrates key areas where reflection is relevant and significant. It could be argued that there are two options for sustainable development which can be seen as complementary. The first concerns learning

for sustainable development by promoting change in one's actions and, through reflection, changing one's behaviour and ways of thinking when the need is clearly identified and accepted. The second option is learning as sustainable development by developing critical thinking skills, challenging the ideas of sustainable development, and exploring and reflecting on the contradictions inherent in sustainable living.

Collaboration and cooperation as sustainable competencies for sustainable development

Collaboration and sustainable competencies

The development of a sustainability competency paradigm using appropriate pedagogical approaches is now seen as a way to promote sustainability, and encourage literate decision-makers, scientists and professionals to better address the pressing challenges that societies are facing to create a sustainable future (Blatti et al., 2019; Lozano et al., 2017; Lozano, Bautista-Puig, et al., 2022; Lozano, López, et al., 2022). Among the sustainable competencies that have arisen as the best options to promote sustainable development, collaboration and interpersonal relations are seen as sustainable competencies that may furnish tertiary students with skills to make societies more sustainable (Cruz-Iglesias et al., 2022; Lozano, Bautista-Puig, et al., 2022; Naseer et al., 2020). Specifically, cooperation in (heterogeneous) groups is seen as an essential competency with which to reflect on the complexity of behaviour in a future-oriented and global perspective of responsibility, and on how to create bottom-up alternatives (Mitakidou & Tamoutseli, 2011; Rieckmann, 2012).

Cooperative and collaborative educational approaches have been developed in science, maths, physical education and geography domains, among others (Baena-Morales et al., 2021; Bassachs et al., 2020, 2022; Cañabate et al., 2023; Colomer et al., 2021; Hung et al., 2023; Kazlauskienė et al., 2021; Prieto-Saborit et al., 2022; Raath & Hay, 2019). These cases propose different recommendations for solving problems and vividly demonstrate the cultivation of students' sustainable capabilities through collaborative learning. Numerous qualitative and quantitative research methods, including surveys and analyses of learning outcomes, highlight the impact of collaboration and cooperation on fostering students' sense of responsibility and their ability to address complex problems to pursue and develop values such as equity, democracy and quality of life in a multicultural setting (Mitakidou & Tamoutseli, 2011). This also underscores the diverse abilities students possess when confronted with different challenges in their environment (Keeley & Benton-Short, 2020; Tyndall et al., 2020). Interacting with others fostered responsibility for learning that was based on developing a dialogue-based culture, promoting strategies for negotiation and opportunities to solve challenges, and on transforming the individual and social role of students (Baena-Morales et al., 2022; Colomer et al., 2021; Lozano, Bautista-Puig, et al., 2022).

Role of education for sustainable development

Education for sustainable development has been found to address relevant social development while considering solidarity, equality and inclusiveness (Anyim, 2021; Cañabate et al., 2021; De Sousa, 2021; Muñoz-Martínez et al., 2021; Prieto-Saborit et al., 2021; Torrents et al., 2021). Within education for sustainable development, students should acquire competencies that will constantly update the need for tackling global challenges, including evaluating risks, dangers and uncertainties, analysing complex systems, assessing the effects of one's own activities, and finally coming up with sustainable change-promoting solutions

(Colomer et al., 2021; Foster & Stagl, 2018). Not only has education for sustainable development – based on cooperative and project-based learning – promoted more individual and group responsibility (Ioannou et al., 2022), but so too has it triggered major positive emotions in students (Lozano, Bautista-Puig, et al., 2022). Furthermore, it has promoted principles operating under the tenet of leave-no-one-behind, providing positive interdependence and promotive interaction (Bofill-Herrero et al., 2022; Cañabate et al., 2021).

Contextualised knowledge and SDGs

When education for sustainable development is rooted in contextualised knowledge on the development of SDGs, it tackles sustainable competencies such as cooperation in addition to subject skills directly (Cáceres-Jensen et al., 2021; Cañabate et al., 2021; Mohd-Yusof et al., 2015). This is of particular interest when sustainable development is intended to link with social responsibility, institutions and cooperatives (Bhowmik, 2021; Ofei-Manu et al., 2018) and raises young student generations to become active agents for societal change (De La Vega-Leinert et al., 2009) by adopting new ways of working that promote multidimensionality through collaboration and an interdisciplinary outlook (Berasategi et al., 2020; Michalopoulou et al., 2019). They see themselves immersed in the real world, closely linked to stakeholders and policy makers, and as future and competent social agents (Baena-Morales et al., 2020; Blatti et al., 2019; Ho, 2021). Contextualising knowledge implies students being immersed in cooperative learning to strengthen their commitment to the sustainable development goals included in Agenda 2030 (Feijoo & Moreira, 2020).

Reflection in cooperation learning

Collaboration and cooperation facilitate the collective resolution of complex issues, providing students with a platform for addressing complex challenges, particularly those related to sustainable development (Stevahn & McGuire, 2017). Through collaboration in (heterogeneous) teams, scholars from diverse disciplines can pool their expertise, comprehensively and from multiple perspectives, to understand and address problems. This collaborative approach further nurtures students' abilities to work collaboratively in complex and dynamic environments (Topping, 2005). These skills not only help students broaden their horizons but also expose them to different cultural environments and the impact of diverse values (Rieckmann, 2018). In such contexts, students are more likely to develop a sense of responsibility for global sustainable development (Barth et al., 2007). This sense of responsibility can further motivate them to become future leaders of change in the international community as these qualities stem from the socialisation skills of collaboration and cooperation, namely social functioning, and cross-cultural communication skills (Chineme et al., 2019).

On the other hand, collaboration and cooperation place a strong emphasis on reflecting on behaviour, especially when facing future global responsibilities (Luna Scott, 2015). Individuals engaged in collaborative learning not only aim to accomplish tasks but also need to understand their own behavioural performance within the team and the impact of their individual contributions on the entire team (Strijbos & De Laat, 2010). Therefore, reflective processes linked to collaboration processes are crucial for cultivating individual sustainable leadership (Penaskovic et al., 2014). However, to address this issue, it is essential to encourage students through collaborative learning to explore sustainable solutions from the grassroots level (Cottafava et al., 2019). The collective exploration efforts within teams enable students to grasp the essence of sustainable development and propose practical recommendations. While promoting sustainable development, this approach indirectly fosters

students' initiative and creative abilities in addressing sustainability issues on a personal level (Tejedor et al., 2019).

Innovation and technology integration

Examining the methods students employ in problem-solving, whether through teamwork, social interaction or feedback on personal emotional values, is helpful in assessing the practical effects collaborative education has on sustainable development (Carmona-Medeiro & Cardeñoso Domingo, 2021). These practical effects, evolving with the times, necessitate corresponding measures.

Therefore, leveraging advanced teaching technologies and tools like big data platforms can significantly enhance students' experiences, generate innovative ideas, stimulate creative thinking, and improve their problem-solving abilities (Susi et al., 2015). When using enriching and evolving educational methods, it is crucial to innovate new teaching strategies to promote sustainability.

Application of SDGs in cooperative learning

Cooperative learning also places significant emphasis on collective responsibility during the learning process, directly impacting the key to the success of the collective. Students must understand that individual attitudes and efforts directly influence the overall outcomes of the team (Kazlauskienė et al., 2021). Therefore, strengthening interaction between individual and collective efforts in collaborative learning is essential to showcase students' individual leadership and coordination skills (Gillies, 2014). Through such interactions, students can better balance individual and collective responsibilities, thus enhancing their ability to adapt flexibly to problems (Heeg et al., 2020). Over extended periods of collaboration, students gradually develop a sense of responsibility for society, actively pursuing social responsibility goals in future careers and lives (Casey & Quennerstedt, 2020).

Simultaneously, it is essential to consider students with different cultural backgrounds and educational levels in collaboration. This ensures the applicability and effectiveness of teaching methods when facing the global challenges of sustainable development (Mehlmann et al., 2015). To better integrate sustainability education, it is crucial to apply sustainable development goals (SDGs) to collaborative learning (Mohd-Yusof et al., 2015). Introducing SDGs into collaborative learning ensures that students, beyond focusing on their individual disciplines, broaden their perspectives to address global issues (Singh & Shah, 2021). This application enables students to appreciate the importance of their acquired knowledge in contributing to global sustainable development through collaborative activities (Lesco et al., 2019).

Numerous studies have demonstrated that students, through project-based learning and community service, utilise their acquired knowledge to promote collective development (Lozano, López, et al., 2022; Zainuri & Huda, 2023). This not only deepens students' understanding of SDGs, but also cultivates their ability to create solutions towards promoting sustainable development (Giangrande et al., 2019). Since sustainable development encompasses social, economic and environmental aspects, it requires students to effectively integrate theoretical knowledge with practical application, enhancing problem-solving skills and adaptability to complex environmental issues (Mohd-Yusof et al., 2015). This integration formation not only promotes the development of a sense of individual, social and environmental responsibility, but also emphasises the development of internal and external awareness, aiming to stimulate the will to actively participate in sustainable development (Chen & Lai, 2022; Johnson, 2014; Kassem et al., 2021).

One of the developmental directions of sustainability education is the integration of current technology with collaborative learning to meet students' learning needs (Salvaterra et al., 2022). The wide application of virtual reality, artificial intelligence and other technologies provides more convenient and scientific tools for collaborative learning (Cebrián, Palau, et al., 2020; Pineda-Martínez et al., 2023). These tools not only help students expand disciplinary knowledge, but also assist in understanding collaboration across diverse cultural backgrounds (Lin et al., 2023; Sims, 2021). In the process of respecting cultural exchanges and development, students gain an understanding and tolerance of cultural differences, avoid gender discrimination, and raise awareness of themselves as global citizens (Baena-Morales & Ferriz-Valero, 2023; Baena-Morales et al., 2020; Dlouhá et al., 2013; UNESCO, 2020).

CONCLUSIONS

The analysis of the scientific literature, based on a targeted selection of sources, reveals three main interpretative approaches to reflection and cooperation as sustainability competencies.

Firstly, they are understood as an integral element of the educational environment for sustainable development, which is purposefully created in a given educational institution. In this context, reflection is defined as a pedagogical strategy to promote sustainable awareness and behaviour, and often sustainable leadership, among learners.

The second approach treats reflection and cooperation as a separate part of the sustainability competency or a sub-competency of the core competency. This approach aims to encourage collective critical thinking and questioning of institutional and societal practices that require social change.

The third approach to reflecting and cooperating as a sustainability competency relates to the learning of individuals and/or groups in the context of sustainable development. Reflection is an intangible, natural and often intrinsic part of the human being that helps to critically evaluate current practices, thinking patterns and self-awareness in relation to sustainability contexts. All interpretive approaches refer to the level of critical reflection, where a change in one's attitudes and values leads to changes in self-awareness about sustainable living and co-creation, as well as to real changes in performance. These changes can range from solving sustainable development challenges in the classroom to initiatives that change social reality on a global scale.

Students must be able to think critically and creatively in order to contribute to the development of sustainability. Through practical teamwork, cooperative learning provides essential experiences for students' personal growth, increasing both their individual and social views. These beneficial experiences in encouraging students' future acquisition of sustainable competencies will inspire them to become advocates for sustainable development. Reflective, collaborative and cooperative learning, in the face of global development progress, provide students globally with competencies, self-regulation, and the tools for resource-sharing and -learning, thus facilitating beneficial changes in the educational environment. The literature research that inspired this study prompted concerns about how innovative teaching approaches can provide students with the ability to generate a variety of learning methods that will lead to sustainable development. Since sustainable development considers social, economic and environmental factors, it necessitates that students successfully combine their academic understanding with real-world application to improve their ability to solve problems and adapt to challenging environmental conditions. In order to do that, coupling competencies for sustainable development with pedagogical instruction is required, along with redefining education for sustainable development.

It is accepted that it is important for individuals to be able to reflect on and explore their practice and its outcomes as a resource for experience. However, in order to do this, one must accumulate some information through experience about the phenomenon being reflected on. In this case, acquired knowledge, values and attitudes are also important and contribute significantly to the process of accumulating experience and to the perception and problem-solving of sustainability as a phenomenon. The impact of collaboration and cooperation on fostering students' sense of responsibility and their ability to address complex problems to pursue and develop values such as equity, democracy and quality of life in a multicultural setting has been highlighted by a number of qualitative and quantitative research methods, including surveys and analyses of learning outcomes.

This study refers to the positive impact of cooperation and collaboration on the development of students' sense of responsibility as well as their ability to solve complex problems; as highlighted through qualitative and quantitative research methods, including surveys and analysis of learning outcomes. However, there may be limitations. For example, in some contexts, individual students may not be able to fully participate in collaboration, or problems may arise in collaboration that affect the development of their sense of responsibility and problem-solving skills. Thus, the effectiveness and applicability of cooperative teaching methods may vary from student to student and from context to context, which is a limitation to be aware of.

AUTHOR CONTRIBUTIONS

Tong Zhou: Investigation; writing – original draft; methodology; visualization; data curation; writing – review and editing. **Dolors Cañabate:** Investigation; validation; formal analysis; writing – original draft. **Remigijus Bubnys:** Conceptualization; methodology; validation; formal analysis; supervision; data curation; writing – original draft. **Brigita Stanikūnienė:** Formal analysis; writing – original draft; investigation; validation. **Jordi Colomer:** Writing – original draft; writing – review and editing; conceptualization; investigation; methodology; validation; visualization; data curation; supervision; formal analysis.

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CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

The project has been approved by the Ethics commission of the Institute of Science Education under code ICE/UDG 2022XINTERAC03.

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REFERENCES

Akçay, N. O. (2016). Implementation of cooperative learning model in preschool. *Journal of Education and Learning*, *5*(3), 83–93. http://www.ccsenet.org/journal/index.php/jel, https://doi.org/10.5539/jel.v5n3p83

Al-Malki, E. A. A., Gulnaz, F., Zahid Javid, C., & Chaudhry, M. Z. (2022). An empirical investigation of the EFL learners attitudes toward the effectiveness of cooperative learning. *SAGE Open*, *12*(4). https://doi.org/10.1177/21582440221141699

Almers, E. (2013). Pathways to action competence for sustainability-six themes. *The Journal of Environmental Education*, *44*(2), 116–127. https://doi.org/10.1080/00958964.2012.719939

Anand Shankar Raja, M., & Kallarakal, T. K. (2021). "COVID-19 and students perception about MOOCs" A case of Indian higher educational institutions. *Interactive Technology and Smart Education*, *18*(3), 450–474. https://doi.org/10.1108/ITSE-07-2020-0106

Annan-Diab, F., & Molinari, C. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the sustainable development goals. *The International Journal of Management Education*, *15*(2), 73–83. https://doi.org/10.1016/j.ijme.2017.03.006

Anyim, W. O. (2021). Sustainable development goal on quality education: A review of E-learning resources and pedagogy in the university system. *Library Philosophy and Practice*, 1–18. ISSN 15220222.

Ayers, J., Bryant, J., & Missimer, M. (2020). The use of reflective pedagogies in sustainability leadership education-a case study. *Sustainability*, *12*(17), 6726. https://doi.org/10.3390/su12176726

Baena-Morales, S., & Ferriz-Valero, A. (2023). What about physical education and sustainable development goals? A scoping review. *Physical Education and Sport Pedagogy*, *30*(2), 200–217. https://doi.org/10.1080/17408989.2023.2214572

Baena-Morales, S., Ferriz-Valero, A., & García-Taibo, O. (2022). Influence of cooperative strategies and mindfulness on the perception of control of emotions in primary physical education. A proposal to improve sustainability in the social dimension. *Journal of Physical Education and Sport*, *22*, 1590–1598. https://doi.org/10.7752/jpes.2022.07200

Baena-Morales, S., Jerez-Mayorga, D., Delgado-Floody, P., & Martínez-Martínez, J. (2021). Sustainable development goals and physical education. A proposal for practice-based models. *International Journal of Environmental Research and Public Health*, *18*, 2129. https://doi.org/10.3390/ijerph18042129

Baena-Morales, S., Jerez-Mayorga, D., Fernández-González, F. T., & López-Morales, J. (2020). The use of a cooperative-learning activity with university students: A gender experience. *Sustainability*, *12*(21), 9292. https://doi.org/10.3390/su12219292

Barth, M., & Rieckmann, M. (2012). Academic staf development as a catalyst for curriculum change towards education for sustainable development: An output perspective. *Journal of Cleaner Production*, *26*, 28–36. https://doi.org/10.1016/j.jclepro.2011.12.011

Barth, M., Godemann, J., Rieckmann, M., & Stoltenberg, U. (2007). Developing key competencies for sustainable development in higher education. *International Journal of Sustainability in Higher Education*, *8*(4), 416–430. https://doi.org/10.1108/14676370710823582

Bassachs, M., Cañabate, D., Serra, T., & Colomer, J. (2020). Interdisciplinary cooperative educational approaches to foster knowledge and competences for sustainable development. *Sustainability*, *12*, 8624. https://doi.org/10.3390/su12208624

Bassachs, M., Serra, T., Bubnys, R., Cañabate, D., & Colomer, J. (2022). Multimodal approaches to math and physical education within cooperative learning to enhance social attitudes. *Sustainability*, *14*(24), 16961. https://doi.org/10.3390/su142416961

Belur, J., Tompson, L., Thornton, A., & Simon, M. (2021). Interrater reliability in systematic review methodology: Exploring variation in coder decision-making. *Sociological Methods & Research*, *50*(2), 837–865. https://doi.org/10.1177/0049124118799372

Ben-Eliyahu, A. (2021). Sustainable learning in education. *Sustainability*, *13*(8), 4250. https://doi.org/10.3390/su13084250

Bendell, J., Sutherland, N., & Little, R. (2017). Beyond unsustainable leadership: Critical social theory for sustainable leadership. *Sustainability Accounting, Management and Policy Journal*, *8*(4), 418–444. https://doi.org/10.1108/SAMPJ-08-2016-0048

Berasategi, N., Aróstegui, I., Jaureguizar, J., Aizpurua, A., Guerra, N., & Arribillaga-Iriarte, A. (2020). Interdisciplinary learning at university: Assessment of an interdisciplinary experience based on the case study methodology. *Sustainability*, *12*, 7732. https://doi.org/10.3390/su12187732

Bhowmik, M. R. (2021). SDGs, social responsibility, institutions and cooperatives: Evidence from the handloom weaving sector in India. *International Journal of Rural Management*, *17*, 97S–114S. https://doi.org/10.1177/0973005221991604

Bianchi, G. (2020). *Sustainability competences*. Publications Office of the European Union. https://doi.org/10.2760/200956

Bjørke, L., & Mordal Moen, K. (2020). Cooperative learning in physical education: A study of students' learning journey over 24 lessons. *Physical Education and Sport Pedagogy*, *25*(6), 600–612.

Blatti, J. L., Garcia, J., Cave, D., Monge, F., Cuccinello, A., Portillo, J., Juarez, B., Chan, E., & Schwebel, F. (2019). Systems thinking in science education and outreach toward a sustainable future. *Journal of Chemical Education*, *96*(12), 2852–2862. https://doi.org/10.1021/acs.jchemed.9b00318

Bofill-Herrero, A., Baena-Morales, S., Garcia-Taibo, O., & Ferriz-Valero, A. (2022). Cooperative learning and SDG5. An intervention for physical education in secondary schools. *Journal of Physical Education and Sport*, *22*, 1570–1580. https://doi.org/10.7752/jpes.2022.07198

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., & Losch, K. (2020). Key competencies in sustainability in higher education-toward an agreed upon reference framework. *Sustainability Science*, *16*, 13–29. https://doi.org/10.1007/s11625-020-00838-2

Byrne, J. A. (2016). Improving the peer review of narrative literature reviews. *Research Integrity and Peer Review*, *1*, 12. https://doi.org/10.1186/s41073-016-0019-2

Cáceres-Jensen, L., Rodríguez-Becerra, J., Jorquera-Moreno, B., Escudey, M., Druker-Ibañéz, S., Hernández-Ramos, J., Díaz-Arce, T., Pernaa, J., & Aksela, M. (2021). Learning reaction kinetics through sustainable chemistry of herbicides: A case study of preservice chemistry teachers' perceptions of problem-based technology enhanced learning. *Journal of Chemical Education*, *98*, 1571–1582. https://doi.org/10.1021/acs.jchemed.0c00557

Cañabate, D., Bubnys, R., Nogué, L., Martínez-Mínguez, L., Nieva, C., & Colomer, J. (2021). Cooperative learning to reduce inequalities: Instructional approaches and dimensions. *Sustainability*, *13*, 10234. https://doi.org/10.3390/su131810234

Cañabate, D., Gras, M. E., Pinsach, L., Cachón, J., & Colomer, J. (2023). Promoting cooperative and competitive physical education methodologies for improving the launch's ability and reducing gender differences. *Journal of Sport and Health Research*, *15*(3), 597–614. https://doi.org/10.58727/jshr.94911

Carmona-Medeiro, E., & Cardeñoso Domingo, J. M. (2021). Social interaction: A crucial means to promote sustainability in initial teacher training. *Sustainability*, *13*(15), 8666. https://doi.org/10.3390/su13158666

Casey, A., & Quennerstedt, M. (2020). Cooperative learning in physical education encountering Dewey's educational theory. *European Physical Education Review*, *26*(4), 1023–1037. https://doi.org/10.1177/1356336X20904075

Casey, A., Dyson, B., & Campbell, A. (2009). Action research in physical education: Focusing beyond myself through cooperative learning. *Educational Action Research*, *17*(3), 407–423.

Cebrián, G., Junyent, M., & Mulà, I. (2020). Competencies in education for sustainable development: Emerging teaching and research developments. *Sustainability*, *12*(2), 579. https://doi.org/10.3390/su12020579

Cebrián, G., Palau, R., & Mogas, J. (2020). The smart classroom as a means to the development of ESD methodologies. *Sustainability*, *12*(7), 3010. https://doi.org/10.3390/su12073010

Chen, Y., & Lai, S. (2022). Constructing a capability maturity model for teacher education students. *Contemporary Educational Research Quarterly*, *30*(2), 1–47. https://doi.org/10.6151/CERQ.202206_30(2).0001

Chineme, A., Herremans, I., & Wills, S. (2019). Building leadership competencies for the SDGs through community/university experiential learning. *Journal of Sustainability Research*, *1*(2), e190018. https://doi.org/10.20900/jsr20190018

Colomer, J., Cañabate, D., Stanikūnienė, B., & Bubnys, R. (2021). Formulating modes of cooperative leaning for education for sustainable development. *Sustainability*, *13*(6), 3465. https://doi.org/10.3390/su13063465

Colomer, J., Serra, T., Cañabate, D., & Bubnys, R. (2020). Reflective learning in higher education: Active methodologies for transformative practices. *Sustainability*, *12*, 3827. https://doi.org/10.3390/su12093827

Correia, M. G., & Bleicher, R. (2008). Making connections to teach reflection. *Michigan Journal of Community Service Learning*, *14*(2), 41–49. https://files.eric.ed.gov/fulltext/EJ831372.pdf

Cottafava, D., Cavaglià, G., & Corazza, L. (2019). Education of sustainable development goals through students' active engagement: A transformative learning experience. *Sustainability Accounting, Management and Policy Journal*, *10*(3), 521–544. https://doi.org/10.1108/SAMPJ-05-2018-0152

Cowan, J. (1998). *On becoming an innovative university teacher*. Open University.

Cruz-Iglesias, E., Gil-Molina, P., & Rekalde-Rodríguez, I. (2022). A navigation chart for sustainability for the Ocean i3 educational project. *Sustainability*, *14*, 4764. https://doi.org/10.3390/su14084764

De Haan, G. (2010). The development of ESD-related competencies in supportive institutional frameworks. *International Review of Education*, *56*(2), 315–328. https://doi.org/10.1007/s11159-010-9157-9

De La Vega-Leinert, A. C., Stoll-Kleemann, S., & O'Riordan, T. (2009). Sustainability science partnerships in concept and in practice: A guide to a new curriculum from a European perspective. *Geography and Natural Resources*, *47*, 351–361. https://doi.org/10.1111/j.1745-5871.2009.00588.x

De Sousa, L. O. (2021). Learning experiences of a participatory approach to educating for sustainable development in a south African higher education institution yielding social learning indicators. *Sustainability*, *13*, 3210. https://doi.org/10.3390/su13063210

Demssie, Y. N., Biemans, H. J. A., Wesselink, R., & Mulder, M. (2023). Fostering students' systems thinking competence for sustainability by using multiple real-world learning approaches. *Environmental Education Research*, *20*, 261–286. https://doi.org/10.1080/13504622.2022.2141692

Dewey, J. (1933). *How we think*.

Dewey, J. (1938). *Experience in education*. Gateway edition. Collier Books.

Díaz-Iso, A., Eizaguirre, A., & García-Olalla, A. (2019). Extracurricular activities in higher education and the promotion of reflective learning for sustainability. *Sustainability*, *11*(17), 4521. https://doi.org/10.3390/su11174521

Dieleman, H. (2017). Urban agriculture in Mexico City; balancing between ecological, economic, social and symbolic value. *Journal of Cleaner Production*, *163*, S156–S163. https://doi.org/10.1016/j.jclepro.2016.01.082
Dlouhá, J., Barton, A., Huisingh, D., & Adomssent, M. (2013). Learning for sustainable development in regional networks. *Journal of Cleaner Production*, *49*, 1–4. https://doi.org/10.1016/j.jclepro.2013.01.041
Duncombe, R., & Armour, K. M. (2004). Collaborative professional learning: From theory to practice. *Journal of in-Service Education*, *30*(1), 141–166. https://doi.org/10.1080/13674580400200230
Dyson, B., & Casey, A. (2012). *Cooperative learning in physical education: A research based approach*. Routledge.
Education for Sustainable Development Guidance. (2021). https://media.www.kent.ac.uk/se/18355/education-for-sustainable-development-guidance2021.pdf
Eizaguirre, A., García-Feijoo, M., & Laka, J. P. (2019). Defining sustainability core competencies in business and management studies based on multinational stakeholders' perceptions. *Sustainability*, *11*(8), 2303. https://doi.org/10.3390/su11082303
ElAlfy, A., Palaschuk, N., El-Bassiouny, D., Wilson, J., & Weber, O. (2020). Scoping the evolution of corporate social responsibility (CSR) research in the sustainable development goals (SDGs) era. *Sustainability*, *12*(14), 5544. https://doi.org/10.3390/su12145544
Elo, M., Torkkeli, L., & Velt, H. (2022). Matching international business teaching with the UN sustainable development goals: Introducing bi-directional reflective learning. *Journal of Teaching in International Business*, *33*, 247–270. https://doi.org/10.1080/08975930.2022.2137277
Fang, J., & O'Toole, J. (2023). Embedding sustainable development goals (SDGs) in an undergraduate business capstone subject using an experiential learning approach: A qualitative analysis. *International Journal of Management Education*, *21*, 100749. https://doi.org/10.1016/j.ijme.2022.100749
Feijoo, G., & Moreira, M. T. (2020). Fostering environmental awareness towards responsible food consumption and reduced food waste in chemical engineering students. *Education for Chemical Engineers*, *33*, 27–35. https://doi.org/10.1016/j.ece.2020.07.003
Forman, E. A., & Cazden, C. B. (2013). Exploring Vygotskian perspectives in education: The cognitive value of peer interaction. In *Learning relationships in the classroom* (pp. 189–206). Routledge.
Foster, G., & Stagl, S. (2018). Design, implementation, and evaluation of an inverted (flipped) classroom model economics for sustainable education course. *Journal of Cleaner Production*, *183*, 1323–1336. https://doi.org/10.1016/j.jclepro.2018.02.177
García-Feijoo, M., Eizaguirre, A., & Rica-Aspiunza, A. (2020). A systematic review of sustainable-development-goal deployment in business schools. *Sustainability*, *12*(1), 440. https://doi.org/10.3390/su12010440
Giangrande, N., White, R. M., East, M., Jackson, R., Clarke, T., Saloff Coste, M., & Penha-Lopes, G. (2019). A competency framework to assess and activate education for sustainable development: Addressing the UN sustainable development goals 4.7 challenge. *Sustainability*, *11*(10), 2832. https://doi.org/10.3390/su11102832
Gillies, R. M. (2014). Cooperative learning: Developments in research. *International Journal of Educational Psychology*, *3*(2), 125–140. http://www.hipatiapress.com, https://doi.org/10.4471/ijep.2014.08
Glasser, H. (2007). Minding the gap: The role of social learning in linking our stated desire for a more sustainable world to our everyday actions and policies. In A. Wals (Ed.), *Social learning: Toward a more sustainable world* (pp. 35–61). Wageningen Academic Publishers.
Glasser, H., & Hirsh, J. (2016). Toward the development of robust learning for sustainability core competencies. *Sustainability: The Journal of Record*, *9*(3), 121–134. https://doi.org/10.1089/sus.2016.29054.hg
Gouwy, V. (2014). Self-reflection and personal evolution as keystone of sustainability. *World Review of Entrepreneurship, Management and Sustainable Development*, *10*(1), 80–87. https://doi.org/10.1504/WREMSD.2014.058055
GP, H., Rusijono, R., Masitoh, S., & Setyawan, W. (2020). Collaborative-cooperative learning model to improve theology students' characters: Is it effective? *Cakrawala Pendidikan*, *39*(2), 1–18. https://doi.org/10.2139/ssrn.3767719
Greig, A., & Priddle, J. (2019). Mapping students' development in response to sustainability education: A conceptual model. *Sustainability*, *11*, 4324. https://doi.org/10.3390/su11164324
Heeg, J., Hundertmark, S., & Schanze, S. (2020). The interplay between individual reflection and collaborative learning–seven essential features for designing fruitful classroom practices that develop students' individual conceptions. *Chemistry Education Research and Practice*, *21*(3), 765–788. https://doi.org/10.1039/C9RP00175A
Ho, B. Q. (2021). Effects of learning process and self-efficacy in real-world education for sustainable development. *Sustainability*, *13*, 403. https://doi.org/10.3390/su13010403
Howell, R. A. (2021). Engaging students for sustainable development: The benefits of active learning, reflective practices and flipped classroom pedagogies. *Journal of Cleaner Production*, *325*, 129318. https://doi.org/10.1016/j.jclepro.2021.129318
Howlett, C., Ferreira, J. A., & Blomfield, J. (2016). Teaching sustainable development in higher education: Building critical, reflective thinkers through an interdisciplinary approach. *International Journal of Sustainability in Higher Education*, *17*(3), 305–321. https://doi.org/10.1108/IJSHE-07-2014-0102

Hung, C., Yu, T., Lin, Y., Lin, Y., Chen, Y., & Lo, W. (2023). Reflective and cooperative learning for understanding sustainability through an eco-innovation strategy in rural travel and hospitality: A STEAM case study. *Sustainability*, *15*(17), 13152. https://doi.org/10.3390/su151713152

Ioannou, T., Bazigou, K., Katsigianni, A., Fotiadis, M., Chroni, C., Manios, T., Daliakopoulos, I., Tsompanidis, C., Michalodimitraki, E., & Lasaridi, K. (2022). The "A2UFood training kit": Participatory workshops to minimize food loss and waste. *Sustainability*, *14*(4), 2446. https://doi.org/10.3390/su14042446

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1984). *Cooperative learning*. Interaction Book Company.

Johnson, K. A. (2014). Cooperative education and sustainability: Students making a difference. *International Journal of Sustainability Education*, *9*(3), 1–4. https://doi.org/10.18848/2325-1212/cgp/v09i03/55303

Kassem, H. S., Al-Zaidi, A. A., & Baessa, A. (2021). Effectiveness of work-integrated learning partnerships: Case study of cooperative education in agricultural tertiary education. *Sustainability*, *13*(22), 12684. https://doi.org/10.3390/su132212684

Kazlauskienė, A., Gaučaitė, R., Cañabate, D., Colomer, J., & Bubnys, R. (2021). Sustainable development of students' assumed responsibility for their own learning during participatory action research. *Sustainability*, *13*(18), 10183. https://doi.org/10.3390/su131810183

Keay, J. (2006). Collaborative learning in physical education teachers' early-career professional development. *Physical Education and Sport Pedagogy*, *11*(3), 285–305.

Keeley, M., & Benton-Short, L. (2020). Holding complexity: Lessons from team-teaching an interdisciplinary collegiate course on urban sustainability. *Social Science*, *9*(5), 76. https://doi.org/10.3390/socsci9050076

Kioupi, V., & Voulvoulis, N. (2019). Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes. *Sustainability*, *11*(21), 6104. https://doi.org/10.3390/su11216104

Kitamura, K., & Ito, K. (2022). Facilitating personal transformation for sustainability: A learning program on the sustainable development goals, combining a card game and a self-reflective questionnaire. *Frontiers in Sustainability*, *3*, 842869. https://doi.org/10.3389/frsus.2022.842869

Landis, J. R., & Koch, G. G. (1977). An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics*, *33*(2), 363–374. https://doi.org/10.2307/2529786

Lesco, G., Squires, F., Babii, V., Bordian, N., Cernetchi, O., Martin Hilber, A., & Chandra-Mouli, V. (2019). The feasibility and acceptability of collaborative learning in improving health worker performance on adolescent health: Findings from implementation research in Moldova. *BMC Health Services Research*, *19*, 1–11. https://doi.org/10.1186/s12913-019-4158-2

Lin, J., Lin, D., Cheng, Y., & Kang, Z. (2023). Inquiry-based teaching approach to improve physics preservice teachers' professional competence: University social responsibility project for place-based education in rural areas. *Journal of Research in Education Sciences*, *68*, 35–60. https://doi.org/10.6209/JORIES.202309_68(3).0002

Lipka, J., Sharp, N., Brenner, B., Yanez, E., & Sharp, F. (2005). The relevance of culturally based curriculum and instruction: The case of Nancy Sharp. *Journal of American Indian Education*, *44*(3), 31–54. https://www.jstor.org/stable/24398496

Liu, Y., Wen, W., Gao, Y., Zhang, X., Qu, T., Yin, D., Peng, X., & Shi, Y. (2022). Online homework intelligent platform based on self-regulated learning (SRL): Essential for sustainable development of online higher education. *Sustainability*, *14*, 16904. https://doi.org/10.3390/su142416904

Lozano, A., López, R., Pereira, F. J., & Blanco Fontao, C. (2022). Impact of cooperative learning and project-based learning through emotional intelligence: A comparison of methodologies for implementing SDGs. *International Journal of Environmental Research and Public Health*, *19*(24), 16977. https://doi.org/10.3390/ijerph192416977

Lozano, R., Bautista-Puig, N., & Barreiro-Gen, M. (2022). Developing a sustainability competence paradigm in higher education or a White elephant? *Sustainability*, *30*, 870–883. https://doi.org/10.1002/sd.2286

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability*, *9*(11), 1889. https://doi.org/10.3390/su9101889

Luna Scott, C. (2015). *The futures of learning 3: What kind of pedagogies for the 21st century?* UNESCO. https://hdl.handle.net/20.500.12799/3747

Malik, R. S. (2018). Educational challenges in 21st century and sustainable development. *Journal of Sustainable Development Education and Research*, *2*(1), 9–20. https://doi.org/10.17509/jsder.v2i1.12266

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276–282. https://hrcak.srce.hr/89395, https://doi.org/10.1016/j.jocd.2012.03.005

Mehlmann, M., Sannum, M., & Benaim, A. (2015). Learning for sustainability: A systemic approach to behaviour and beliefs. In V. W. Thoresen, D. Doyle, J. Klein, & R. J. Didham (Eds.), *Responsible living: Concepts, education and future perspectives* (pp. 41–55). Springer Nature. https://doi.org/10.1007/978-3-319-15305-6_4

Michalopoulou, E., Shallcross, D. E., Atkins, E., Tierney, A., Norman, N. C., Preist, C., O'Doherty, S., Saunders, R., Birkett, A., Willmore, C., & Ninos, I. (2019). The end of simple problems: Repositioning chemistry in higher education and society using a systems thinking approach and the United Nations' sustainable development goals as a framework. *Journal of Chemical Education*, *96*(12), 2825–2835. https://doi.org/10.1021/acs.jchemed.9b00270

Mitakidou, S., & Tamoutseli, K. (2011). Engaging learners in cooperative learning through environmental and cross-cultural activities. *Journal of Teacher Education for Sustainability*, *13*, 5–18. https://doi.org/10.2478/v10099-011-0001-5

Mogensen, F., & Schnack, K. (2010). The action competence approach and the 'new' discourses of education for sustainable development, competence and quality criteria. *Environmental Education Research*, *16*(1), 59–74. https://doi.org/10.1080/13504620903504032

Mohd-Yusof, K., Wan Alwi, S. R., Sadikin, A. N., & Abdul-Aziz, A. (2015). Inculcating sustainability among first-year engineering students using cooperative problem-based learning. In P. Davim (Ed.), *Sustainability in higher education* (pp. 67–95). Chandos Publishing. https://doi.org/10.1016/B978-0-08-100367-1.00004-4

Mokhele, P. R. (2006). The teacher-learner relationship in the management of discipline in public high schools. *Africa Education Review*, *3*(1_2), 148–159. https://hdl.handle.net/10520/EJC31809, https://doi.org/10.1080/18146620608540448

Moon, J. A. (1999). *Reflection in learning and professional development*. Theory and practice. Routledge Falmer.

Moon, J. A. (2004). *A handbook of reflective and experiential learning*. Theory and Practice. Routledge Falmer.

Mora, H., Signes-Pont, M. T., Fuster-Guilló, A., & Pertegal-Felices, M. L. (2020). A collaborative working model for enhancing the learning process of science & engineering students. *Computers in Human Behavior*, *103*, 140–150. https://doi.org/10.1016/j.chb.2019.09.008

Muñoz-Martínez, Y., Gárate-Vergara, F., & Marambio-Carrasco, C. (2021). Training and support for inclusive practices: Transformation from cooperation in teaching and learning. *Sustainability*, *13*, 2583. https://doi.org/10.3390/su13052583

Naseer, M., Zhang, W., & Zhu, W. (2020). Prediction of coding intricacy in a software engineering team through machine learning to ensure cooperative learning and sustainable education. *Sustainability*, *12*, 8986. https://doi.org/10.3390/su12218986

Nguyen, P. M., Elliott, J. G., Terlouw, C., & Pilot, A. (2009). Neocolonialism in education: Cooperative learning in an Asian context. *Comparative Education*, *45*(1), 109–130. https://doi.org/10.1080/03050060802661428

Nortvig, A.-M., & Christiansen, R. B. (2017). Institutional collaboration on MOOCs in education—A literature review. *The International Review of Research in Open and Distance Learning*, *18*(6), 306–316. https://doi.org/10.19173/irrodl.v18i6.3110

Ofei-Manu, P., Didham, R. J., Byun, W. J., Phillips, R., Dickella Gamaralalage, P. J., & Rees, S. (2018). How collaborative governance can facilitate quality learning for sustainability in cities: A comparative case study of Bristol, Kitakyushu and Tongyeong. *International Review of Education*, *64*(3), 373–392. https://doi.org/10.1007/s11159-017-9667-9

Olsson, D., Gericke, N., & de Pauw, J. B. (2022). The effectiveness of education for sustainable development revisited—A longitudinal study on secondary students' action competence for sustainability. *Environmental Education Research*, *28*(3), 405–429. https://doi.org/10.1080/13504622.2022.2033170

Osterman, K. F., & Kottkamp, R. B. (2004). *Reflective practice for educators*. Professional Development to Improve Student Learning. Corwin Press.

Oxford, R. L. (1997). Cooperative learning, collaborative learning, and interaction: Three communicative strands in the language classroom. *The Modern Language Journal*, *81*(4), 443–456. https://doi.org/10.1111/j.1540-4781.1997.tb05510.x

Pacis, M., & VanWynsberghe, R. (2020). Key sustainability competencies for education for sustainability creating a living, learning and adaptive tool for widespread use. *International Journal of Sustainability in Higher Education*, *21*(3), 575–592. https://doi.org/10.1108/IJSHE-12-2018-0234

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C., Shamseer, L., Tetzlaff, J. M., & Moher, D. (2021). Updating guidance for reporting systematic reviews: Development of the PRISMA 2020 statement. *Journal of Clinical Epidemiology*, *134*, 103–112. https://doi.org/10.1016/j.jclinepi.2021.02.003

Pauw, J. B., Gericke, N., Olsson, D., & Berglund, T. (2015). The effectiveness of education for sustainable development. *Sustainability*, *7*(11), 15693–15717. https://doi.org/10.3390/su71115693

Pavlova, M. (2013). Teaching and learning for sustainable development: ESD research in technology education. *International Journal of Technology and Design Education*, *23*, 733–748. https://doi.org/10.1007/s10798-012-9213-9

Penaskovic, R., DeVries, D. R., & Chadwick, N. E. (2014). Teaching about sustainability: Raising consciousness and taking action. In K. D. Thomas, & H. E. Muga (Eds.), *Handbook of research on pedagogical innovations for sustainable development* (pp. 383–397). IGI Global. https://doi.org/10.4018/978-1-4666-5856-1.ch018

Peters, M. D. J., Marnie, C., Tricco, A. C., Pollock, D., Munn, Z., Alexander, L., McInerney, P., Godfrey, C. M., & Khalil, H. (2020). Updated methodological guidance for the conduct of scoping reviews. *JBI Evidence Synthesis*, *18*(10), 2119–2126. https://doi.org/10.11124/JBIES-20-00167

Pineda-Martínez, M., Llanos-Ruiz, D., Puente-Torre, P., & García-Delgado, M. Á. (2023). Impact of video games, gamification, and game-based learning on sustainability education in higher education. *Sustainability*, *15*(17), 13032. https://doi.org/10.3390/su151713032

Prieto-Saborit, J. A., Méndez-Alonso, D., Cechhini, J. A., Fernández-Viciana, A., & Bahamonde-Nava, J. R. (2021). Cooperative learning for a more sustainable education: Gender equity in the learning of maths. *Sustainability*, *13*(15), 8220. https://doi.org/10.3390/su13158220

Prieto-Saborit, J. A., Méndez-Alonso, D., Fernández-Viciana, A., Dixit, L. J. D., & Nistal-Hernández, P. (2022). Implementation of cooperative learning and its relationship with prior training of teachers, performance and equity in mathematics: A longitudinal study. *Sustainability*, *14*, 16243. https://doi.org/10.3390/su142316243

Raath, S., & Hay, A. (2019). Preservice geography students' exposure to systems thinking and cooperative learning in environmental education. *Journal of Geographical Sciences*, *118*(2), 66–76. https://doi.org/10.1080/00221341.2018.1516231

Ralph, N. (2015). *Critical reflection as a catalyst for sustainable leadership development*. Conference: Leading Wellbeing Research Festival, Brathay Hall, Cumbria. https://doi.org/10.13140/RG.2.1.2990.8568

Redman, A., Wiek, A., & Barth, M. (2021). Current practice of assessing students' sustainability competencies: A review of tools. *Sustainability Science*, *16*, 117–135. https://doi.org/10.1007/s11625-020-00855-1

Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures*, *44*, 127–135. https://doi.org/10.1016/j.futures.2011.09.005

Rieckmann, M. (2018). Learning to transform the world: Key competencies in education for sustainable development. *Issues and Trends in Education for Sustainable Development*, *39*, 39–59.

Rogers, R. (2001). Reflection in higher education: A concept analysis. *Innovative Higher Education*, *26*(1), 37–57. https://doi.org/10.1023/A:1010986404527

Salvaterra, C., Bencivenni, A., Fogagnolo, M., Gheldof, T., & Vagionakis, I. (2022). ENCODE4OpenU and the preparation and delivery of an international collaborative MOOC: A preliminary analysis of its pedagogical and technical implementation. *Education in Science*, *13*(1), 43. https://doi.org/10.3390/educsci13010043

Sass, W., de Pauw, J. B., Olsson, D., Gericke, N., de Maeyer, S., & van Petegem, P. (2020). Redefining action competence: The case of sustainable development. *The Journal of Environmental Education*, *51*(4), 292–305. https://doi.org/10.1080/00958964.2020.1765132

Schön, D. (1991). *The reflective practitioner. How professionals think in action*. Maurice Temple Smith Ltd.

Serra, T., Gras, M. E., Cañabate, D., & Colomer, J. (2023). Fostering cognitive control through reflection in scientific writing. *Reflective Practice*, *24*(4), 433–446. https://doi.org/10.1080/14623943.2023.2210064

Shah, E., Lopes Cardoso, M., & Hjarrand, J. (2024). Learning as ecosystems: Shifting paradigms for more holistic programming in education. *International Journal of Educational Development*, *104*, 102943. https://doi.org/10.1016/j.ijedudev.2023.102943

Silva, M. F., Malheiro, B., Guedes, P., Duarte, A., & Ferreira, P. (2018). Collaborative learning with sustainability-driven projects: A summary of the EPS@ISEP programme. *International Journal of Engineering Pedagogy*, *8*, 106–130. https://doi.org/10.3991/ijep.v814.8260

Sims, L. (2021). How a dairy cooperative transformed a community: Learning results from a Colombian case study. *Social Sciences & Humanities Open*, *4*(1), 100205. https://doi.org/10.1016/j.ssaho.2021.100205

Singh, A. S., & Shah, M. (2021). Tata trusts: Positively and sustainably contributing to the development of sport in India. *Emerald Emerging Markets Case Studies*, *11*(2), 1–37. https://doi.org/10.1108/EEMCS-09-2020-0333

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Spires, H. A., Himes, M. P., Paul, C. M., & Kerkhoff, S. N. (2019). Going global with project-based inquiry: Cosmopolitan literacies in practice. *Journal of Adolescent and Adult Literacy*, *63*(1), 51–64. https://doi.org/10.1002/jaal.947

Stevahn, L., & McGuire, M. E. (2017). The plot thickens: Supporting pre-service teachers in authentic use of cooperative learning through the Storypath instructional approach. *Journal of Education for Teaching*, *43*(3), 316–327. https://doi.org/10.1080/02607476.2017.1321674

Strijbos, J.-W., & De Laat, M. F. (2010). Developing the role concept for computer-supported collaborative learning: An explorative synthesis. *Computers in Human Behavior*, *26*(4), 495–505. https://doi.org/10.1016/j.chb.2009.08.014

Susi, T., Lindblom, J., & Alenljung, B. (2015). *Promoting sustainability: Learning new practices through ICT*. 11th International Conference on Computer Supported Collaborative Learning, June 7–11, Gothenburg, Sweden, The University of Gothenburg. https://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-457225

Svanström, M., Lozano-García, F. J., & Rowe, D. (2008). Learning outcomes for sustainable development in higher education. *International Journal of Sustainability in Higher Education*, *9*(3), 339–351.

Takala, A., & Korhonen-Yrjänheikki, K. (2019). A decade of Finnish engineering education for sustainable development. *International Journal of Sustainability in Higher Education*, *20*, 170–186. https://doi.org/10.1108/IJSHE-07-2018-0132

Tejedor, G., Segalàs, J., Barrón, Á., Fernández-Morilla, M., Fuertes, M. T., Ruiz-Morales, J., Gutiérrez, I., García-González, E., Aramburuzabala, P., & Hernández, À. (2019). Didactic strategies to promote competencies in sustainability. *Sustainability*, *11*(7), 2086. https://doi.org/10.3390/su11072086

Thomas, I., & Day, T. (2014). Sustainability capabilities, graduate capabilities, and Australian universities. *International Journal of Sustainability in Higher Education*, *15*(2), 208–227. https://doi.org/10.1108/IJSHE-05-2012-0046

Topping, K. J. (2005). Trends in peer learning. *Educational Psychology*, *25*(6), 631–645. https://doi.org/10.1080/01443410500345172

Torrents, C., Balagué, N., Hristovski, R., Almarcha, M., & Kelso, J. A. S. (2021). Metastable Coordination Dynamics of Collaborative Creativity in Educational Settings. *Sustainability*, *13*, 2696. https://doi.org/10.3390/su13052696

Trad, S. P. (2019). A framework for mapping sustainability within tertiary curriculum. *International Journal of Sustainability in Higher Education*, *20*(2), 288–308. https://doi.org/10.1108/IJSHE-09-2018-0151

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., … Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, *169*(7), 467–473. https://doi.org/10.7326/M18-0850

Tyndall, D. E., Kosko, D. A., Forbis, K. M., & Sullivan, W. B. (2020). Mutual benefits of a service-learning community–academic partnership. *Journal of Nursing Education*, *59*(2), 93–96. https://doi.org/10.3928/01484834-20200122-07

Uhrqvist, O., Carlsson, L., Kall, A. S., & Asplund, T. (2021). Sustainability stories to encounter competences for sustainability. *Journal of Education for Sustainable Development*, *15*(1), 146–160. https://doi.org/10.1177/09734082211005041

UNESCO. (2017). https://unesdoc.unesco.org/ark:/48223/pf0000247444

UNESCO. (2020). *Education for sustainable development: A roadmap*. https://unesdoc.unesco.org/ark:/48223/pf0000374802

Van den Berg, B., Poldner, K. A., Sjoer, E., & Wals, A. E. J. (2022). Sweet Acid' An interpretative phenomenological analysis of students' navigating regenerative higher education. *Education in Science*, *12*(8), 533. https://doi.org/10.3390/educsci12080533

Varga, A., Kószó, M. F., Mayer, M., & Sleurs, W. (2007). Developing teacher competences for education for sustainable development through reflection: The environment and school initiatives approach. *Journal of Education for Teaching*, *33*(2), 241–256. https://doi.org/10.1080/02607470701259564

Wals, A., & Jickling, B. (2002). Sustainability in higher education: From doublethink and newspeak to critical thinking and meaningful learning. *International Journal of Sustainability in Higher Education*, *3*(3), 221–232. https://doi.org/10.1108/14676370210434688

Warner, B. P., & Elser, M. (2015). How do sustainable schools integrate sustainability education? An assessment of certified sustainable K–12 schools in the United States. *The Journal of Environmental Education*, *46*(1), 1–22. https://doi.org/10.1080/00958964.2014.953020

Whalen, K., & Paez, A. (2021). Student perceptions of reflection and the acquisition of higher-order thinking skills in a university sustainability course. *Journal of Geography in Higher Education*, *45*, 108–127. https://doi.org/10.1080/03098265.2020.1804843

Wiek, A., Bernstein, M., Foley, R. W., Cohen, M., Forrest, N., Kuzdas, C., Kay, B., & Keeler, L. W. (2015). Operationalising competencies in higher education for sustainable development. In *Routledge handbook of higher education for sustainable development* (pp. 241–260). Taylor and Francis.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability—A reference framework for academic program development. *Sustainability Science*, *6*(2), 203–218.

Wihlborg, M., Friberg, E. E., Rose, K. M., & Eastham, L. (2018). Facilitating learning through an international virtual collaborative practice: A case study. *Nurse Education Today*, *61*, 3–8. https://doi.org/10.1016/j.nedt.2017.10.007

Yip, K. (2006). Self-reflection in reflective practice: A note of caution. *British Journal of Social Work*, *36*, 777–788. https://doi.org/10.1093/bjsw/bch323

Youniss, J., & Damon, W. (2013). Social construction in Piaget's theory. In J. Youniss, & W. Damon (Eds.), *Piaget's theory* (pp. 267–286). Psychology Press.

Zainuri, A., & Huda, M. (2023). Empowering cooperative teamwork for community service sustainability: Insights from service learning. *Sustainability*, *15*(5), 4551. https://doi.org/10.3390/su15054551

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