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What is needed to act as a professional change agent for sustainability? A scoping review

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Abstract

Professionals across diverse work environments play a crucial role in facilitating and accelerating essential transformations towards sustainability. Recognising the urgent need to avert severe, irreversible harm to vital Earth systems, professional actors have been increasingly identified as a key target group for sustainability-related training programmes. While Education for Sustainable Development (ESD) scholarship has significantly contributed to identifying key competences of higher education programmes, there is a noticeable gap in research dedicated to competences needed from a professional perspective. This gap makes it challenging to design training programmes to foster such competences. To address this research gap, the authors of this article conducted a scoping review on SCOPUS, Web of Science and ERIC to identify professional sustainability competences outlined in the literature. Furthermore, they examined training activities designed to cultivate these competences and corresponding evaluation practices. By evaluating the abstracts of 475 identified articles, a sample of 37 papers was generated, which were then coded based on a qualitative content analysis. The results show that, consistent with higher education learning outcomes, systems thinking competence, interpersonal competence and strategic competence are particularly relevant. Anticipatory competence, however, assumes a secondary role, while intrapersonal competence and implementation competence – contrary to the higher education context – are considered as not emerging but pivotal. In addition, leadership competence emerges as particularly relevant in the professional field. Finally, this review indicates that intentional competence development in professional training is often not thoroughly evaluated.

Keywords professional sustainability competences · education for sustainable development (ESD) · evaluation of sustainability initiatives · change agents

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Résumé

Que faut-il pour opérer en tant qu'agent de changement professionnel en faveur de la durabilité ? Une revue exploratoire – Les professionnels jouent un rôle crucial dans des environnements de travail divers pour faciliter et accélérer les transformations essentielles vers la durabilité. Reconnaissant le besoin urgent d'éviter des dommages graves et irréversibles aux systèmes vitaux de la Terre, les acteurs professionnels sont de plus en plus identifiés comme un groupe cible clé pour les programmes de formation liés à la durabilité. Tandis que les études sur l'éducation au développement durable (EDD) ont largement contribué à identifier les compétences clés des programmes d'enseignement supérieur, il existe une lacune notable dans les recherches consacrées aux compétences nécessaires sur le plan professionnel. Elle complique la conception des programmes de formation visant à promouvoir ces compétences. Pour combler cette lacune dans les recherches, les auteurs du présent article ont effectué une revue exploratoire de SCOPUS, Web of Science et ERIC afin d'identifier les compétences professionnelles en matière de durabilité décrites dans la littérature. En outre, ils ont examiné les activités de formation conçues pour cultiver ces compétences et les pratiques d'évaluation correspondantes. L'évaluation des résumés de 475 articles identifiés a permis de constituer un échantillon de 37 articles, qui ont ensuite été codés sur la base d'une analyse qualitative des contenus. Les résultats indiquent que, en cohérence avec les résultats de l'apprentissage dans l'enseignement supérieur, les compétences en matière de réflexion sur les systèmes, les compétences interpersonnelles et les compétences stratégiques sont particulièrement pertinentes. La faculté d'anticiper joue, cependant, un rôle secondaire, tandis que – contrairement au contexte de l'enseignement supérieur – les compétences intrapersonnelles et l'aptitude à mettre en œuvre ne sont pas considérées comme émergentes, mais comme essentielles. En outre, les compétences en matière de leadership se révèlent particulièrement pertinentes dans le domaine professionnel. Enfin, cette étude indique que le développement intentionnel des compétences dans le cadre de la formation professionnelle ne fait souvent pas l'objet d'une évaluation approfondie.

Introduction

The global challenges of sustainability require ever faster and more effective action to achieve realignment of our economic systems and societies. Education and learning have a key role to play in this. With its "ESD for 2030" programme, launched in 2020, the United Nations Educational, Scientific and Cultural Organization therefore presented an "urgent call for action" and a roadmap for strengthening education for sustainable development (ESD) in all areas of education (UNESCO 2020). Professional actors are receiving increased attention in the discourse on ESD (e.g. McGrath and Powell 2016). On the one hand, they hold positions from which they could potentially contribute to initiating, accelerating or continuing change processes towards sustainable development. On the other hand, they may not have acquired the requisite knowledge, skills and abilities through formal education, necessitating professional training to act as effective change agents for sustainable development

(e.g. English and Carlsen 2019). Despite this increased attention, we currently lack a comprehensive overview of competences for sustainability professionals.

Through this scoping review, we aim to contribute to the development of a shared understanding of competences deemed essential for enabling professionals to drive change processes towards sustainable development. We analyse existing literature which discusses professional sustainability competences and explore how current training activities reference these sustainability competences to inform the design and evaluation of these initiatives.

Theoretical background

Against the backdrop of accelerating and interconnected problems, such as crossing planetary boundaries and thereby risking a safe operating space for humanity on Earth (Rockström et al. 2023), the international agenda on sustainable development aims to stay within planetary boundaries and contribute to inter- and intragenerational justice (WCED 1987). While ESD was initially recognised as a primary catalyst for empowering individuals of all ages to devise solutions to sustainability challenges, many individuals lacked the opportunity to develop sustainability competences either before or during their professional careers, hindering their progression towards becoming sustainability professionals.

A profession is understood as a field of activity with highly complex demands which require specialised, scientific and rapidly changing knowledge, as well as ethical standards (e.g. Cruess et al. 2004). While some professions have a long tradition and standardised codes (such as the Hippocratic oath in medicine), the increasingly complex problems in different fields of occupation (e.g. social work) and the description of our societies as knowledge societies have led to more and more working contexts being described as professions. This is also true for sustainability. Sustainability professionals are individuals who specialise in promoting and implementing sustainable practices within various fields. They possess expertise in environmental protection, social responsibility and economic resilience, following the ethical goal of contributing to more inter- and intragenerational justice and fostering long-term viability of ecosystems and communities (Peiró et al. 2021). Sustainability professionals are not just individuals whose official job description mandates their contribution to sustainability solutions. They include individuals with diverse disciplinary and occupational backgrounds who address sustainability problems proactively and with lasting intensity over an extended period. In doing so, they expand the scope of their official mandate, or even create a new one, driven by ethical obligation. Acting as change agents, they frequently navigate and challenge the boundaries between business, policy and sustainability science to promote the achievement of sustainable development goals (Milana et al. 2016).

In ESD scholarship, the knowledge, skills and abilities required to act as change agents for sustainable development have been summarised as "sustainability competences" (Rieckmann 2022). These competences empower individuals to address and overcome sustainability-related challenges in both their private and professional lives (Lambrechts et al. 2013). Sustainability competences have garnered increased

attention in defining desirable learning outcomes in formal education, particularly within Higher Education for Sustainable Development (HESD). The European Union (EU) has also directed a focus towards the education and training needs of individuals of all ages through its recent Green Competencies (GreenComp) initiative (Bianchi et al. 2022).

Following principles of constructive alignment (Biggs 1996), specification of sustainability competences is meant to support educators in purposefully designing formal educational learning programmes and systematically evaluating learning activities with regard to their potential to stimulate these competences. Scholars have suggested several competence frameworks to inform the design and evaluation of formal HESD programmes and activities (Lozano et al. 2017). Over time, these concepts have become more and more differentiated, and a consensus has gradually emerged as to which competences should be promoted in HESD (Rieckmann 2012). Arnim Wiek et al. (2011) have succeeded in mapping the state of the international debate and proposing a condensed sustainability competence framework which has met with a very positive response internationally (see also UNESCO 2017) and is regarded in many places as a reference work for the implementation of HESD. They distinguish between five key competences: systems thinking, anticipatory, normative, strategic and interpersonal competence (Wiek et al. 2011). This sustainability competence framework was recently validated in an international Delphi study conducted by Katja Brundiers et al. (2021) and augmented with intrapersonal and implementation competence.

Parallel to Brundiers et al. (2021), Aaron Redman and Arnim Wiek (2021) also address the international status of the competence discourse for graduates as future professionals in their systematic review of the relevant literature (see Figure 1). One of their core results is that most of the publications refer to the original framework proposed by Wiek et al. (2011). In addition, they describe implementation and intrapersonal competences as "emerging key competences", in contrast to the original key competences (Redman and Wiek 2021). Implementation competence, they argue, challenges higher education institutions, as these do not always fully prepare graduates for "doing sustainability" (Alvarez and Rogers 2006). Implementation competence calls for that to change, yet this is a "largely unexplored space for university programs" (Redman and Wiek 2021, p. 8). The same has been said about intrapersonal sustainability competence, which remains a neglected area of expertise within (H)ESD institutions (Brundiers et al. 2021; Frank 2021). Redman and Wiek (2021) also argue that general competences (critical thinking, creativity, learning) are relevant.

The work of Redman and Wiek illustrates that many sustainability competences have been proposed and defined from the perspective of higher education, as well as sustainability science. Conversely, limited research exists which specifically examines the challenges faced by sustainability professionals and the corresponding competences needed to address them from the perspective of the relevant professional fields. In this sense, Redman and Wiek (2021) have built a bridge to the field of sustainability professionals, but in the derivation of their competence framework they remain very much in the realm of the
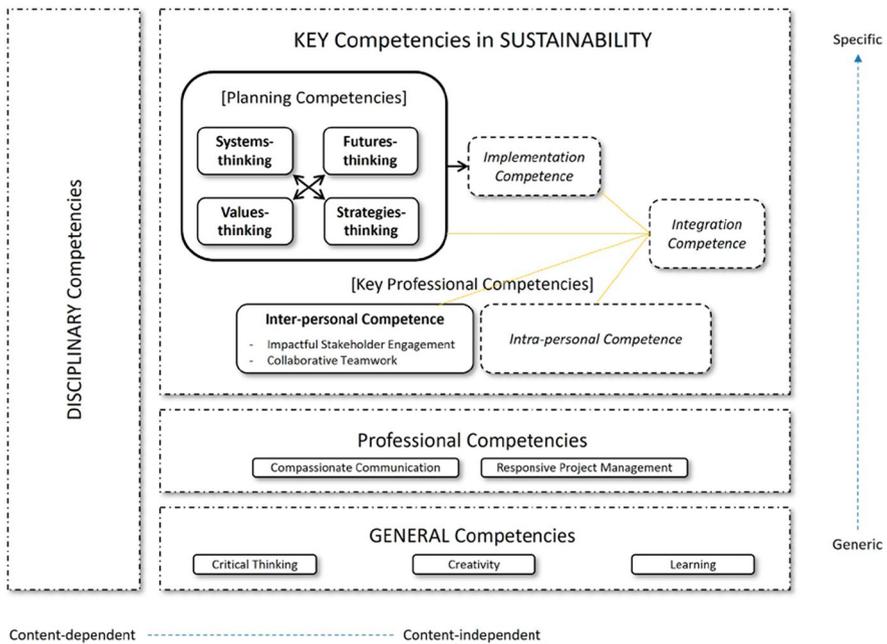
Figure 1 Competence framework for advancing sustainability by Redman and Wiek (2021, p. 7). *Note:* As Redman and Wiek explain, this figure depicts their "[u]nified framework of competencies for advancing sustainability transformations; centred on 8 key competencies in sustainability with 5 established (bold) and 3 emerging (italic); … complemented by disciplinary, general, and other professional competencies" (ibid.)

university-specific competence discussion.[1] However, there are also people working in professional fields of sustainability who have vocational training and could benefit from various further training programmes. Until now, there are hardly any systematic descriptions of learning objectives for the work of academies or institutes which offer further education courses in sustainability (in contrast to the competences addressed in study programmes in the higher education sector). Thus, a robust knowledge base which addresses the challenges faced by professionals working towards sustainability is still lacking.

Some regional exceptions exist, such as the work of Clare D'Souza et al. (2019) in Australia and Corinne Ruesch Schweizer (2023) in Switzerland, along with specific approaches for certain professions or fields of activity, including sustainability management (Osagie et al. 2016; Miller and Akdere 2019), entrepreneurship (Foucrier and Wiek 2019), energy management (Pilipczuk 2020), facility management (Sarpin et al. 2016), supply management (Schulze et al.

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[1] In the systematic literature review conducted by Redman and Wiek (2021), the term "professional" was not part of their search string. It included numerous synonyms for competences (including "capabilities" and "learning outcomes"), while the professional contexts examined remained almost indefinite (except for the exclusion of papers from the field of medicine).

2022), agriculture (Sørensen et al. 2021) and medicine (Wegener et al. 2018). Nevertheless, most of the "approaches to education for sustainable development (ESD) prioritise the context of schooling and/or formal education" (Schreiber-Barsch and Mauch 2019, p. 519). Additionally, review results on the assessment of learning outcomes from the field of ESD and Global Education show that only a small number of studies refer to learning environments in the field of adult education or further education (O'Flaherty and Liddy 2018).

Without solid knowledge about sustainability-related challenges and corresponding competences of professional actors, it becomes difficult to design evidence-informed, interdisciplinary and cross-professional training programmes and activities that prepare this target group to become change agents of sustainable development. Put differently, while the importance of professional training for sustainability is increasingly recognised, there is still a gap between the theoretical foundation and the actual planning and realisation of continuing education and training in sustainability. As a consequence, there is a risk that professional training formats are designed without pre-defined learning outcomes or competences, and thus do not enable professional learners to deal with the challenges they face in their professional lives. In turn, professional training could greatly benefit from a deeper understanding of required professional sustainability competences, adequate learning activities to foster the latter, and appropriate evaluation tools that allow training providers to assess and improve the quality of these activities.

Against this backdrop, our main research question was:

(RQ1) What competences of sustainability professionals are described in the literature?

Related questions were:

(RQ2) In which training formats can the development of these competences be promoted?
(RQ3) How can these trainings be evaluated?
(RQ4) How are the learning outcomes described linked to educational interventions and their evaluations in the sense of constructive alignment?

Our objective was to map the scientific discourse on professional sustainability competences, contribute to theory development and provide guidance for academies and other institutions offering interdisciplinary and cross-professional training.

Methods

In order to address these research questions, we conducted a scoping review (Munn et al. 2018). A scoping review is a type of literature review which explores literature to find knowledge gaps, clarify concepts, or investigate research trends and characteristics (Tricco et al. 2018; Gutirrez-Bucheli et al. 2022). The overarching purpose is to determine "the coverage of a body of literature on a given topic" (Munn et al.

2018, p. 2). As Rebecca Armstrong et al. (2011) point out, scoping reviews are especially useful if the questions under investigation are broad, because it is still unclear which more specific questions can be posed. In contrast to systematic literature reviews, scoping reviews do not require specific quality standards from the identified literature to be included (e.g. a minimum number of participants in empirical studies) (Tricco et al. 2018). As the aim of our research was to better understand how learning goals in professional sustainability trainings are defined, which learning activities are applied to foster these learning goals, and how the latter are evaluated, we opted for a scoping review because it would be able to provide the methodical qualities needed to analyse the existing body of literature (Gutierrez-Bucheli et al. 2022).

To ensure that the scoping review would be conducted in a rigorous and transparent manner, we followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al. 2018). These guidelines provide a standardised approach for conducting and reporting on scoping reviews, ensuring that the study is transparent, systematic and replicable. In order to identify relevant studies for this review, we systematically searched the following databases: Web of Science, SCOPUS and ERIC (October 2022).

Our search string included the use of the following keywords and relevant synonyms and concepts in abstract, title or keywords: "competences" AND "learning" AND "professional"[2] AND "sustainability", and excluded the use of school and higher education keywords (see Appendix 1 for the search string).[3] These keywords were chosen to ensure that the search captured literature on the competences needed by sustainability practitioners in a professional context, as well as the learning and development of these competences. We excluded articles from primary, secondary and higher education in order to reduce redundancy, since much sustainability competence research has been done in the field of higher education (exclusion criterion 1). We further excluded articles which met the following criteria:

- if sustainability was understood as long-termism or durability, instead of the normative political definition (exclusion criterion 2);
- if they only addressed informal learning, as we were interested in structured (non-formal) learning environments (exclusion criterion 3); and
- if there was no learning or competence focus (exclusion criterion 4).

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[2] We intentionally did not look at specific professional sectors but instead considered any professional group as potentially concerned with sustainability. Consequently, we were less interested in domain-specific competences and more in competences which are relevant to sustainability beyond disciplinary boundaries.

[3] Appendix 1 is available at https://figshare.com/articles/dataset/Appendices_for_the_article_What_is_needed_to_act_as_a_professional_change_agent_for_sustainability_A_scoping_review_/28172108?file=51667745. Unlike Redman and Wiek (2021), we related our search, sample selection and analysis to concrete professional fields.

Our search was not limited to any specific type of article. It was, however, limited to articles written in English and published in peer-reviewed journals. The selection process was performed using PRISMA guidance (depicted in Figure 2). Initially, we identified 547 items (287 from Web of Science, 252 from SCOPUS and 8 from ERIC), but removed 73 from that total before screening (see Figure 2). Abstract screening of the remaining 474 articles was conducted by three reviewers using the SysRev platform, with conflicting cases discussed between at least two researchers in the team. Seven additional articles were sampled through already known literature by the researchers, resulting in a total of 85 full texts being read for eligibility. After having applied all exclusion criteria, 37 papers were eligible for full inclusion (see Figure 2 and the final list of included reports in Appendix 2).[4]

Our data analysis for this scoping review followed a set of steps to ensure a rigorous and transparent process. First, we imported all of the included articles into MAXQDA software. Two researchers then independently coded the articles using the following topics and categories: type of article (empirical, theoretical/conceptual), target group of competence development (leadership, employees, not specified), professional field (public sector, private sector, non-profit sector), competences or learning outcomes, and information about training interventions and evaluation approaches. This coding process allowed for the articles to be systematically organised and classified according to relevant themes and categories. It also facilitated the identification and extraction of relevant data to synthesise the findings.

To ensure that the coding process was reliable and valid, the initial coding of five articles (approximately 10% of the data) was conducted by both researchers. Conflicting cases were discussed and the codebook refined as required. The remaining articles were then coded by the same two researchers, with the main researcher randomly selecting and cross-checking a subset of the articles coded by the second researcher to ensure that the coding was consistent. Any discrepancies in coding were discussed and resolved to reach consensus.

To analyse the competences addressed in the corpus, we used a qualitative content analysis (Kuckartz 2019) in MAXQDA to extract all competences discussed per article. This involved closely reading and coding the articles to identify and extract the relevant data. The lists of competences extracted by the researchers during that step were then coded within an Excel file and imported into a new MAXQDA file, with one document for each article. Afterwards, we coded the competences according to the framework of competences for advancing sustainability transformations developed by Redman and Wiek (2021) as a comparative basis to analyse our findings. The codes were extended inductively where the reference framework did not suffice to describe our results. This process allowed for systematic and comprehensive analysis of the competences discussed in the literature. The coding was refined as needed until consensus was reached. This final step of the data analysis ensured that our findings were rigorous and reliable.

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[4] Appendix 2 is available at https://figshare.com/articles/dataset/Appendices_for_the_article_What_is_needed_to_act_as_a_professional_change_agent_for_sustainability_A_scoping_review_/28172108?file=51667748.
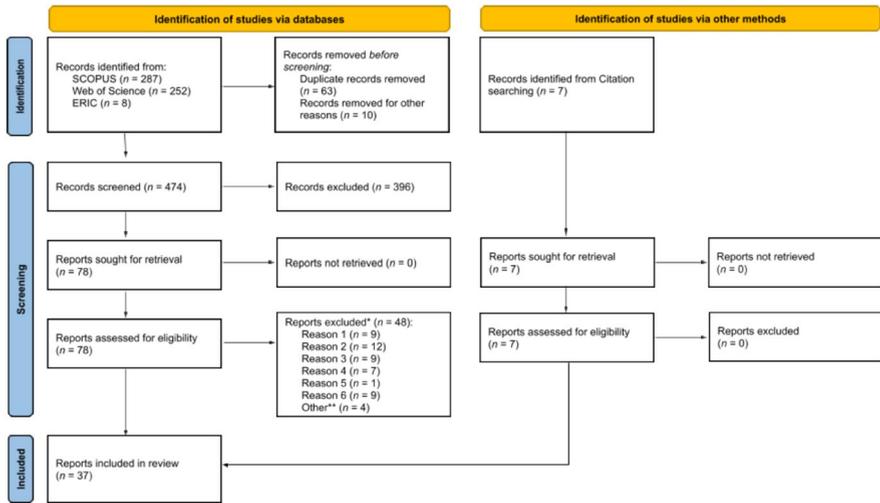
Figure 2 PRISMA 2020 flow diagram for new systematic reviews (based on Page et al. 2021). *Note:* *Studies were excluded for the following reasons: (1) did not correspond to our sustainable development concept ($n = 9$); (2) target group from (higher) education ($n = 12$); (3) there was no reference to learning outcomes or competences ($n = 9$); (4) focus on learning environment(/learning platforms) ($n = 7$); (5) focus on informal learning ($n = 1$); or (6) the articles were themselves literature reviews ($n = 9$). Some articles were excluded for two reasons rather than only one, which is why the total number of reports excluded does not correspond to the difference between assessed and included reports. **Beyond our exclusion criteria, two articles were removed because they were described in a common framework paper which was also part of our sample, and two because they were intersubjectively judged to be irrelevant

We undertook the same procedure for training and intervention formats and evaluation approaches (three main categories) introduced in the sampled literature (see Appendix 3 for the code book).[5]

Results

Metadata

Looking at the year of publication, we found most of the articles to have been published within the last 10 years, demonstrating an increasing interest in the field (see Figure 3).

Almost two thirds of the articles (62%) were empirical, while 38% were theoretical or conceptual (see Figure 4).

With regard to the target group of competence development described in the articles (allowing multiple entries), we found 17 articles (46%) to refer to

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[5] Appendix 3 is available at https://figshare.com/articles/dataset/Appendices_for_the_article_What_is_needed_to_act_as_a_professional_change_agent_for_sustainability_A_scoping_review_/28172108?file=51667751.

Figure 3 Year of publication

Number of Publications per Year
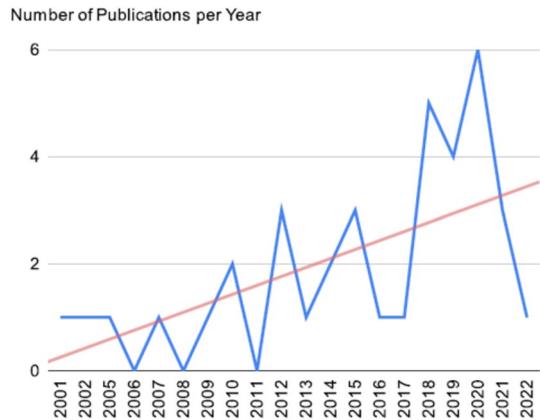
Figure 4 Type of articles

- Empirical 62%
- Theoretical/ Conceptual 38%
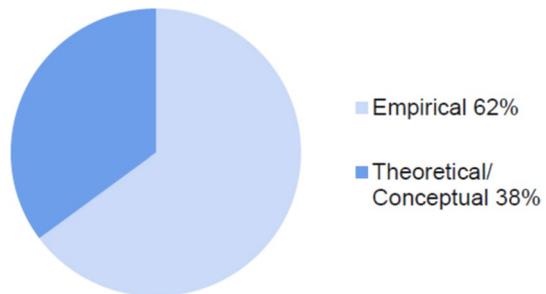
people in management positions within the training programmes; 13 articles (35%) addressed employees in training; and 17 articles (46%) did not specify the target group.

For the professional field the articles reported on (again multiple entries were possible), 14 articles (38%) included results on professional competences within the public sector, e.g. civil servants of municipalities (Picchi et al. 2020); 15 articles (41%) reported on the private for-profit sector, e.g. sustainable electricity (Gitelmann et al. 2018); and nine articles (24%) focused on the non-profit sector, e.g. biosphere reserve (Ngyuen et al. 2012) and NGOs. One article (3%) included information about the non-profit sector but within broader conceptions of voluntary work (Oldenhuizing et al. 2013).

Competences described

As described in the methods section, we first coded the competences mentioned in our final sample of 37 articles inductively. Afterwards, we related the codes to the Redman and Wiek (2021) framework for sustainability competences (see Figure 5).

Figure 5 Professional competences addressed based on the Redman and Wiek (2021) framework for sustainability competences
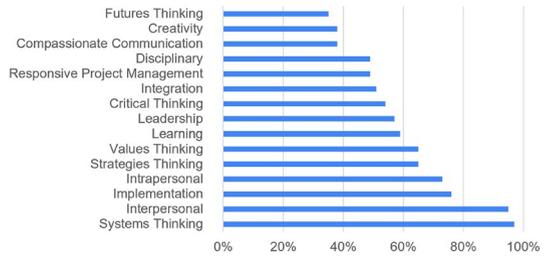
Most of the key competences in sustainability identified by Wiek et al. (2011) and later used by Redman and Wiek (2021) ranked relatively high, which means they were addressed in the majority of our final sample of articles. Systems thinking was mentioned in 97% of the articles (36 out of 37), interpersonal competence in 95%, and strategic and values thinking in 65% (24 out of 37). Only 14 (38%) of the articles refer to compassionate communication or creativity, and only 13 (35%) to futures thinking. Interestingly, the so-called "emerging competences" of implementation and intrapersonal competence were described in 76% and 73% of the analysed studies respectively. Integration competence ranked in the middle of the field at 51%. The competences described as more general in the Redman and Wiek (2021) framework tended to rank low to medium in order of frequency, like creativity (38%) and critical thinking (54%) as well as learning (59%). This was also true for disciplinary thinking, at 49%, which also included research competences. Another interesting insight is that the competences described by Redman and Wiek (ibid.) as overall professional competences ranked relatively low: compassionate communication at 38% and responsive project management at 49%. The only competence not explicitly mentioned by Redman and Wiek which nevertheless plays a crucial role in the papers we analysed was leadership competence, with 57% articles referring to it. The category of leadership competence was almost always coded together with other competences, such as implementation competence or responsive project management.

Training and educational intervention formats

Fourteen out of the 37 articles considered educational interventions or training formats aimed to further professional sustainability competences. We analysed these articles with regard to the reported professional context of these trainings, their overall intervention design and educational background, as well as the specific learning activities comprising the interventions.

The contexts within which the interventions took place ranged from community-based assessments of environmental activities (Sims 2012) and biosphere reserve and protected area management (Rao et al. 2014; Nguyen et al. 2012) to the private chemical sector (da Silva et al. 2019) and the energy sector (Gitelman et al. 2018), as well as private businesses more generally (Haney et al. 2020) and local administration (Picchi et al. 2020). Several studies (e.g. Nguyen et al. 2012; Moore et al. 2018; Marton-Lefèvre and Martin Mehers 2007) addressed decision-makers and

sustainability professionals more generally, pointing out the necessity of transdisciplinary collaboration and learning for addressing sustainability-related challenges.

With regard to the reported intervention and training design, two studies (da Silva et al. 2019 and Haney et al. 2020) took a more generic perspective: Marco da Silva et al. (2019) examined descriptions of environmental training programmes run in chemical companies in Brazil with the aim of fostering sustainability competencies. They developed a system to categorise these training programmes, but without further specifying the exact training activities or their theoretical foundations. Aoife Haney et al. (2020) analysed business managers' experiences of experiential learning programmes offered by two external companies. The programmes offered by these companies ranged from half-day field trips to workshops lasting between two and seven days. The remaining studies describe more specific interventions and training programmes, from shorter workshops such as the "Anthropocene Visioning Workshop" (Pereira et al. 2018) or short-term trainings for decision-makers within sustainable resource management (Geertshuis 2009) to long-term fellowship programmes fostering the ability to navigate emergence and system reflexivity (e.g. Moore et al. 2018) or leadership capacity building for 10–15 weeks within a period of 12–18 months (Marton-Lefèvre and Martin Mehers 2007).

If reported at all, most interventions were built upon transformative and/or experiential learning theory (e.g. Moore et al. 2018), although participatory learning (Kliskey et al. 2021) and social learning (Picchi et al. 2020) were also mentioned as guiding principles. Most interventions focused on in-person learning, but many also included elements of distance/online learning (Marton-Lefèvre and Martin Mehers 2007) or were designed as blended learning programmes (Kliskey et al. 2021) (see Table 1). While only a few of the in-person interventions were connected to in-house training (Rao et al. 2014), most of them gathered participants from various sectors and fields at locations independent of the workplace (e.g. Moore et al. 2018).

The studies analysed differed significantly in terms of their description of specific learning activities. These included classroom activities, such as lecturing and theoretical input (e.g. Nguyen et al. 2012), case study analysis and applying tools and methods to specific cases (Kliskey et al. 2021), or simulations and role play (Marton-Lefèvre and Martin Mehers 2007). Alongside these, several studies mentioned experiential activities such as field trips which allowed participants to immerse themselves in new real-world environments and connect with new people (Picchi et al. 2020; Haney et al. 2020). Furthermore, programmes foresaw asynchronous learning activities, including peer coaching (Moore et al. 2018) and independent work on home assignments to put into practice concepts and skills acquired during training workshops (e.g. Halldórsson et al. 2018). Networking activities also played an important role in most reported programmes (e.g. Marton-Lefèvre and Martin Mehers 2007; Moore et al. 2018; Kliskey et al. 2021).

Evaluation

In terms of evaluation approaches, we identified the following three main categories: (1) type of evaluation (summative vs. formative); (2) evaluation perspective

Table 1 Training programmes and interventions described

	Programme title	Target population	Duration & scope	Learning activities	Theoretical background
Marton-Lefêvre and Martin Mehers (2007)	Leadership for Environment and Development (LEAD) programme	Mid-career individuals from all sectors	10–15 weeks distributed over 12–18 months	Case studies on selected sustainability themes, site visits, problem-solving activities, simulations and role play, interactive presentations and panel discussions, distance learning and virtual events, individual and group projects	Not indicated
Geertshuis (2009)	Making Good Decisions programme	Decision-makers from different sectors	Single workshops (specific duration not clear)	Open debates, sharing experiences, lectures, problem-solving and decision-making exercises, role plays, simulations, decision-making tools	Not indicated
Sims (2012)	Community-Based Strategic Environmental Assessment (CBSEA)	Community members	4 half-day workshops	Participatory activities	Transformative learning, participatory learning
Rao et al. (2014)	NCEP programme	Conservation biology academic experts/National and provincial protected area managers	9 modules teachers' training, 8 modules managers' training 2–3-day workshops covering 1 or 2 modules (exact timeframe unclear)	Lectures, interactive teaching methods, application of tools and methods	Not indicated

Table 1 (continued)

	Programme title	Target population	Duration & scope	Learning activities	Theoretical background
Wang (2015)	EcoPartnership programme	Staff at social service organisations and local environmental non-profits Municipal government officials	Not indicated	technical support, learning opportunities, tools, networking	Not indicated
Gitelman et al. (2018)	Anticipatory training	Managers in energy sector	Not indicated	Specific knowledge/tools/methods applied to modelled real-life challenges	Not indicated
Halldórsson et al. (2018)	Lean energy programme	Employees of organisations associated with energy supply	5 two-day modules over 6 months	Workshops (games), lectures, applied home assignments	Not indicated
Moore et al. (2018)	Global Fellowship programme	Decision-makers in organisations from various sectors	7 modules (exact length not clear)	Peer-coaching, role playing, artistic expression, storytelling, lectures, immersion in different environments and challenges	Transformative & experiential learning
Pereira et al. (2018)	Anthropocene Visioning workshop	Transdisciplinary	3-day workshop	Theoretical input, group work, envisioning activities (e.g. Futures Wheel, STEEPY, VERGE)	Not indicated
da Silva et al. (2019)	Trainings from various chemical companies	Employees chemical sector companies	Not specified	Unspecified trainings in companies	Not indicated
Haney et al. (2020)	Various (programmes from external organisations)	Business Managers	2–7 days (mostly 2–3) Half-day field trips	Immersion in different environments, speaking to real people, storytelling, role models and examples for change	Transformative & experiential learning

Table 1 (continued)

	Programme title	Target population	Duration & scope	Learning activities	Theoretical background
Picchi et al. (2020)	Not indicated	Civil servants	4 days	Lecturing, working on specific cases, networking, field trips, self-study	Social learning
Kliskey et al. (2021)	SESTEP certificate programme	Sustainability practitioners	In-person and virtual, 8 weeks in total 5 two-week online sessions (participants choose two modules)	Case studies, heuristic tools, networking	Experiential and participatory
Nguyen et al. (2012)	Not indicated	Policymakers, managers and technical officers from different sectors	8-week programme	Meeting decision-makers, theorical input (systems theory, educational theory), energisers, case studies, field trips, applying tools and methods, mind mapping	Not indicated

(self-evaluation vs. external evaluation) and (3) concrete methods of data collection. Altogether, 13 out of 37 articles (35%) reported more or less explicitly on an evaluation of a training or intervention format (see Table 2).

Almost half of those studies ($n = 6$) reported a formative *and* summative approach, while 10 studies were based on a summative and nine on a formative approach. The evaluation perspective was mostly based on the participant's point of view (participant self-assessment $n = 9$, participant feedback $n = 7$). External assessment ($n = 5$) and outcome-based assessment ($n = 3$), overlapping in two out of these five cases, were rarely applied. Out of these studies only the evaluations of Susan Geertshuis (2009) and da Silva et al. (2019) used measures which can be linked to self-reported competence assessment. Other studies, such as the evaluation of Madhu Rao et al. (2014) were based on external tests, but mainly included knowledge about a sustainability problem (in this case nature conservation management).

Twelve out of 13 evaluation cases were based on qualitative methods, while seven of the studies were supplemented with evaluation results gained through quantitative methods. As far as reported, quantitative data were collected through surveys (six out of seven). Qualitative data collection methods were more diverse, using interviews or other methods such as participatory observation. Nearly half of the evaluation approaches ($n = 6$) were based on at least two different methods, which shows the value of multi- and/or mixed-methods approaches in evaluation. Longitudinal data were collected in five out of six studies which used quantitative surveys for data collection. Only two studies report on a pre–post evaluation: Geertshuis (2009) regarding the decision-making competences within sustainable resource management, and Rao et al. (2014) on knowledge and skills in biodiversity conservation management.

To find out how the learning objectives identified related to the evaluations in terms of constructive alignment, we analysed in detail those papers which made explicit or implicit statements about this link. Only a few studies followed approaches which could be related to constructive alignment. Andrew Kliskey

Table 2 Evaluation methodology ($n = 13$)	Evaluation approach	
	Exclusive use of a summative evaluation type	10
	Exclusive use of a formative evaluation type	9
	Evaluation perspective	
	Participant self-assessment	9
	Participant feedback	7
	External assessment	5
	Outcome-based assessment	3
	Methodology	
	Mixed method	7
	Quantitative methodology	7
	Qualitative methodology	12
	Longitudinal evaluation	5

et al. (2021) used a 12-step heuristic from social-ecological systems theory to structure their programme and developed seven learning objectives which were evaluated quantitatively (albeit with a small participant sample, $n = 7$) (ibid., p. 294). Rao et al. (2014) used a predefined set of knowledge and skills for biodiversity conservation management to design a locally adapted training for conservation managers in Laos. Alongside feedback from the participants, they assessed their knowledge of biodiversity using standardised tests (ibid., p. 721). The study by Geertshuis (2009) measured self-reported decision-making competence before and after a two-day-training. Michele-Lee Moore et al. (2018, p. 6) saw the design of the Global Fellowship learning experience as "most closely aligned with the principles described in transformative learning theory". They applied "qualitative evaluations that sought information about issues that related to social innovation and the core theoretical concepts [...] introduced" (ibid., p. 7), implicitly following the principles of constructive alignment. Laura Sims (2012) based her educational intervention, regarding sustainable management of natural resources in Costa Rica, on transformative learning theory. She conducted interviews with the participants and coded them using core categories from transformative learning.

Nevertheless, most of the authors did not explicitly link their learning goals to the specific methods used in their intervention and their evaluation. Aoife Haney et al. (2020) did not conduct an evaluation in a strict sense, but carried out an interview study with various managers who had participated in two different sustainability programmes. Árni Halldórsson et al. (2018) did not evaluate predefined competences but focused on self-described learning outcomes some time after the programme. Julia Marton-Lefèvre and Gillian Martin Mehers (2007) reported on evaluation results of their Leadership for Environment and Development (LEAD) programme. Nam Nguyen et al. (2012) developed a training to promote systems thinking capacity, but its components were not reflected in their extensive evaluation (per programme week) and only partially in the overall evaluation of the programme. Nevertheless, the post-programme evaluation identified aspects in the participants' statements that were related to systems thinking.

Laura Pereira et al. (2018) focused more on soft factors of their Anthropocene workshop design in their evaluation of the success of the intervention. They describe

> (1) inspiring the imagination by incorporating the arts and artists, (2) including a wide diversity of participants, and (3) engaging participants' emotions and challenging their beliefs to find a way to accept complexity and apply this learning in their own lives (ibid., p. 11).

These aspects were not linked to predefined learning outcomes. The study of da Silva et al. (2019) investigated the extent to which training covers organisational sustainability goals which are increasingly perceived as relevant to the competitiveness of organisations, aligned with individual competence identification. An analytical framework was created for the study in which evaluation was included as a third category alongside needs assessment/development and implementation. As a result, one of the problems identified by the authors of the paper was a "lack of alignment of environmental issues with organisational and social values" (ibid., p. 47).

Discussion

The primary objective of this study was to ascertain the competences required by sustainability professionals to facilitate sustainable transformation processes in their working contexts – processes which have yet to be determined and to the shaping of which the professionals will actively contribute. Additionally, our study aimed to identify appropriate training formats to develop these competences and to explore the evaluation approaches which have been employed so far.

Overall, we found a relatively high degree of agreement with Redman and Wiek's (2021) framework, since systems thinking, interpersonal and strategic competence and values thinking are among the most-coded competences. At the same time, some differences emerged. Futures thinking played a minor role, with only 35% of the papers mentioning a kind of anticipatory competence. This finding gives reason to assume that the requirements for professional competences described in the studies analysed focus more on problem-solving in the "here and now" than on anticipatory competence (Gardiner and Rieckmann 2015). However, some studies did integrate foresight thinking (in the sense of futures thinking) as one of the core competences (e.g. Wesselink et al. 2015). This aligns with other studies, in which six competences were identified and validated as important for sustainable entrepreneurs: strategic management competence and action competence, embracing diversity and interdisciplinary competence, systems thinking competence, normative competence, foresight thinking competence, and interpersonal competence (Ploum et al. 2018). Given that having a vision and the capacity for forward-thinking are pivotal to acting sustainably (Gardiner and Rieckmann 2015), it is disconcerting that these factors seem to play only a subordinate role in training programmes for sustainability professionals.

Remarkably, the so-called "emerging competences" (intrapersonal and implementation competence) turned out to play a pivotal role in the professional context. This observation indicates an important discrepancy between the two discourses (HESD and professional training). While the scholarly discourse on competences such as learning outcomes in HESD has begun within the last two decades and their relevance (especially that of intrapersonal competence) remains controversial (Brundiers et al. 2021; Frank 2021; Redman and Wiek 2021), our results indicate that their relevance for sustainability professionals is well recognised, and that they are considered highly important within professional training. In terms of implementation competences, university courses often refer "only" to exemplary cases of transformation (Alvarez and Rogers 2006). In contrast, the professionals referred to in the literature we studied were directly involved in transforming their organisations/networks and even entire societal and economic fields of action. This makes their task more challenging and at the same time more real than in the protected space of the university. However, this also raises the question of how these competences could be addressed more directly in university study programmes.

In addition, one crucial competence emerged which does not feature in the Redman and Wiek (2021) framework: leadership. This was addressed in 57% of the articles that we analysed. Literature from this field describes a shift from "great man" conceptualisations of leadership towards more group-oriented ideas of shared leadership,

empowerment and collective action (Praszkier 2022). This is even more important for leading sustainability transformation. Professionals who take on leadership roles or decision-making responsibilities need to focus on efforts to stimulate and facilitate collaboration among different kinds of actors and stakeholders. This was reflected in many of the training formats in our sample. A recent interview study about decision-makers' competences for sustainability (Eberz et al. 2023) identified certain pivotal abilities for leaders that have to be addressed when working towards sustainability transitions:

- translating between heterogeneous disciplines, stakeholders and communities;
- extrapolating knowledge among systems, time scales and ontological levels;
- dealing with uncertainty; and
- building resilience (ibid.).

Nevertheless, conceptions of leaders remained strongly tied to formal roles and the legitimations which went with them. This does not apply to all professionals, which was also reflected in the participants in pedagogical interventions in the studies included in our sample. We therefore prefer the broader term "change agents", who can work independently of externally formalised status in an organisation. Based on Raymond Caldwell (2003, pp. 139–140, cited in Hesselbarth and Schaltegger 2014), change agents are seen as

"responsible for initiating, sponsoring, directing, managing or implementing a specific change initiative, project or complete change programme" [...] Change agents are opinion leaders and driving forces in change processes. They convince superiors, form coalitions, allay fears as well as motivate and inspire employees and teams to leave old paths and take responsibility for social and environmental issues (Hesselbarth and Schaltegger 2014, p. 26).

The low number of articles explicitly describing training approaches mirrors the lack of systematic studies on sustainability professionals and the need for further research. Although there have been a number of extensive training programmes, only a few of the authors reported encompassing evaluation approaches. Additionally, the small number of external evaluation approaches shows that there is a lack of approaches that go beyond self-assessment. This issue affects research on competence development in the field of sustainability in general (Rieckmann 2022). Elaborated training evaluations are complex and expensive in practice. This is probably why there is a greater reliance on simple feedback and self-assessment surveys, which are more resource-efficient. It was noticeable that evaluations could be designed more stringently when the professional fields of action were clearly defined and there was already a consolidated body of research on the relevant knowledge and competences (e.g. nature conservation management, Rao et al. 2014). The more general the professional fields and the connected key competences seemed to be, the more difficult it was to achieve a rigorous evaluation approach based on clearly defined learning goals. Overall, we found few approaches that linked their learning objectives explicitly to the training formats as well as the evaluation approaches. In terms of constructive alignment, a stronger interweaving of explicit learning objectives, programmes and their evaluation would increase their quality.

Based on these findings, we recommend that providers of training for professionals in the context of sustainability, such as academies, should give greater consideration to ideas of constructive alignment when planning their programmes and evaluations. They should have a clear understanding of exactly which competences they want to promote, for what reasons, and with reference to which challenges. Appropriate teaching–learning methods must then be used, and suitable evaluation approaches chosen. Particularly against the backdrop of limited resources in terms of time and funding, training providers should make sure that the chosen evaluation approaches do not yield only superficial and potentially biased information, but actually help them reflect on and improve their activities in an evidence-based manner.

That said, it must be taken into account that our review is based on scholarly representations related to professional training, as well as associated learning outcomes and evaluation practices. It remains open to what extent these representations actually describe prevailing professional sustainability training on a larger scale. It seems unlikely that all these trainings have been captured by scientific, peer-reviewed literature. Further research (and different methodological approaches) will be required to expand the understanding of training and evaluation practices and corresponding learning outcomes within the professional context.

Our review has certain methodological limitations. We restricted our inclusion criteria to English papers due to constraints in systematically covering other languages. Moreover, we exclusively considered peer-reviewed papers, to maintain a minimum standard of quality assurance, even though scoping reviews have the potential to include non-peer reviewed articles or so-called "grey" literature (Gutierrez-Bucheli et al. 2022, p. 650). It is noteworthy that we identified numerous articles not included in Redman and Wiek's (2021) review, as our keyword selection differed slightly from theirs. However, in concentrating on professional training for adults we also excluded several articles, omitting consideration for non-formal learning among younger individuals or informal learning settings.

Conclusion

This scoping review shows which competences are considered particularly important for professionals and training. There are many overlaps with research on sustainability competences in higher education, but also some specificities. Thus, futures thinking competence seems to play a somewhat subordinate role, and implementation competence a greater one than in the HESD competence discourse. In addition, we found leadership competence to be of particular relevance to the professional field. What has not been researched enough so far is the interaction among the different competences. It is also clear that the competence development of professionals has not yet been sufficiently evaluated (externally), and that constructive alignment is not given due consideration in continuing education. Here, therefore, there is also a need for further research, but also space for suggestions for the practice of continuing education.

Overall, this article provides a first overview of required competences, as well as already established training formats and evaluation approaches which have the

potential to inform further training for professionals. Their further use and development can contribute to empowering professionals to co-create complex sustainability transformations entangled with their own lifelong learning processes.

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