

Review

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Review

Designing a Sustainability Competencies Questionnaire: Insights from a Literature Review

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Abstract

In the 20th century, the imperative of promoting endeavours that cultivate competencies for sustainability became evident. However, fostering these competencies is not enough; there is a need to rigorously evaluate such endeavours' outcomes and the evolution of the competencies themselves. The aim of this paper is to initiate a discussion on the development of a questionnaire to evaluate the conceptions of participants in initiatives aiming to promote sustainability competencies, regarding their ability to promote those competencies. To this end, this contribution reports the results of a literature review that was conducted in Scopus, Web of Science and Eric to map the research on data collection tools for evaluating these competencies. The systematized review process, integrating a set of the recommendations of the PRISMA 2020 statement, did not yield the anticipated outcome, due to the absence of identified or explicit data collection instruments suitable within this context, as only two documents met the defined inclusion criteria. However, this review did contribute to a more comprehensive understanding of the necessity for standardizing nomenclatures and, concurrently, facilitate the development of a questionnaire that will align with the initial objectives. To this end, the two academic papers that have been identified, which will inspire and inform the subsequent stage of research, where a questionnaire will be developed, either *ex novo* or based on pre-existing.

Keywords: sustainability; sustainable development; competencies for sustainability assessment tool; literature review; EduCITY

Introduction

In the final decades of the 20th century and the first quarter of the 21st, the concept of sustainability has been one of the most extensively discussed and debated. Although the Brundtland Report (WCED, 1987) is considered the origin of the current discourse on sustainability and sustainable development, it is possible to trace the concept of sustainability and its associated terminology back to earlier periods. In this regard, similar terms were used in classical antiquity in Europe and ancient China (Shi et al., 2019). Furthermore, the earliest documented use of the term 'nachhaltigkeit' (Paraskeva et al., 2020; Shi et al., 2019) as a synonym for sustainability is found in a document from 1713 pertaining to the management of forests and fisheries in a region that is now part of Germany (Egelston, 2013; Paraskeva et al., 2020; Shi et al., 2019). Until the 20th century, there were several records in which issues related to sustainability were occasionally highlighted. For example, in 1864, the book "Man and Nature", by George Perkins Marsh, warned of the consequences of over-exploiting resources and linked resource scarcity to economic decline (Stoll, 2023). Throughout the 20th century, there were also several warnings about the fragility of the planet and life in the face of intensive exploitation of natural resources and the use of chemical agents. This warning came, for example, in the book "Silent Spring" (1962/2023) by Rachel Carson. In it, Carson describes all the problems associated with intensive agriculture, in particular the uncontrolled use of pesticides such as DDT (dichlorodiphenyltrichloroethane). The use of these and other pesticides had

a negative impact on insect populations and was highly toxic to human health. The author also alluded to the importance of a harmonious relationship between humans and nature, and the significance of this relationship for the planet itself (Carson, 1962/2023).

The publication of the report "Our Common Future" (WCED, 1987) finally brought the issue of sustainability into the public domain, and for the first time it was discussed from academic, scientific and citizen perspectives. This helped to establish sustainability as a concept that links the economy, nature and people. This concept promotes the connection of social, economic and environmental aspects in a single word, providing an effective and common term understood by all. To achieve sustainability, it is necessary to pursue sustainable development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 41), aiming at "how we must live today if we want a better tomorrow" (UN, 2023, p. 1). The concept of sustainability is a "long-term" concept (WCED, 1987, p. 43)

Given their importance, these terms have opened to new realities and gained new possibilities and areas of development and action (UNESCO, 2022), enriching themselves as complex and polysemic concepts, thus giving rise to new challenges (Shi et al., 2019). This conceptual evolution has resulted from the evolution of society itself, its needs and the recognition of the need to change the way in which humans have exploited the Earth's resources. As a result of all these processes and dynamics, an in-depth study focused entirely on the operationalization of sustainability was established at the Academy. Thus, in addition to the birth of sustainability science, emerged a whole set of related terms that have guided academic research and are commonly used by society. One of such term is "competencies for sustainability", as defined by Schirone (2024).

Although not yet explicit, Kates et al. (2001) referred to the notion of competencies for sustainability in terms of problem-solving and solution-oriented approaches. In fact, these competencies are broadly described as the *modus operandi* of sustainability, both as a means and an end.

About Sustainability Competencies

Given the importance of concrete actions in effective sustainable development, it is essential to operationalize them through a set of processes and dynamics that can be effectively implemented to promote a medium and long-term impact. In this sense, and given the importance of the problem-solving approach mentioned in the previous point, over the last 20 years the scientific community has theorized on a set of key competencies for sustainability. The conceptualization on these competencies has evolved, with new ones emerging, being renewed, or even merged. This work, with a strong emphasis on higher education contexts, takes a top-down approach, but as Cairns (2003) noted, the issue is too complex to be reduced to a one-way strategy. As for the top-down strategy movement, it relies heavily on a vision that emphasizes the importance of higher education in operationalizing knowledge transfer as something transformative. This 'transfer' is indeed very complex, but as many authors such as de Hann (2006), Barth & Thomas (2012) or Redman & Wiek (2021) point out, competencies for sustainability need to be developed or promoted on a lifelong continuum, as this is not an issue that can be easily understood or solved in one moment or one occasion (Wiek et al., 2011). It is therefore crucial to reinforce the role of emerging actors and discourses in sustainability research. The interface between traditional and novel knowledge, and their practical application, is a pivotal area of inquiry in understanding the necessity for a paradigm shift in development theory (NRC, 1999).

Despite the multitude of definitions of 'competence', what is important for this study is its meaning as a word of understanding-reflection-action with the aim of transformation. This conceptualization of competence is in line with what Wiek et al. (2011) said about the differences between competencies and learning outcomes. They argue that the former is a more encompassing and intricate concept than the latter. However, as the same authors highlight, the expansive and intricate nature of the competence concept necessitates delineating specific actions to operationalize it in any given context.

In addition to the importance of understanding competence, it is essential for this study to comprehend the evolution of the set of competencies for sustainability, although this remains a challenging task.

Based on the work of Wiek et al. (2011) and the conceptual framework they have established, it became evident that there was a necessity to devise a unified, integrated, and comprehensive approach to disparate labels and discourses pertaining to sustainability. This led to the formulation of a set of core competencies that encapsulate the essential elements for achieving sustainability: Systems Thinking Competence; Strategic Competence; Normative Competence; Anticipatory Competence; and Interpersonal Competence.

At that time, these key competencies enabled the complexity inherent in sustainability issues to be addressed in a problem-solving and solutions-oriented approach, supported by integrated research and linked to multiple fields of knowledge. This is illustrated in Figure 1, which has been adapted from the work of Wiek et al. (2011).

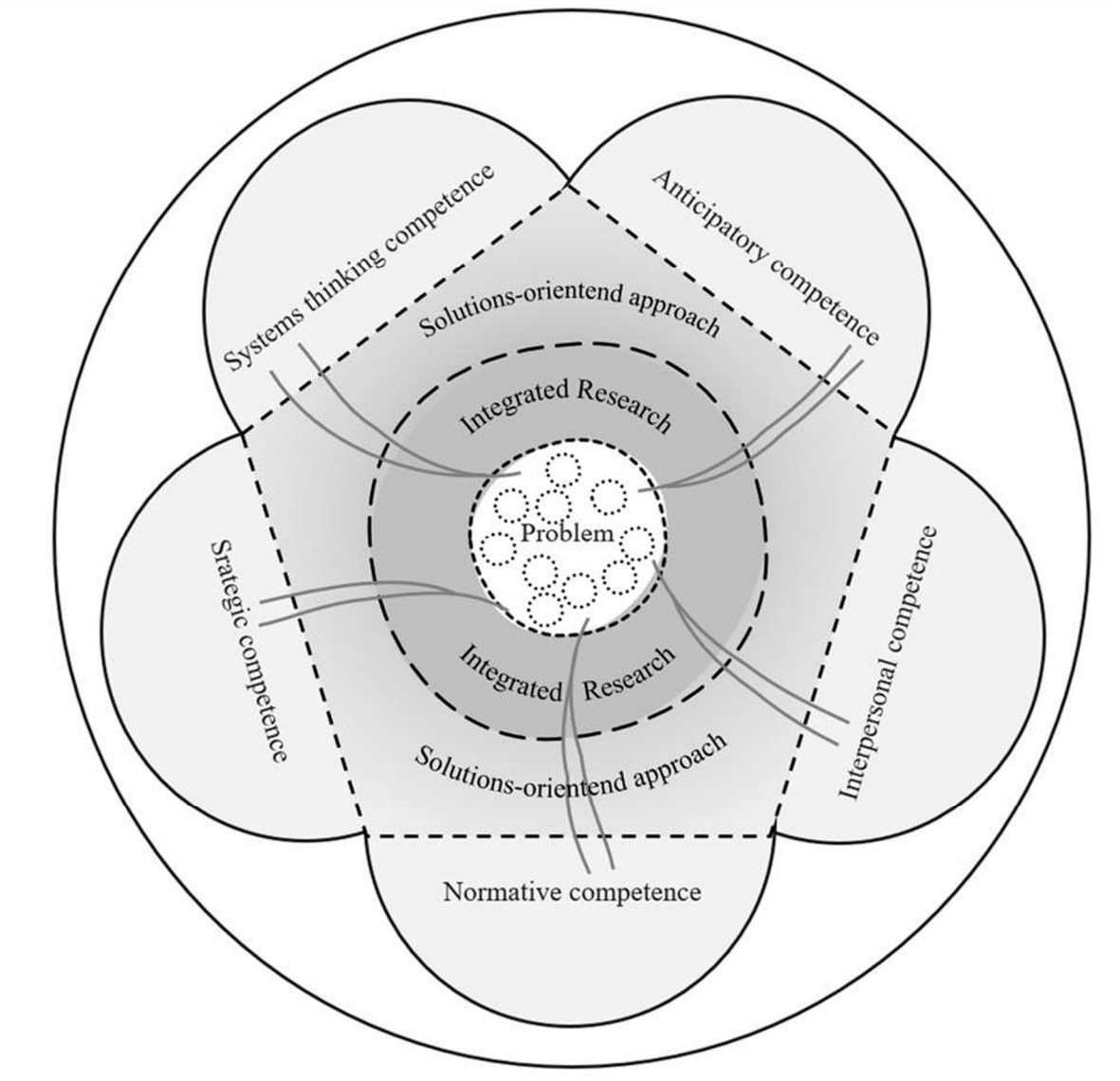


Figure 1. System of key-competencies for sustainability in a problem-solving and solution-orientated approach, supported by integrated research (adapted from: Wiek et al., 2011) (Developed by the authors).

In this context, Wiek and colleagues have attempted to synthesize and bring together different conceptions and to shape and frame them according to categories proposed through an exhaustive literature review process. As the authors have noted, this work was not intended to be a definitive

document. Instead, it was conceived as a document that could be expanded and improved upon. It is also interesting to note that the authors affirmed the need for further theoretical justification of these competencies should be embraced with research on all sustainability fields. Furthermore, they advocated for the practical application of these competencies in real-world contexts to substantiate their suitability for such settings. The authors pointed to the need for more research to study and understand the characteristics of the competencies presented and their role in relation to the objectives set. Finally, they stress the importance of adapting the competencies to the needs and challenges that characterize the field of sustainability and the knowledge we acquire about it.

Over the years, and given the challenges and complexities of sustainability, Wiek and many other authors have discussed the relevance of developing competencies for sustainability. These studies, as Brundiers et al. (2021) point out, have been based on Wiek et al. (2011) framework and its specificities. These studies have deepened and narrowed the gap between theoretical and empirical knowledge on sustainability, strengthening the path between academia and society and reinforcing the importance of further exploring the issue of sustainability. Brundiers et al. (2021), as well as Redman & Wiek (2021), presented a new reading of competencies for sustainability, starting from a deeper study of this topic and seeking other perspectives and contributions, such as UNESCO's "Education for Sustainable Development Goals: Learning Objectives" (UNESCO, 2017), but with the aim of reaching a continued and new consensus (Brundiers et al., 2021).

The paper by Redman & Wiek (2021) presents an in-depth analysis of the "convergence on key competencies in sustainability" (p.4). These authors based this paper on previous research (Wiek et al., 2011), considering that it can be considered as the first effort concerning the convergence of key competencies in sustainability.

In addition to the inclusion of these "new" competencies, which allow the mobilization and implementation of pre-existing competencies, we have also seen a change in their nomenclature. This is a natural consequence of the evolution of studies on competencies themselves, their definitions, and objectives, which need to be established and "standardized". In this regard, the following list of competencies for sustainability is presented in the paper by Redman Wiek (2021): Systems Thinking Competence, Futures Thinking Competence, Values Thinking Competence, Strategic Thinking Competence, Interpersonal Competence, Implementation Competence (2018), Intrapersonal Competence (2013) and Integration Competence (2016). The first five are referred to by these authors as 'established' (Redman & Wiek, 2021, p. 5) competencies and the rest as emerging competencies. However, in addition to these "specific" competencies for sustainability, the authors have identified others that are more transversal to other domains, which they refer to as disciplinary, generic, and professional competencies. The last two are in turn made up of different components. To better understand these emerging competencies, the authors point out that the "original" framework of competencies in the field of sustainability (Wiek et al., 2011) has been analysed and expanded by various authors, and that competencies for sustainability are evolving in line with the evolution of society itself and the way this issue is understood. Therefore, it is important to be aware that, since sustainability is not a finished subject, the more research is done on it, the more "new" possibilities will emerge. In addition to efforts to implement a competencies for sustainability framework, the authors have distinguished between core and complementary competencies. This distinction refers to the action and specificity of each competence. Figure 2 illustrates the relationships between the set of competencies mentioned and their interrelationships.

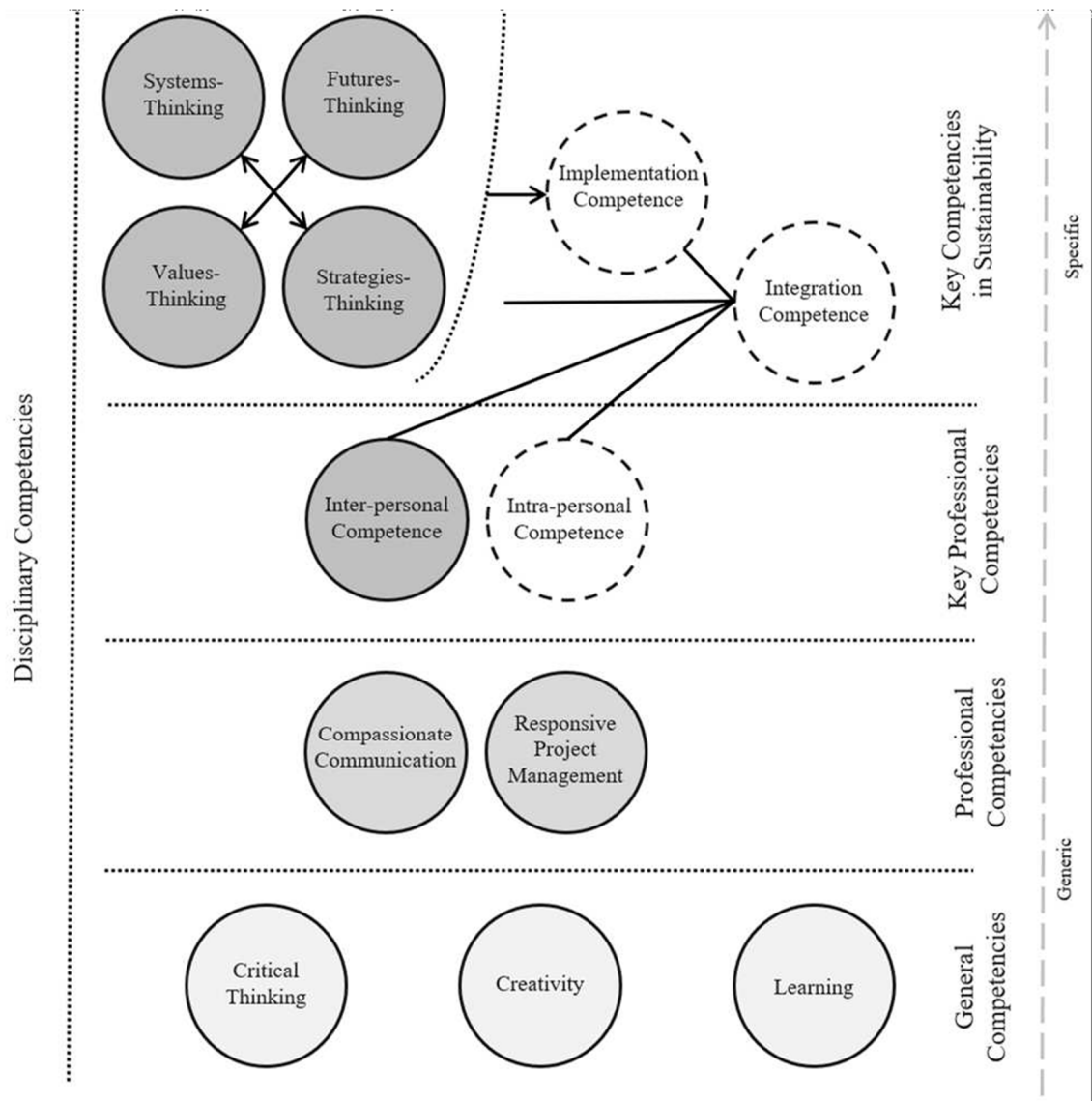


Figure 2. Articulation between general, professional, and key competencies for sustainability (adapted from: Wiek & Redman, 2021) (Developed by the authors).

Wiek & Redman (2021) also point out that this unified framework (presented above) facilitates the interconnection between the fields of science, education and society, and enables the mapping of the prerequisites and processes necessary to achieve the Sustainable Development Goals (UN, 2015). Considering the aforementioned observations, it becomes evident that this framework still does not represent a definitive research endeavour, particularly in the following areas:

- Continuing the study of emerging competencies;
- Exploring the framework between different learning contexts and modalities;
- Exploring the framework in real contexts and situations;
- Continuing to jointly explore, extend and improve the framework, for example through complementary and comparative studies to better inform and shape it.

Building on the need for more research in the field of sustainability, particularly regarding the formulation of activities that explore the trinomial of science, education, and society, it becomes imperative to promote endeavours that cultivate competencies for sustainability. This is in accordance with the recommendations put forth by Wiek and other scholars (2011, 2021), who emphasise the importance of not only fostering these competencies but also of rigorously evaluating the outcomes of such endeavours and the evolution of the competencies themselves.

Purpose of the Paper

In response to the call for further research to explore frameworks for sustainability competencies in different learning contexts and modalities, this paper contributes with a literature review. The aim is to identify or, if necessary, adapt data collection tools for evaluating these competencies in the context of the EduCITY project (<https://educity.web.ua.pt/index.php>). This research and development project, developed at the University of Aveiro, Portugal, promotes the concept of sustainable and resilient cities and communities by creating a smart learning city environment. This is achieved through the provision of a mobile application with games based on interdisciplinary challenges, integrating multimedia and augmented reality educational content that are developed to be played through paths in the city. The games' content may include 3D animations, information spots, and other multimedia elements, and is accompanied by the possibility of using low-cost and easy-to-use environmental sensors.

An exclusive and novel aspect of the EduCITY project is the capacity for active civic engagement in the development of not only mobile games, but also the multimedia and augmented reality content. This is made possible by the project's online platform, which is accessible to all users, and provides tutorials to assist them in creating this content autonomously. The use of ubiquitous technologies, such as mobile devices, facilitates a "learn by doing" approach, thereby fostering awareness of the significance of sustainability and the implementation of sustainable development. This is possible by engaging citizens as creators of knowledge and active agents of change, encompassing diverse local contexts to broader contexts, within the framework of citizen science. However, beyond the creation of the resources and games, it is essential to understand the connection between them and the EduCITY project's underlying research question, which is: "How does EduCITY – a smart learning city environment, integrating a user-friendly mobile app with co-created games and appealing AR resources, with paths and challenges, targeting educational stakeholders and the wider community – promote changes in knowledge, skills, values and attitudes in citizens to empower them towards sustainable development?" The research team understands that the terms 'citizens' knowledge, skills, values and attitudes (...) towards sustainable development' encompass the concept of sustainability competencies. This research question guides the project towards researching and developing competencies for sustainability. Therefore, it was necessary to identify, adapt or develop data collection tools to answer the research question of the EduCITY project. One of the tools considered was the use or adaptation of a questionnaire that could assess perceptions regarding the development of sustainability competencies in an initiative of education for sustainable development. Such questionnaire should i) Support answering the research question of the EduCITY project; ii) Offer sufficient comprehensiveness to be employed in other research or studies; and iii) Be applicable in other research contexts, highlighting its operational efficacy within the Portuguese national context or among Portuguese speakers. It became evident that a literature review was necessary to map assessment instruments, specifically questionnaires, and their associated methodological development processes.

Structure of the Paper

This paper is divided into several interrelated sections. The first, the introduction, provides a narrative context towards sustainability and sustainable development, problematising and linking these concepts. This is followed by a subsection focusing on competencies for sustainability, which takes a diachronic view of the conception and development of these competencies, drawing on the work of some of the leading authors on the subject. Then, in the second subsection, the aim of this work is presented, linking it to a real research context. The research methodology is presented in the second section, following a set of recommendations of the PRISMA 2020 statement (Page et al. 2021). The results of the analysis of the two included publications and their discussion are presented in the third section, followed by the conclusions in the fourth section. This section includes two subsections on this literature review limitations and future work, which is essential to the research begun in this paper.

Methodology

The purpose of this Literature Review is to identify existing questionnaires that could be used to evaluate the outcomes of endeavours aiming to foster sustainable development competencies, or to provide data that could inform the development of a new questionnaire. To gain a deeper understanding of this process, it is essential to consider that a Literature Review works to answer a question that has been or is being carried out (Siddaway et al., 2019). To answer this question, it is necessary to conduct a search on a specific topic, exploring it in depth (Grant & Booth, 2009), but based on an informed research direction, using predefined criteria, and transforming the search results into a replicable study (Siddaway et al., 2019). This ensures consistency and validity in the research procedures and results. Therefore, the research question of the EduCITY project is: "How does EduCITY – a smart learning city environment, integrating a user-friendly mobile app with co-created games and appealing AR resources, with paths and challenges, targeting educational stakeholders and the wider community – promote changes in knowledge, skills, values and attitudes in citizens to empower them towards sustainable development?". To answer this research question, the methodological approach considered a set of relevant recommendation of the PRISMA 2020 statement (Page et al., 2021). Its use made it possible to reduce biases, such as repeated information or even inaccurate results.

Given the importance of evaluating the development of competencies for sustainability, the team in charge of this process defined a set of criteria to ensure the quality and validity of the material collected during this review process. To define the analysis *corpus* for this paper, several inclusion and exclusion criteria were identified, as shown in Table 1.

Table 1. Inclusion and exclusion criteria for this systematized literature review concerning the development of a questionnaire to answer the EduCITY project’s Research Question.

Criteria	Inclusion	Exclusion
a) Questionnaire construction process	Presents the process; follows methodological guidances sustained by adequate structure with references	Does not present or presents with gaps
b) Questionnaire items/statements	Present and explicit	Does not present
c) Date of publication	From 2020 to 2024 inclusive	Prior to 2020 exclusive
d) Language	English	Other languages
e) Type of study	Paper on completed research, published in a scientific journal or in the proceedings of scientific meetings	Other publications, such as reviews, conference abstracts, thesis, books, etc.
f) Quality	With peer review	Without peer review

The search was conducted in two subject comprehensive and well-known academic databases, namely Scopus and Web of Science. Additionally, the ERIC digital library, with a particular focus on education, was also searched through the EBSCO host services.

Once the databases had been selected, the search expression (search string) was developed through several iterations with the aim of improving the quality of the publications collected. Along with the development of the string, several keywords were also selected, as shown in Figure 3.

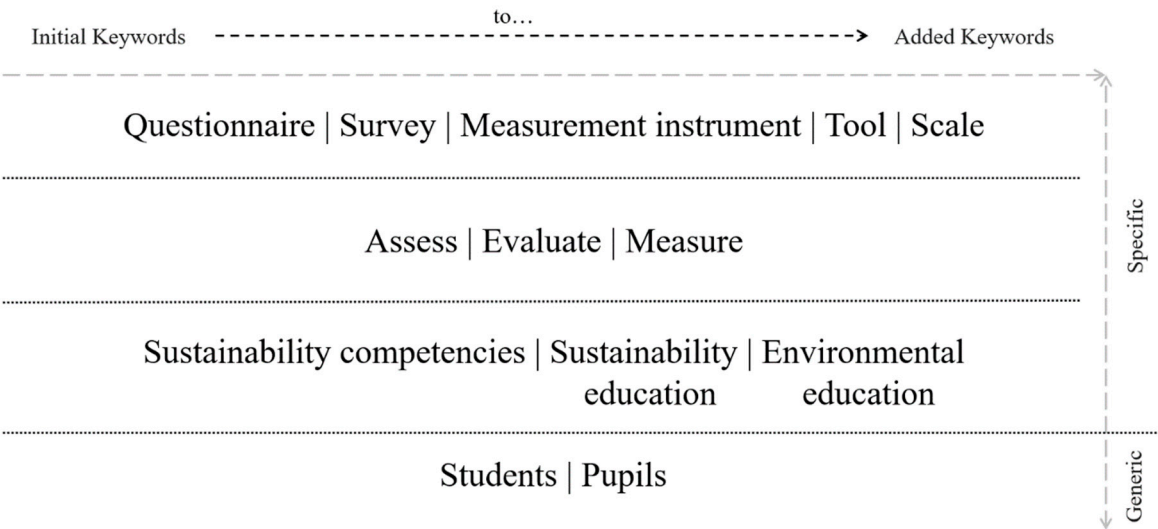


Figure 3. Presentation of the Keywords used for the String development. This figure shows the initial keywords and the addition of other keywords, as well as the specificity or generalisation of these keywords for the object of study addressed in this paper (Developed by the authors).

Before presenting the string, it is important to clarify the choice of some of these keywords, as some may appear overly expansive, while others may be unduly limiting. Keywords such as 'skills' or 'environmental education' may warrant scrutiny in this regard. The choice of keywords was influenced by a previous (unpublished) explorative literature review. As mentioned above, the polysemy and complexity of the terms 'sustainability' and 'sustainable development' (Barbosa et al., 2014) result in ambiguous or unsystematic nomenclature due to their umbrella-like nature. This is also the case with the concept of 'competence' itself, or even the fact that for some authors sustainability is directly linked to something that is exclusively focused on the environment. This position is supported by Ziaul & Shuwei (2023). On the other hand, since the string was created through several attempts, it is possible to see how the keywords were added to the previous ones in order to ensure a valid analysis corpus.

At the end of this process, the finalised strings are presented below:

at SCOPUS: (TITLE-ABS-KEY (questionnair* OR surv* OR "measurement* instrument*" OR "measurement* tool*" OR scale) AND TITLE-ABS-KEY (assess* OR evaluat* OR measur*) AND TITLE-ABS-KEY ("sustainab* competenc*" OR "sustainab* educat*" OR "environment* educat*") AND TITLE-ABS-KEY (student* OR pupil*)) AND PUBYEAR > 2019 AND PUBYEAR < 2025 AND (LIMIT-TO (OA , "all")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "re"));

at Web of Science: questionnair* OR surv* OR "measurement* instrument*" OR "measurement* tool*" OR scale (All Fields) AND Assess* OR Evaluat* OR measur* (All Fields) AND "sustainab* competenc*" OR "sustainab* educat*" OR "environment* educat*" (All Fields) AND Student* OR pupil* (All Fields) and 2020 or 2021 or 2022 or 2023 or 2024 (Publication Years) and Article or Proceeding Paper (Document Types) and 2024 or 2023 or 2022 or 2021 or 2020 (Publication Years);

and, at ERIC, through EBSCO host services: (questionnair* OR surv* OR "measurement* instrument*" OR "measurement* tool*" OR scale) AND (assess' or evaluat' or measur') AND ("sustainab* competenc*" OR "sustainab* educat*" OR "environment* educat*") AND (Student* OR pupil*).

As presented, there were slight discrepancies in the strings. These discrepancies are exemplified by the search methodology employed, whereby the "TITLE-ABS-KEY" search strategy was utilized in Scopus, whereas the "All Fields" search strategy was employed in Web of Science. It is acknowledged that these differences result in the promotion of disparate results. The search expression (search string) was developed through several iterations with the objective of enhancing

the quality of the publications collected. The use of the "AND" operator in lieu of the "OR" operator, as exemplified by the search terms "questionnaire," "survey," and "measurement instrument," OR "measurement tool" Additionally, the OR scale, OR assess*, OR evaluate*, OR measure* was also trialled during the iteration of the search expression. It was decided that the use of the AND operator would yield a greater number of results.

To ensure the most favourable outcomes, the PRISMA flow diagram (Page et al., 2021) was employed in its most recent iteration. The PRISMA flowchart (Figure 4) provides a visual representation of the various stages involved in this review process, facilitating a more comprehensive understanding of the process.

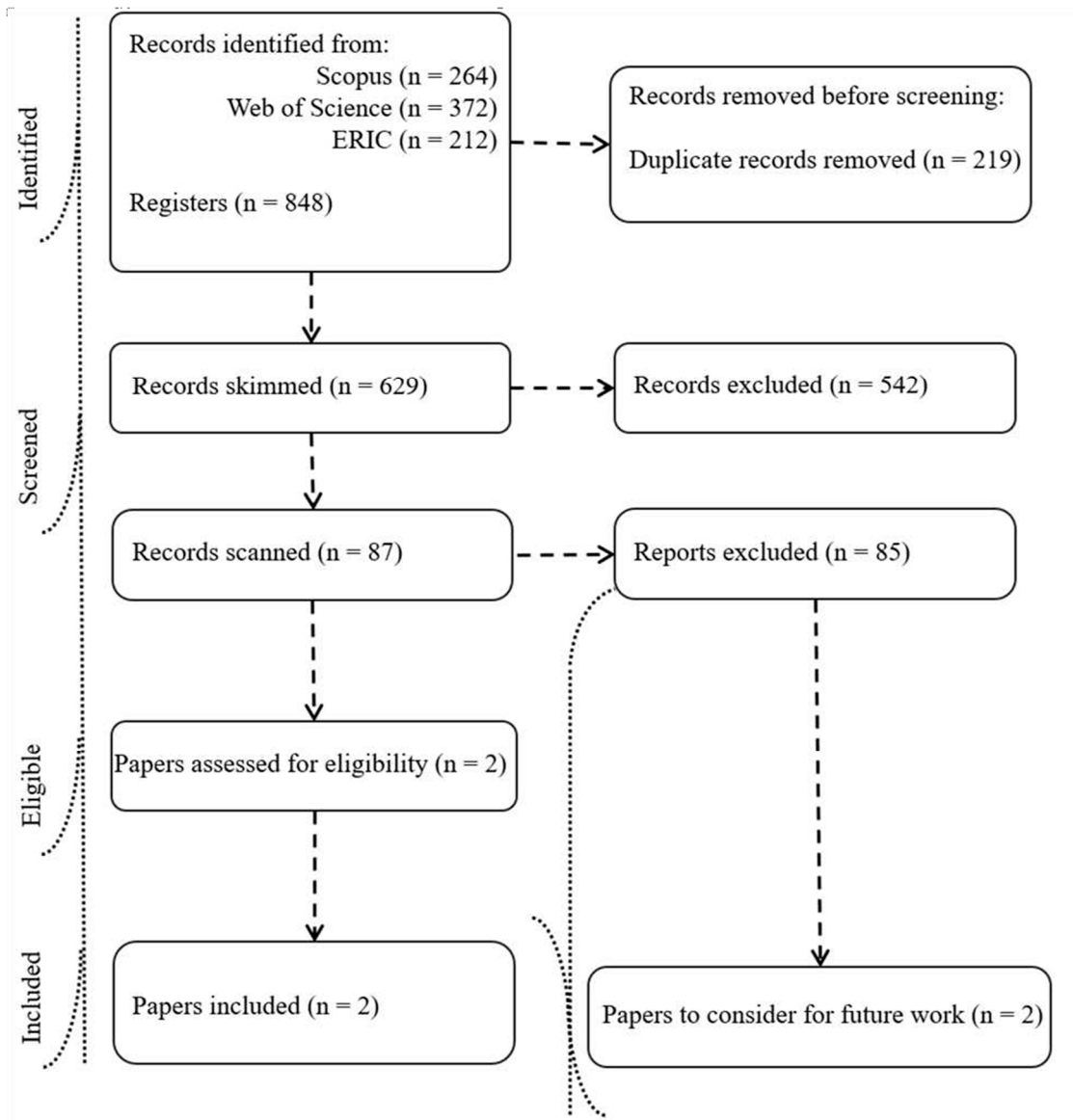


Figure 4. Adapted PRISMA flow (adapted from Page et al.,2021).

Before moving on to the *corpus* analysis, it is important to understand the data collected to better frame all the work that follows. It is easy to see the amount of research that has been done on this topic from the number of papers that this review has generated, even considering the short period of time that was searched. It is also clear from the number of excluded records that the conceptual polysemy contributes to the real need for conceptual clarification with the aim of establishing this area of research more effectively. On the other hand, the number of results obtained shows the importance of this area of research, but it is essential to use all terms correctly, as mentioned by Barbosa et al. (2014), to validate this same area of research. Although all the skimmed results have

been systematised, due to the volume of data, only the scanned results are presented, grouped by category/subtopic. This is illustrated in Figure 5.

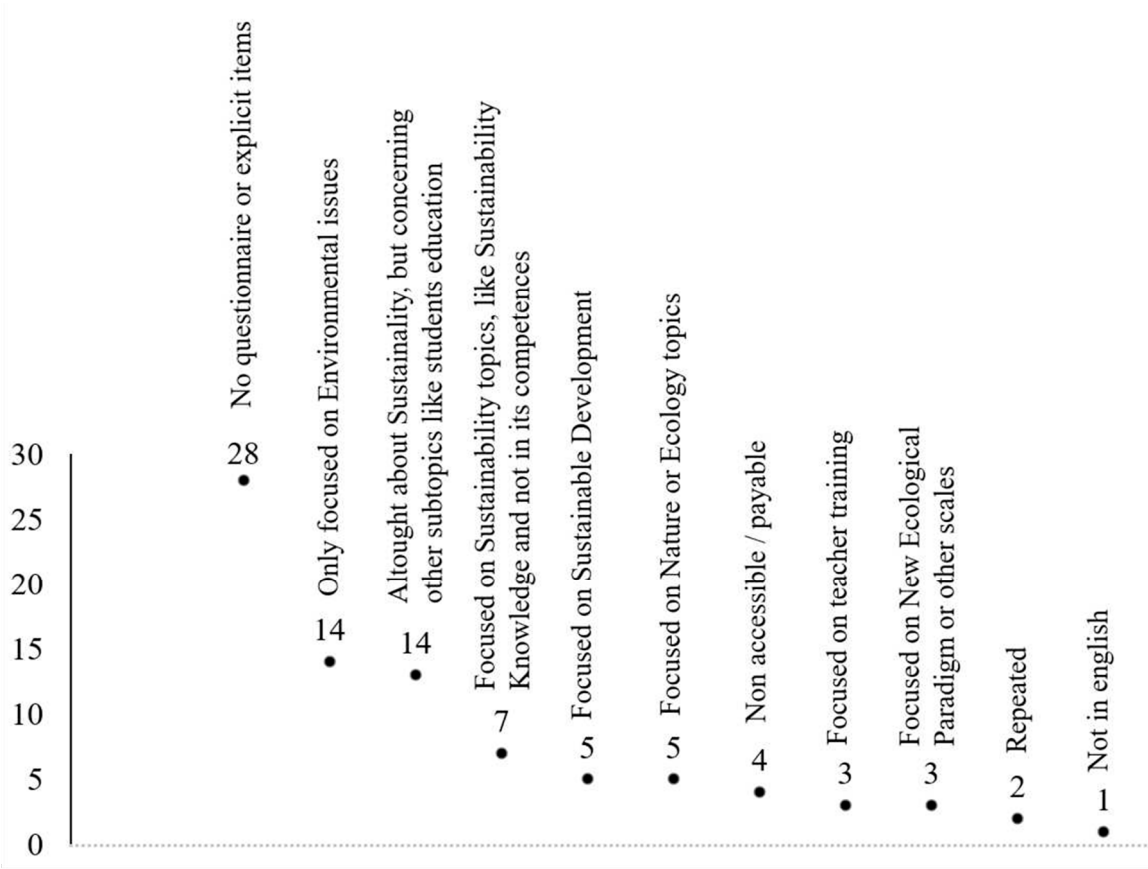


Figure 5. Presentation of the excluded scanned results, grouped by category/subtopic.

The data in Figure 5 show, among others, an interesting result: 28 articles refer to questionnaires, but do not present them in the main text or as an appendix. It is also important to point out the interest in teacher training on the topic of sustainability and the existence of different scales on similar topics of interest, such as the New Ecological Paradigm (Dunlap & Van Liere, 1978/2014), which has its roots in the environmental movement in the United States, promoted by Rachel Carson's book 'Silent Spring' (first published in 1962).

Upon completion of the corpus selection process for this paper, only two documents met the previously defined inclusion criteria. As illustrated in Figure 4 (adapted PRISMA flow), two documents have been highlighted for further analysis in future research.

Results and Discussion

The *corpus* that constitutes this paper is defined by two papers that, in addition, explicitly present the items or statements used in the questionnaires that they address. These two papers were analysed by a member of the EduCITY team. The data were obtained according to previously established criteria, which are presented in Figure 6.

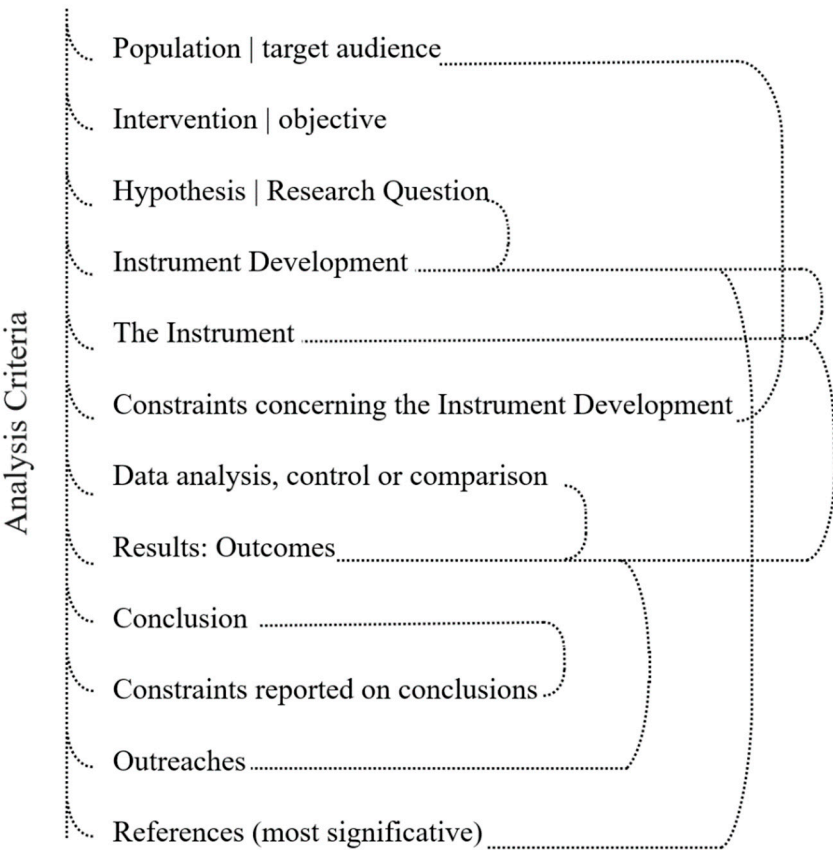


Figure 6. Analysis criteria of the corpus of this paper. The interconnectivity between some of the criteria enables the enumeration of, for instance, the development particularities of how the instrument was developed, validated and applied, or aspects pertaining to outcomes and dissemination (Developed by the authors).

Considering the analysis criteria presented, two researchers carried out an exhaustive analysis of the two papers. This analysis was subsequently presented and discussed. This process, although complex and time-consuming, allowed us to understand the various processes and dynamics that gave rise to the papers and, more specifically, the questionnaires presented there. The corpus of this research is comprised by the papers presented in Table 2.

Table 2. Titles, authors, and year of publication of this research *corpus*.

Title	Authors	year
Perceived interest in learning sustainability competencies among higher education students	Hyytinen et al.	2023
The environmental citizenship opinions questionnaire: a self-assessment tool for secondary students	Harskamp et al.	2023

Corpus analysis

This *corpus* analysis is based on the criteria presented in Figure 6 and all the data collected on the two papers are presented in Appendixes A and B, respectively. The data presented in the appendixes are direct quotations from each paper analysed and constitute a working tool in themselves. The following *corpus* analysis begins with a brief analysis of each paper and ends with a summary of the main aspects and conclusions of both papers.

Hyytinen et al. (2023) set out to gain insight into the motivations of university students in acquiring sustainability competencies and to ascertain their pro-ecological worldview. To achieve this goal, the researchers developed a survey comprising a series of statements taken from existing

questionnaires. The questionnaire addressed academic issues, sustainability competencies and the New Ecological Paradigm through 15 statements, using a seven-point Likert scale as the response format. The scale ranged from 1 (not at all interested) to 7 (very interested) or from 1 (strongly disagree) to 7 (strongly agree), depending on the section. The online questionnaire was confidently distributed to a potential pool of 30,000 students, but only 797 responses were received. Regarding the results of this work, the authors report that students perceived learning critical thinking, values thinking, self-regulation and interpersonal skills as the most interesting sustainability skills, as opposed to the collaborative skill of using digital technology. The findings also suggest a positive correlation between students' propensity to develop sustainability competencies and their pro-environmental attitudes globally. Conversely, the findings suggest that the willingness to cultivate sustainability competencies varies across academic disciplines. For example, it was found that students in the humanities had the highest level of commitment to adopting a pro-ecological perspective, whereas students in the health and well-being disciplines had the lowest level of commitment. In terms of the scope of the research, the researchers were able to establish a direct correlation between the improvement of sustainability-related competencies and prior exposure to the field, whether through academic endeavour or professional engagement.

In their conclusions, the authors made several considerations, namely that the interest of the participants in learning more about sustainability competencies is high, with a strong focus on the development of critical thinking competencies, a fact that cuts across the different learning areas of the participants. In addition, the authors emphasised the importance of developing initiatives and programmes aimed at promoting the development of sustainability competencies in individuals from a younger age, highlighting the crucial impact such initiatives can have in both intermediate and long-term periods. Hyytinen et al. (2023) also pointed out that there is a need to develop sustainability competency development activities that are more targeted and focused or specific to different age targets, and that specific disciplinary knowledge should be promoted, supported by "adaptable learning content". Competency development activities should be balanced between knowledge and environmental behaviour change, and future work should develop activities that strengthen these two development vectors.

The second paper was authored by Harskamp et al. (2023), whose objective was to develop and validate an assessment tool focusing on the opinion-forming and decision-making aspects of environmental citizenship at lower secondary level. The authors state that one of the aims of this work is the fact that most existing instruments focus on learning related to sustainability attitudes and values, while there is a lack of learning objectives focused on opinion formation and the ability to participate in dialogue on sustainability issues.

To develop the questionnaire, the authors conducted research into similar instruments and work references, emphasising that these instruments have in common an emphasis on aspects related to knowledge, attitudes, skills and reflection. In this sense, their proposal integrates the same dimensions and adds the dimension of 'environmental citizenship complexity'.

As the questionnaire was developed for Dutch students, all pre-existing statements or statements based on pre-existing statements that were not in Dutch were 'backtranslated'. The development went through several stages of implementation, after being piloted with a group of 27 students and analysed and reviewed by experts and teachers. The final questionnaire, the Environmental Citizenship Opinions (ECO) questionnaire, has a total of 73 items.

The instrument uses a seven-point Likert scale as the response format. The scale ranges from 1 (strongly disagree) to 5 (strongly agree); in the case of the reflection subscale, the scale ranges from 1 (never) to 5 (very often). Some items or statements have an inverted scale to check for response bias.

Once the whole process of developing this instrument had been completed, it was administered on a large scale, online, with 758 respondents.

The authors state that this questionnaire provides a valid and reliable way of assessing environmental citizenship among lower secondary school students, but they also point out that this instrument was developed for the Dutch reality and for a very defined age and school group. The

authors also emphasise that this instrument can be used in research with a pre-post-test experimental design. Its use by teachers requires some complementary activities, namely the correct way of collecting data, in that it must take place in appropriate circumstances, as well as the development of instructions for collecting and processing the data obtained after using the tool, which, as mentioned, was online. The authors have highlighted a crucial point regarding the questionnaire, emphasising that its 73-item structure enhances its usability, especially in situations that require a higher level of efficiency and speed.

To summarise this *corpus* analysis, Hyytinen et al. (2023) examined the interest of higher education students in acquiring sustainability competencies and their ecological perspectives, using a questionnaire derived from existing surveys and a seven-point Likert scale for responses. Harskamp et al. (2023) aimed to develop and validate an instrument to assess environmental citizenship among lower secondary school students, focusing on opinion formation and dialogue on sustainability, using a similar Likert scale and a reflection subscale. The study by Hyytinen et al. (2023) showed a high interest in sustainability competencies among the participants, especially in critical thinking, and suggested the need for targeted competency development activities for different age groups. Harskamp et al. (2023) found that their Environmental Citizenship Opinions (ECO) questionnaire was a valid and reliable tool for assessing Dutch students' environmental citizenship, although it was tailored to a specific demographic group. Both research efforts highlight the importance of incorporating sustainability literacy and environmental citizenship into academic curricula. This entails not only the acquisition of knowledge but also the promotion of behavioural change, with the aim of fostering long-lasting environmental awareness and engagement. Future research should focus on developing and implementing sustainability literacy activities that are more targeted and focused, addressing different age groups and specific disciplinary knowledge, to ensure a long-term impact on sustainability education. There is a need to develop activities that reinforce both acquisition of knowledge and environmental behaviour change, suggesting a dual approach to skills development in future sustainability education programmes. There is a need to establish protocols for the collection and manipulation of data resulting from the use of assessment tools such as the Environmental Citizenship Opinions questionnaire, specifically for their use in science education and various other settings. Further research is recommended to investigate the correlation between students' enthusiasm for sustainability skills and their pro-environmental perspective across different academic disciplines, with the aim of improving understanding of the willingness to cultivate these dispositions.

Conclusions

As previously stated, the objective of this paper is to theoretically sustain the development of a questionnaire that, in addition to meeting the specifications outlined in the section entitled "Purpose of the paper", can address the research question posed by the EduCITY project. The objective of this study is to ascertain the impact of EduCITY (a smart learning city environment that integrates a user-friendly application with co-created games and AR resources with paths and challenges, designed to involve educational actors and the community at large) on the knowledge, skills, values and attitudes of citizens, with a view to empowering them for sustainable development. As previously stated, the research team considered the terms "knowledge, skills, values and attitudes of citizens" to be synonymous and collectively referred to as "competencies". Consequently, a literature review was conducted on the development or utilisation of a questionnaire capable of addressing the same research question. Accordingly, the search string was constructed using a number of keywords, including "questionnaire" and "competencies" and their equivalent terms. A comprehensive search for scientific articles was conducted in two well-known scientific databases, Scopus and Web of Science. Additionally, the digital library ERIC, which is focused on education, was explored through the EBSCO host services. An adaptation of the PRISMA statement (Page et al., 2021) was employed to obtain the *corpus* of articles. As illustrated in the adapted PRISMA flow diagram (Page et al., 2021), the process resulted in two articles, which were selected according to previously defined inclusion

and exclusion criteria. Both papers present valid information for the purposes of this paper, but are limited to their target population and context, as stated by Hyytinen et al. (2023) and Harskamp et al. (2023). Therefore, and considering the need for continuous research and development of activities and better understanding of competencies for sustainability, as mentioned by authors such as Barth, Brundiers, Wiek and others in most of their papers on this topic, the EduCITY research team decided to attempt to develop a questionnaire.

Study Limitations

It is inherent to the nature of research studies, including the current one, that they are constrained by limitations. These restrictions provide essential context for interpreting the findings and gauging the broader impact of this research endeavour. The narrow scope of the literature review was a notable limitation, resulting in the identification of only two studies that met the inclusion criteria. While this facilitated a focused analysis, the limited scope of the research constrained the comprehensiveness of the findings and may have precluded the incorporation of additional perspectives or methodologies pertinent to assessing sustainability competencies.

The examination was limited to articles published between 2020 and 2024. Although the temporal restriction ensured the relevance and timeliness of the findings, the exclusion of previous research may have limited the incorporation of fundamental studies that could have enhanced the discussion, particularly considering the ongoing development of sustainability and competency frameworks. The two studies focused on Dutch secondary school and higher education students, respectively, and thus the findings are contextually specific. This distinctiveness limits the applicability of the findings to different cultural or educational settings that may have contrasting practices in sustainability education.

A further significant limitation is the applicability of the results. Both studies faced challenges, including low response rates, with one study noting a response rate of just 2.6%, and very specific target populations. These factors may limit the generalisability of the results to larger or more diverse populations. Furthermore, the literature review identified a notable absence of robust and standardised instruments for evaluating sustainability skills. The lack of comprehensive tools underscores the challenge of developing a universally applicable and theoretically robust assessment instrument in this field.

Moreover, the polysemantic nature of key terms such as 'sustainability' and 'competences' constituted a significant challenge during the evaluation phase. The existing literature frequently employs these terms in an inconsistent manner, which may impede the creation of a cohesive and standardised evaluation framework. Despite its systematized nature, the methodological approach is not without constraints. The research was based on searching online databases with keywords and criteria for inclusion. It is possible that this approach may have accidentally omitted important works that were not listed in these databases or that did not align with the chosen keywords. Furthermore, factors such as limited survey participation and the utilisation of preliminary methodologies in the research conducted may impact the trustworthiness of the results.

Considering these limitations, this study highlights the need for continued research and refinement in sustainability assessment.

Future Work

It is recommended that future research should aim to broaden the scope of literature reviews, integrate diverse cultural and educational contexts, and address the gaps in standardised assessment tools for sustainability competencies. It is imperative that methodological approaches are expanded and that participants are engaged to a greater extent if the reliability and applicability of findings are to be improved. In light of these limitations, this research offers valuable insights and establishes a foundation for the advancement of more comprehensive, robust, and effective tools for the understanding and promotion of sustainability literacy in diverse educational and societal contexts.

As part of future work, the EduCITY research team plans to utilise the insights gained from this study to develop a more refined and purpose-driven questionnaire. The objective of this tool is to address the research questions posed by the EduCITY project in an effective manner while also ensuring its adaptability for broader applications. The questionnaire will be designed in such a way as to accommodate diverse research contexts, thereby ensuring comprehensiveness for future studies and practical applicability within the Portuguese national context and among Portuguese-speaking populations. Furthermore, the focus will be on refining the construction of the questionnaire and improving the formulation or adaptation of statements and response items in order to enhance its validity and operational utility.

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Appendix A

Title (LINK)	Perceived interest in learning sustainability competencies among higher education students
Authors	Heidi Hyytinen, Senja Laakso, Janna Pietikäinen, Rami Ratvio, Lotta Ruippo, Tarja Tuononen and Annukka Vainio
Journal	International Journal of Sustainability in Higher Education
DOI	10.1108/IJSHE-06-2022-0198
Population/ target audience	797 Higher Education students -> online survey; (represents 2.6% of the total student population – 30,000 students)
Intervention/ objective	-> to assess higher education students’ interest in learning sustainability competencies and their pro-ecological worldviews; -> to develop a university-wide sustainability themed introductory course for all university students;
Hypothesis /Research Question	Main: RQ1 – How interesting do the students perceive the learning of different sustainability competencies? RQ2. How are students’ interest in learning sustainability competencies related to their pro-ecological worldviews? RQ3. How are students’ interest in learning of sustainability competencies and proecological worldview related to field of study? RQ4. How is previous study or work experience related to sustainability associated with interest in learning of sustainability competencies?
Instrument Development	-> The questionnaire was provided in the languages used in instruction in the university; -> Voluntary participation, informed consent and anonymity of the participants were ensured and communicated to respondents; -> Questionnaire development: used generic academic competencies (Tynjälä et al., 2016; Muukkonen et al., 2019) and sustainability competencies (Wiek et al., 2015; Lozano et al., 2017). Students’ pro-ecological worldview was measured with the NEP questionnaire (Dunlap et al., 2000).

The Instrument	-> The questionnaire measured students' interest in learning sustainability competencies and their pro-ecological worldview; -> Interest in learning sustainability competencies was measured with 39 items, which were formulated based on the previous studies on generic academic competencies and sustainability Competencies; -> All items were rated on a seven-point Likert scale (1 = not at all interested; 7= very interested); -> Students' pro-ecological worldview was measured with the NEP questionnaire. The scale included 15 items which were rated on a seven-point Likert scale (1 = completely disagree; 7 = completely agree) -> the section measuring students' interest in learning sustainability competencies was used for the first time, its functionality was examined with explorative factor analysis
Constraints concerning the Instrument Development	Not reported.
Data analysis, Control or Comparison	-> The data were analysed by using Pearson's correlation, independent samples t-tests, and analysis of variance; -> data used in this study was collected through an online survey in spring 2020 -> SPSS version 27 was used for the analyses
Results: Outcomes	-> students perceived learning of critical thinking, values thinking, self-regulation and interpersonal competency as the most interesting sustainability competencies; -> Collaborative use of digital technology appeared to be the least interesting competency; -> results also indicate that students' interest in learning sustainability competencies was related to their pro-ecological worldview -> results suggest that pro-ecological worldview is correlated positively with values thinking and critical thinking as well as communication and collaboration skills and self-regulation; -> results indicate that students' interest in learning sustainability competencies and pro-ecological worldview differed across fields of study; -> [it was] explored the relationship between previous study or work experience and students' interest in learning sustainability competencies with t-test. The results suggest that previous study experience related to sustainability was related to higher interest in learning of critical thinking and values thinking and collaborative use of digital technology; -> Similarly, students with prior work experience related to sustainability seemed to have more positive perceptions of learning of collaborative use of digital technology, interpersonal competence and values thinking than students without sustainability work experience. Previous experience of organisational and voluntary activities was related to higher interest in learning critical thinking, values thinking and interpersonal competence.
Conclusions	-> findings suggest that the participants' interest in learning sustainability competencies was high; -> The greatest interest in learning was towards critical thinking, which was the most interesting sustainability competence among students in all study fields, followed by values thinking, interpersonal competence and self-regulation skills

	-> it is known from the earlier research that interest is influencing students' learning outcomes; -> Students in different fields of study appear to have similar levels of interest in learning critical thinking, interpersonal competence and self-regulation skills; -> results indicate potential differences between fields of study in the endorsement of the pro-ecological worldview; -> In this study, participants studying humanities had the highest, and participants studying health and welfare had the lowest endorsement of proecological worldview; -> The results indicate that previous study experience related to sustainability may be related to a higher interest in learning critical thinking, values thinking and the collaborative use of digital technology. This suggests that it is possible that students' interest in learning these sustainability competencies may grow as they study sustainability-related courses; -> Therefore, including sustainability education in the early phases of studies could potentially be beneficial in increasing the interest towards learning sustainability and other relevant competencies;
Constraints reported on conclusions	-> The empirical results obtained in the study have some limitations. Firstly, the response rate of the survey was low, which likely impacts the collected data and the generalisability of the results - further studies with larger datasets on the current topic are recommended; -> The study only examined the interest in learning these competencies instead of the level students are at, or how these competencies can be learned - In future studies, exploring the development of sustainability competencies during university studies across different fields would be important; -> the study is limited by a lack of robust instruments for measuring these competencies, and lack of a coherent theoretical framework. For example, there are different definitions and lists of sustainability Learning sustainability competencies - developing an instrument to measure them would be important in the future.
Outreaches	-> that sustainability education should be developed considering these [fields/areas of study] differences - Teaching and learning need to be arranged in a more tailored way by, e.g. offering more disciplinary based and individually customizable learning contents; -> receptivity of students may differ between students with different disciplinary and cultural background, age and personal values - This calls for adapting sustainability education to diverse needs and including personal reflection and close connection to disciplinary contents -> finding shows that caring for the environment, gaining sustainability knowledge and acting or working for sustainability are connected to values thinking. This is important as to further sustainability, values, attitudes, motivation, worldviews and behaviour are needed in addition to knowledge and skills; -> Previous studies suggest that environmental and sustainability knowledge provided by formal education promotes environmental attitudes, but the contribution to students' engagement in direct environmental behaviours is weak or nonexistent show that

	sustainability knowledge has significant, but weak correlation with sustainability behaviour. -» Future studies should address the issue of how to design and deliver sustainability education with an impact in values and attitudes together with behaviours.
References (the most significant)	-» Bianchi, G., Pisiotis, U., Cabrera, M., Punie, Y., & Bacigalupo, M. (2022). The European sustainability competence framework. In Publications Office of the European Union. https://doi.org/10.2760/13286 -» Brundiens, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. Sustainability Science, 16(1), 13–29. https://doi.org/10.1007/s11625-020-00838-2 -» Hay, R., Eagle, L., Saleem, M.A., Vandommele, L. and Li, S. (2019), “Student perceptions and trust of sustainability information”, International Journal of Sustainability in Higher Education, Vol. 20 No. 4, pp. 726-746, doi: 10.1108/IJSHE-12-2018-0233. -» Redman, A., & Wiek, A. (2021). Competencies for Advancing Transformations Towards Sustainability. Frontiers in Education, 6(November), 1–11. https://doi.org/10.3389/feduc.2021.785163 Wiek, A., Withycombe, L., & Redman, C. (2011). Key competencies in sustainability: A reference framework for academic program development. Sustainability Science, 6(2), 203–218. https://doi.org/10.1007/s11625-011-0132-6

Appendix B

Title (LINK)	The environmental citizenship opinions questionnaire: a self-assessment tool for secondary students
Authors	Michiel van Harskamp, Marie-Christine P. J. Knippels, Jelle N. A. Boeve-de Pauw Wouter R. van Joolingen
Journal	Frontiers in Education
DOI	10.3389/feduc.2023.1182824
Population/ target audience	-» 781 lower secondary students -» The instrument was developed and administered in Dutch -» Data were collected from January 2020 till June 2022. The questionnaire was administered online using FormDesk software. -» Data collection took place within ethical boundaries set by Utrecht University.
Intervention/ objective	-» the current study aims to develop and validate an assessment tool that focusses on opinion forming and decision making aspects of EC at lower secondary level; -»
Hypothesis /Research Question	Not a RQ, but an aim! -» Most existing instruments focus on learning aims that deal with attitudes and sustainability behavior, whereas learning aims related to sustainability opinion forming and the ability to take part in dialogue about sustainability issues remain uncovered. (Harskamp et al., 2023)
Instrument Development	-» The ECO questionnaire was validated through a pilot round and a subsequent large-scale study (781 lower secondary students). Several

	rounds of Confirmatory Factor Analysis resulted in a final model of 38 items divided in 7 first order and 5 s order constructs. -» existing instruments and references: - Sustainability Consciousness Questionnaire (SCQ; Gericke et al., 2018); - Environmental Citizenship Questionnaire (Hadjichambis & Paraskeva-Hadjichambi (2020); - Action Competence in Sustainable Development Questionnaire (ACiSD-Q) (Sass et al., 2021a) - Self-Perceived Action Competence for Sustainability Questionnaire (SPACS-Q; Olsson et al., 2020) - Relevance Of Science Education (ROSE) questionnaire (Schreiner and Sjøberg, 2004); - Civic and Citizenship Education Study (ICCS; Schulz et al., 2018) - Citizenship Competences Questionnaire (CCQ) (Ten Dam et al. (2011) - the five key sustainability competences of Wiek et al. (2011) - Socio-Scientific Reasoning (Sadler et al., 2007) -» Common aspects of many of the previously discussed tools are knowledge, attitudes, skills, and reflection -» conceived as an integrative tool - graphic info; - [this] model unites these three dimensions in its five main constructs: EC Knowledge, EC Attitudes, EC Skills, EC Reflection, and EC Complexity; -» [first] designed a pilot version of the Environmental Citizenship Opinions (ECO) questionnaire in which we included an items battery drawn from existing surveys. -» The instrument was developed and administered in Dutch. To ensure translation accuracy, backtranslation was used whenever items were originally written in English. -» The tool's items offer 5-point Likert scale response options, in either a Strongly disagree, Disagree, Neutral, Agree, Strongly agree format or, for the Reflection subscales, a Never, Occasionally, Sometimes, Often, Very often format. Several items adopted inverted scales in order to check for response bias. -» The pilot version of the questionnaire was discussed in one-on-one setting with several independent experts - graphic info; -» small-scale test with a class of 27 students followed, which was aimed mainly at testing the platform and the process of online administration. Finalizing the pilot phase, the initial questionnaire of 65 items was tested in a large-scale data collection round with 758 lower secondary students. The data for this pilot round were analyzed with IBM SPSS (version 25); -» new items were designed for the knowledge and complexity subscales in order to improve their quality.
The Instrument	-» [It is a] validated instrument for assessing Environmental Citizenship (EC) of students in lower secondary education;
The Instrument	-» The Environmental Citizenship Opinions (ECO) questionnaire focusses on general citizenship components, key sustainability competences, and Socio-Scientific Reasoning aspects;

	-» The construct of EC is composed of five latent psychometric constructs: knowledge, attitudes, skills and reflection, with the addition of complexity of EC issues graphic info; -» Leading to 73 items
Constraints concerning the Instrument Development	Not reported.
Data analysis, Control or Comparison	-» conducted a series of Confirmatory Factor Analyses (CFAs) using the Mplus software package, version 8.8 (Muthen and Muthen, 2010) -» Cronbach's alpha was calculated using IBM SPSS Statistics (version 82.0.1.1) for each second- and third order construct to explore their reliability as an indication of their internal consistency. -» Model fit indices and Cronbach's alpha estimates indicate that our assessment tool is both valid and reliable.
Results: Outcomes	-» the results of our analyses, the ECO questionnaire offers a valid and reliable way to assess EC of students in lower secondary education. For the first time, opinion forming and decision making aspects are integrated in a single validated EC assessment tool. Our effort to unify these EC elements thus fills a gap in the availability of tools. -» enables teachers to assess learning aims other than those related to behaviors or knowledge. It also allowed us to explore the different constituents of EC and their underlying relationships which improved our understanding of EC in general. Second, the scores from our assessment tool show a large spread and there is no ceiling effect among the data. -» [The] tool therefore is sensitive enough to discern differences between individual students; -» [The] instrument was aimed at lower secondary students, age 11–15. This specific target group has not yet been selected as main target group for previously developed Ec assessment tools. With the development of the Environmental Citizenship Opinions questionnaire, we have filled several gaps in availability of EC assessment tools
Conclusions	-» The added value of this new tool to the existing pool of instruments is threefold. First, it is the first time that these three dimensions of EC, the general citizenship components of Ten Dam et al. (2011), the key sustainability competences of Wiek et al. (2011), and the Socio-Scientific Reasoning aspects from Sadler et al. (2007), are unified in one coherent tool.
Constraints reported on conclusions	-» Our instrument was validated in a Dutch context, and was developed with the specific age group of lower secondary level in mind
Outreaches	-» assessment tool can be used by researchers to monitor EC opinion forming and decision-making learning outcomes at lower secondary level, for instance by pre-post-test design. -» To make our instrument usable by (science) teachers, several steps need to be taken. First, guidelines need to be provided for teachers to ensure data collection conditions are appropriate. Second, instructions need to be written which describe how to calculate scores for first, second, and third order constructs. An (online) tool to perform these calculations would be helpful. Finally, an explanation needs to be given for how to interpret the results and for drawing conclusions and understanding implications for teaching practice.

	-» Furthermore, with 38 items, [this] assessment tool is relatively short, which enhances usability in a field where time is a scarce commodity
References (the most significant)	-» Buckler, C., and Creech, H., UNESCO. (2014). Shaping the future we want: UN Decade of Education for Sustainable Development (2005–2014): Final Report. International Report; UNESCO: Paris, France. -» European Commission. (2019). Key competences for lifelong learning. International report; EC: Luxembourg. doi: 10.2766/569540 -» Sass, W., Quintelier, A., Boeve-de Pauw, J., De Maeyer, S., Gericke, N., and Van Petegem, P. (2021b). Actions for sustainable development through young students’ eyes. Environ. Educ. Res. 27, 234–253. doi: 10.1080/13504622.2020.1842331 -» Walshe, N. (2008). Understanding students’ conceptions of sustainability. Environ. Educ. Res. 14, 537–558. doi: 10.1080/13504620802345958

References

Barbosa, G. S., Drach Regina, P., & Corbella, O. D. (2014). A Conceptual Review of the Terms Sustainable Development and Sustainability. *International Journal of Social Sciences*, III(2), 1–15.

Barth, M., & Thomas, I. (2012). Synthesising case-study research - ready for the next step? *Environmental Education Research*, 18(6), 751–764. <https://doi.org/10.1080/13504622.2012.665849>

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. *Sustainability Science*, 16(1), 13–29. <https://doi.org/10.1007/s11625-020-00838-2>

Cairns, J. (2003). Integrating top-down/bottom-up sustainability strategies: An ethical challenge. *Ethics in Science and Environmental Politics*, 3(1), 1–6. <https://doi.org/10.3354/esep003001>

Carson, R. (2023). *Primavera Silenciosa*. Imprensa da Universidade de Lisboa.

de Haan, G. (2006). The BLK “21” programme in Germany: A “Gestaltungskompetenz”-based model for Education for Sustainable Development. *Environmental Education Research*, 12(1), 19–32. <https://doi.org/10.1080/13504620500526362>

Dunlap, R. E., & Van Liere, K. D. (1978). The “New Environmental Paradigm.” *The Journal of Environmental Education*, 9(4), 10–19. <https://doi.org/10.1080/00958964.1978.10801875>

Egelston, A. E. (2013). *Sustainable Development: A History*. Springer Science+Business Media.

Grant, M., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, 26(2), 91–108. <https://doi.org/10.1111/j.1471-1842.2009.00848.x>

Harskamp, M., Knippels, M.-C. P. J., Boeve-de Pauw, J. N. A., & van Joelingen, W. R. (2023). The environmental citizenship opinions questionnaire: a self-assessment tool for secondary students. *Frontiers in Education*, 8. <https://doi.org/10.3389/feduc.2023.1182824>

Hyytinen, H., Laakso, S., Pietikäinen, J., Ratvio, R., Ruippo, L., Tuononen, T., & Vainio, A. (2023). Perceived interest in learning sustainability competencies among higher education students. *International Journal of Sustainability in Higher Education*, 24(9), 118–137. <https://doi.org/10.1108/IJSHE-06-2022-0198>

Kates, R. W., Clark, W. C., Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., McCarthy, J. J., Schellnhuber, H. J., Bolin, B., Dickson, N. M., Faucheux, S., Gallopin, G. C., Grübler, A., Huntley, B., Jäger, J., Jodha, N. S., Kaspersen, R. E., Mabogunje, A., Matson, P., Svedin, U. (2001). Sustainability Science. *Science*, 292(5517), 641–642. <https://doi.org/https://doi.org/10.1126/science.1059386>

NRC. (1999). *Our Common Journey: A Transition Toward Sustainability*. National Academies Press. <https://doi.org/10.17226/9690>

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T.,

- Loder, E. W., Mayo-Wilson, E., McDonald, S., Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Systematic Reviews*, 10(1), 89. <https://doi.org/10.1186/s13643-021-01626-4>
- Paraskeva, F., Karampa, V., & Brinia, V. (2020). Sustainable Development in Higher Education: A Constructivist Conceptual Framework for Smart Learning and Education. In V. Brinia & J. P. Davim (Eds.), *Designing an Innovative Pedagogy for Sustainable Development in Higher Education* (pp. 42–80). Taylor & Francis Group, LLC.
- Redman, A., & Wiek, A. (2021). Competencies for Advancing Transformations Towards Sustainability. *Frontiers in Education*, 6(November), 1–11. <https://doi.org/10.3389/educ.2021.785163>
- Schirone, M. (2024). The formation of a field: sustainability science and its leading journals. *Scientometrics*, 129(1), 401–429. <https://doi.org/10.1007/s11192-023-04877-1>
- Shi, L., Han, L., Yang, F., & Gao, L. (2019). The Evolution of Sustainable Development Theory: Types, Goals, and Research Prospects. *Sustainability (Switzerland)*, 11(24), 1–16. <https://doi.org/10.3390/su11247158>
- Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2019). How to Do a Systematic Review: A Best Practice Guide for Conducting and Reporting Narrative Reviews, Meta-Analyses, and Meta- Syntheses. *Annual Review of Psychology*, 70, 747–770. <https://doi.org/10.1146/annurev-psych-010418-102803>
- Stoll, M. (2023). *Lucro - Uma História Ambiental*. Edições 70.
- UN. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development (A/RES/70/1)*. UN General Assembly. <https://doi.org/10.1163/15718093-12341375>
- UN. (2023). *Fast Facts – What is Sustainable Development* https://www.un.org/sustainabledevelopment/wp-content/uploads/2023/08/SustDev_Explainer.pdf
- UNESCO. (2017). *Education for Sustainable Development Goals: learning objectives*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000247444>
- UNESCO. (2022). *The concept of sustainability and its contribution towards quality transformative education: Thematic paper*. UNESCO. <http://www.unesco.org/open-access/terms-use->
- Veschi, B. (2020). <https://etymology.net/>. <https://etymology.net/sustainability/>
- WCED. (1987). *Our Common Future: Report of the World Commission on Environment and Development*. <http://www.un-documents.net/ocf-ov.htm>
- Wiek, A., Withycombe, L., & Redman, C. (2011). Key competencies in sustainability: A reference framework for academic program development. *Sustainability Science*, 6(2), 203–218. <https://doi.org/10.1007/s11625-011-0132-6>
- Ziaul, I. M., & Shuwei, W. (2023). *Environmental Sustainability: A major component of Sustainable Development*. 4(3), 900–907.

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