Creating a Next Generation Participatory Contest for Young People to integrate Circularity in School Curricula

CircularCityChallenge

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CREATING A NEXT-GENERATION PARTICIPATORY CONTEST FOR YOUNG PEOPLE TO INTEGRATE CIRCULARITY INTO SCHOOL CURRICULA

Deliverable D2.2

Literature review on CC & ESD, education approaches & methods, and challenges

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Author(s):	Özlemnur Ataol, UM
Contributors:	Antonija Bogadi, SYNYO Johannes Braunbruck, SYNYO Adrian Ibric, UAUIM Victor Gimeno, LOGRO Natalia Magureanu, UAUIM Veronica Ileana Marin, UAUIM Darian Meacham, UM Nicole Wohltran, TROI Corina Șimon, BIST
Reviewers:	Darian Meacham, UM

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Introduction

Drawing on a systematic literature review, this section defines a framework on how cities potentially process circularity and then explores potential innovative approaches of incorporating circular development/urban circularity as a part of education for sustainable development (ESD) into upper secondary education curricula. It addresses the following questions: **(1)** What is urban circularity / circular city / circular development in urban settings? **(2)** How does ESD support education for circular development (methods / approaches / traditions)? **(3)** What are the potential challenges/barriers in ESD to teaching circular development?

This section conducts a systematic literature review following the methodology described by Boland et al. (2017) and uses Scopus as the primary database next to Web of Science and Semantic Scholar as the secondary database for further identifying relevant publications.

First, a keyword list was identified through preliminary research of keywords within related research of circular cities (CC) and education for sustainable development (ESD). A keyword string was formed from this list in order to answer the research questions. The final strings specialized for CC and ESD and used in searches were formed as below:

- **CC:** *TITLE-ABS-KEY (["circular city" OR "urban circularity" OR "spatial circular economy" OR "circular built environment"] AND ["framework" OR "indicator*" OR "concept" OR "toolbox"])*
- **ESD:** *TITLE-ABS-KEY (["education for sustainable development" OR "sustainable development education"] AND ["approach*" OR "challenge*" OR "competition" OR "method*"] AND ["secondary" OR "highschool" OR "high school" OR "secondary school" OR "lycee" OR "lyceum" OR "teenager*"])*

Secondly, the queries were carried out within the databases and returned 114 and 238 publications, respectively. The search included only peer-reviewed journal articles and excluded books, book chapters, conference papers, and dissertations. In order to address the research questions, publications were included if, in general, they were in English, and they reflected the inclusion criteria for CC and ESD separately, detailed in the PICOSS table below **(Table 1)**.

Table 1: the Population, Intervention, Comparator, Outcomes, Study Design, Setting table

	(CC)	(ESD)
RESEARCH QUESTIONS	**(1)** What is urban circularity / circular city / circular development in urban settings?	**(2)** How does ESD support education for circular development (methods/approaches/traditions)? **(3)** What are the potential challenges/barriers in ESD to teaching circular development?
POPULATION	N/A	upper secondary education, teenagers, 14-18 years olds, high-schoolers
INTERVENTION	adaptation of circular economy (CE) in urban settings	potential approaches/traditions/methods for and challenges to teaching ESD application competition-based Learning

		adaptation of (urban) circularity in ESD OR including circular actions
COMPARATOR	No comparison	No comparison
OUTCOMES	framework, indicators, concept, toolbox, definition	learning outcomes such as a change in attitudes and lifestyle, gaining new skills and awareness towards elements of the CC framework (circular actions, local collaborative actions, and taking actions/experimenting)
STUDY DESIGN	qualitative (based on secondary and primary data) and quantitative studies	qualitative (based on secondary and primary data) and quantitative studies
SETTING	the natural environment, built environment, socio-economic environment AND/OR social and procurement system of cities	formal and informal educational settings

Finally, a total of 352 publications underwent an elimination process based on the PICOSS table, firstly in the titles and abstracts and then through scans of full texts. In the end, 30 publications (10 for CC and 15 for ESD + 5 by snowballing for ESD) **(Appendix 1)** were selected for the review process.

This section is structured as follows. First, an urban circular development/circular cities framework is developed from CC literature to explain how circular development in cities operates with a special focus on the social system of cities. Next, the ESD literature is analyzed to explore the circular cities framework based on the actions circular cities pursue their progress as the means of sustainable development. Moving to the approaches and barriers to teaching sustainable development, ESD literature is explored with special attention to the circular cities framework, and approaches and barriers are reported separately.

- **Circular Cities as the means of Sustainable Development (RQ#1)**

Cities are social habitats for more than half of the world's population. Cities, also known as "resource sinks" (Kisser & Wirth, 2021, p. 140), are ecosystems conflating mass production (of goods and waste) and consumption (of resources and goods) since cities consume 60–80% of the world's resources and produce 50% of global waste (Williams, 2021, p. 1). As cities face increasing challenges from rapid urbanization, climate change, resource depletion, and waste generation, there is a growing need for more resilient urban environments and communities, as an ongoing process of enhancing the skills of residents and the adaptability of infrastructure and systems of cities rather than chasing an ultimate end goal of sustainability (Callaghan & Colton, 2008). Thus, very recently, "circular development" in urban settings (Williams, 2021, p. 1) or "urban circularity" (Marin & De Meulder, 2018, p. 1) emerged as a wake-up call for how to achieve this.

Circular development in urban settings is defined as "a new normative model for urban development" (Williams, 2021, p. 2) that allows cities to become "future-proof" (Prendeville et al., 2018, p. 17) by embracing circular economy principles in the two main systems of a city: While the social system (consumption patterns, lifestyles, community-led actions) finds its roots in the community and its citizens, in other words, users; procurement system (production of goods and services) is built on the producer, such as in food and fashion industry and service providers, such as local governments.

Circular development in urban settings is principally the adaptation of circular economy principles of industry; specifically, the translation of six actions[1] in the RESOLVE framework introduced by the Ellen MacArthur Foundation (EMF, 2015) to urban settings that is pioneered by Williams (2019). Her framework introduces three main circular actions –loop (RE-actions), regenerate, and adapt (and three supporting actions –localize, substitute, and share)[2], and she notes a critical role attached to the social system of cities as the distinction of cities as complex ecosystems over industrial ecosystems where circular economy principles are mostly adopted. This critical role of the social system is also highlighted by others (Marin & De Meulder, 2018; Paiho et al., 2020) in their exploration of the frameworks of circularity indicators. They criticize the existing projects adapting circular development as lacking partnerships on inter-scales (neighborhood, city, and region) and among diverse stakeholders, including civil society, to regulate consumption behavior and lifestyles. Therefore, these critics feed Prendeville et al. (2018)'s "future-proof" concept, with such, to reach it by requiring CO-actions, such as co-plan, co-design, and co-decision, in the social system next to main circular actions, including RE-actions, in both systems (Prendeville et al., 2018; Paiho et al., 2020; Williams, 2021, 2022). This echoes the questions asked by Shakespeare (1898, Act III. Scene I): "*What is the city but people?*"

In the emerging literature, the circular development approach and its actions within the systems of cities are explored under the concept of circular cities. State-of-the-art collaboratively defines circular cities as **(1)** a new means, which is experimental and yet not just, to pave the way to sustainable futures, and **(2)** a potential collaborative platform that aims at circular societies emerged, supported by local networks and community-led actions.

It is increasingly acknowledged that circular cities as a sustainable city concept are more than the accumulation of businesses that apply circular economy principles (Marin & De Meulder, 2018). Circular cities, as a way of renewal of cities, help communities to target sustainable development goals (Fusco Girard & Nocca, 2019; Papageorgiou et al., 2021; Williams, 2021). Inheriting the argument of Hassan & Lee (2015, p. 1) on the limiting usage of the term' sustainable cities,' the circular city concept, next to other means of sustainability, such as eco-cities and zero-carbon cities, presents a process of the "transition towards the sustainable city" because circular cities accommodate the act of transition through ongoing experimental processes to facilitate sustainable development. It is an ongoing process, not only because theories on the circular city concept have been planted in recent growing literature (literature on conceptualizing circular cities goes far back only to the 2010s with a peak after 2020) but also because there is little empirical evidence available to crosscheck the concept in the

[1] RESOLVE by EMF (2015) describes six actions that move industrial systems to circular economy. Six actions includes (1) Regenerate (2) share, (3) optimize, (4) loop, (5) virtualize, and (6) exchange.

[2] *Looping actions* aim to close resource loops through RE-actions, such as recycle, reuse, recover, reduce, repair, refurbish, remanufacture, repurpose and refuse (as referred as 9Rs in Kalmykova et al., 2018). *Regenerative actions* aim to restore the urban ecosystem by preserving natural capital through implementation of such permeable surfaces, green roofs and urban farms. *Adaptive actions* refer to approach of planning and designing cities aiming to enable adaptation and renewal of existing infrastructure of cities with wasting minimal urban resources. *Localization* works for developing local symbiotic capital, encouraging collaboration and pro-environmental behavior. *Substitute* requires change physical with virtual, non-durable with durable, and non-renewable with renewable. Finally, *share* refers to co-existence by promoting systems such as co-housing, co-working, vehicle sharing and public interest in mobility infrastructure, such as public transportation. All sub actions are adopted from Williams (2019).

international context (Cavaleiro de Ferreira & Fuso-Nerini, 2019). Existing empirical knowledge yet induced an experimental front facade to circular cities as they narrated a process of learning from failure/success based on the evidence from the implementation of circular development mostly in European cities such as London, Amsterdam, Rotterdam, Barcelona, Stockholm, and Paris (Prendeville et al., 2018; Williams, 2021) and the conceptual circular city projects called Masdar City and R-Urban (Marin & De Meulder, 2018).

The path toward sustainable futures through circular development in cities entails promoting diverse skills that create opportunities for all (Williams, 2021). Unfortunately, the path is not saturated yet, affected by its experimental nature, to serve everyone equally even though it has the potential to simultaneously cure social inequality and ecological & economic crisis, as reported by Fusco Girard & Nocca (2019). The scholars mean that circular cities entail rejecting the compromise that had been made between environmental health and human well-being. However, concessions have been made in favor of specific groups at the expense of the general health and well-being of citizens. For example, Williams (2021, p. 1) explores the disparities in accessing the benefits of circular development throughout society, what she calls "the unintended consequences." In this research, she reports that regenerative actions can result in only wealthy groups and areas benefitting from accessing the natural environment and services of the adjacent ecosystem. She also describes insecure, underpaid, and unhealthy working conditions for low socio-economic groups as a result of the informal recycling sector serving circular development. These examples show another face of circular development that potentially creates opportunities and benefits but not for all to enjoy.

At the same time, in those opportunities offered by circular development, some activities that work for solidarity can promote equal benefits. Williams (2021) accordingly reports that circular activities, which are locally rooted, such as food recycling/reuse programs, cooperative energy/farming projects, and repair cafes, benefit everyone, including the socio-economically disadvantaged groups. Based on those circular activities, it is no surprise that circular cities are called "collective action" (Paiho et al., 2020, p. 7) that operates dominantly on the local scale (as seen among the examples introduced by Williams, 2021). In other words, circularity for solidarity and vice versa requires locally boosted collaborative synergy created through engagement among providers and users. However, collaborative synergy usually omits users in existing experiments in circular cities simultaneously in the literature on circular cities, as generating collaborative environments is costly in time and money, especially for local governments (Williams, 2022).

A few pieces of literature focus on citizens and communities –the social system of a city as one of the strategic areas of implementing circularity and as a stakeholder in the collaborative synergy (Prendeville et al., 2018; Gravagnuolo et al., 2019; Williams, 2022). They reason that even though cities are made of non-living assets (infrastructure, buildings, and such), efforts only in circular production of non-living assets stay ineffective without a shift towards sustainable lifestyles in the community, in other words, in the social system of a city. Besides, circular actions through community-led projects help build stronger communities; they are the fuels of circular development because they hold transformative power in both users' lifestyles and producers' approaches in line with these lifestyles (Fusco Girard & Nocca, 2019). Thus, by engaging local communities in the process, circular cities can foster a sense of ownership and accountability and create more resilient and circular communities. As more communities adopt circular development, future-proof cities, where waste is minimized, resources are conserved, and communities thrive, are becoming easy to achieve. Yet, community-led

projects encounter barriers as urban citizens need funding, land, and regulative support from local governments (Williams, 2022).

More importantly, urban citizens need to be equipped with the knowledge, values, and competencies necessary for collective actions toward creating resilient communities that can overcome barriers and adapt to new situations. Because the success of the collective action depends on not only the diversity of the participants but also how well they are informed (Williams, 2022). To be able to absorb and interpret the information, therefore, education for sustainable development (ESD) is an essential part of the solution to this challenge, starting from earlier ages, as it gives individuals the ability to understand the interdimensional (social, environmental, and economic) nature of the sustainability challenge and to think critically about the impact of their decisions and actions on global sustainability (Zwolińska et al., 2022). Additionally, education finds itself a place within urban circularity indicators as part of the social system of a city (Papageorgiou et al., 2021). Specifically, through education mainstreaming (urban) circularity, citizens, particularly children as future adults, by becoming well-informed stakeholders towards circular development, gain the capacity to take proactive steps in their lives and communities as well as to initiate and scale up community-led projects. On this note, exploring aspects of circular development, such as experimental, just, and collaborative approaches, within the education for sustainable development, appears important.

- **Approaches and Methods in ESD supporting Experimental, Just, and Collaborative Nature of Circular Development in Cities (RQ#2)**

This section explores the approaches that form the circular city concept based on its approach of pursuing progress in circular development as a means of sustainable development (SD) within education for sustainable development (ESD). ESD emerged from the need to address the dramatic challenges the planet faces by employing certain approaches toward enabling the creation of knowledge and skills for learners to reach sustainable communities (UNESCO, 2020). Achieving this aim requires specific pedagogy, adopting learning on multiple levels, and utilizing appropriate teaching & learning methods. On that note, according to Eilam & Trop (2010), ESD pedagogy relays **four basic iterative principles** building upon each other as steps where each step brings an additional component for reaching the above-mentioned goal of ESD **(Table 2)**. As seen in **Table 2**, furthering each step approaches the realm of natural learning by adding time, space, and emotion dimensions into the learning process, and in the meantime, methods become more interactive, collaborative, and action based.

As a recap of the previous part, the circular city concept carries the potential to lead cities to sustainable futures and/or help them to become future-proof cities, inheriting the ultimate goal of ESD of that reaching sustainable communities along the way. From the social domain perspective that embodies individuals and communities, the concept can achieve this through its globally untested – experimental nature, bringing a new space for communities to try innovative, collaborative, and community-led localized solutions, with special attention to the creation of just processes and also just outcomes that benefit everyone in the community. Therefore, building upon Eilam & Trop (2010)'s steps of ESD pedagogy and examining approaches, traditions, and methods within ESD, the following part explores the possibility of the concept of education for sustainable development and tracks approaches dominant in the circular city concept that relays how circular cities achieve circular development: **(1)** experimental, **(2)** just, and **(3)** collaborative.

Academic knowledge of facts constitutes the basis for furthering more natural learning and is acquired through fact-based tradition within ESD (Eilam & Trop, 2010, Step#1 in **Table 2**). The fact-based tradition is a teacher-centered approach delivering one discipline/subject-related content (such as geography, chemistry, and so on) (Borg et al., 2012). Considering the new novel approaches to reaching sustainable communities, it is expected that ESD literature presents facts about (urban) circularity as a means of sustainable development in cities. ESD has evolved around facts on consumption habits, biodiversity, social inequality, environmental footprint, green energy, entrepreneurship, and local economy that are natural to the circular economy and (urban) circularity (Kopnina, 2020; Sukiennik et al., 2021; Scalabrino et al., 2022; Díaz-López et al., 2023) with most of the examples from higher education. Yet, within the studied literature on ESD at the level of secondary education, there was no integration of facts on (urban) circularity and its closed-loop/circular actions that were presented in the previous section as RE-actions (or supported actions) as one of the main components of the circularity framework on what circular cities do to achieve circular development. It might constitute a content-wise gap in the creation of education for circular development. Instead, a broader exploration of textbooks of related subjects/fields would give more insights into this content-wise gap.

Table 2: Essentials of ESD Pedagogy, designed by the authors synthesizing Eilam & Trop (2010) and Borg et al. (2012)

STEP#1 LEARNING FACTS	**STEP#2** LEARNING SYSTEM(S)	**STEP#3** LINKING SYSTEMS	**STEP#4** LINKING EMOTIONS
Non-natural (traditional) Learning	Multi-disciplinary Learning	Multi-dimensional Learning	Emotional Learning
• The most common style of learning • Supports the development of analytical–rational modes of intelligence	• Simultaneously learning the facts from various disciplines • Gaining in-depth knowledge • Acquisition of systematic thinking	• Development of contextual ways of thinking • Acquisition of the ability to think out of the box • Development of an intuitive sense of nonlinear changes in time and space	• Activating a process of value and ethics clarification • Encouragement to raise questions of values and ethics • Advancing teamwork and cooperation toward a common goal
METHODS: Non-interactive methods, such as presentation-based methodologies by teachers	**METHODS:** More hands-on methods, such as experimenting with the facts	**METHODS:** More out-of-school methods, visiting archives, and multi-dimensional presentations by students on the data they collected.	**METHODS:** More action-based (collaborative) methods, such as debates, interviews, and planning community activities.
FACT-BASED tradition	NORMATIVE and PLURALISTIC tradition		
APPROACHING A MORE HOLISTIC VIEW (combining ecological, economic, and social aspects)			

APPROACHING IN THE REALM OF NATURAL LEARNING

ADDING TIME, SPACE, AND EMOTIONAL DIMENSIONS

On the note of how circular cities achieve circular development, disciplines/subjects of high school education rooted in social and applied sciences, such as geography, economics, life skills, chemistry, biology, and history, carry the potential within their specific tradition to respond to the urban circularity framework as they individually respond to ecological, economic, and social aspects of sustainable development. Borg et al. (2012, 2014) unintentionally relay this potential in their effort to compare the contents, traditions, and methods of social science and applied science in secondary education. According to them, applied sciences, originated in fact-based tradition, emphasize ecological issues, such as conservation, renewable energy, and climate change, and teach through traditional methods, such as presentations and experiments. On the other hand, social sciences, which originated in pluralistic tradition, teach the social dimensions of sustainable development; on issues such as human rights, poverty reduction, and gender equality and commonly through collaborative and cooperative methods, such as small group research projects, class debates, and group discussions.

Requiring fact-based tradition for forming the basis not equally but for all dimensions of sustainable development, the pluralistic approach further helps learners to get familiar with different perspectives, views, and values on individual and community levels as well as non-human levels; it equips them with a comprehensive understanding of conflict of interests causing environmental problems (Borg et al., 2012) and with skills, such as systematic thinking for linking different systems as introduced by Eilam & Trop (2010, Step#2 in **Table 2**). The pluralistic approach is built upon the concept of a pluriform society (Roegholt et al., 1998) that potentially explains the contemporary world –the interconnectedness of systems (social and procurement) of cities through a further interest of more-than humans as called inclusive pluralism by Kopnina & Cherniak (2016). Pluralism is associated with active citizenship, which is required for (urban) circular development as a panacea for the creation of concerned citizens, as it operates exchanges of ideas democratically (Kopnina & Cherniak, 2016) and evaluation of various perspectives actively and critically (Borg et al., 2012) through deliberative communication issuing equality on decision-making in finding collective values and norms (Englund, 2006). So, the pluralism approach fosters acquiring willingness and capacity to engage in arguments, collaborate with others to find weaknesses in their own arguments, and explore their own contributions (Roegholt et al., 1998). It is apparent that pluralistic tradition carries the potential to feed the just and collaborative nature of (urban) circularity, furthering non-natural learning towards natural and multi-dimensional learning that includes different scales of urban environments (local and regional). Even though, as demonstrated, the pluralistic approach constitutes a lank list of benefits for learners to activate their citizenship and to afford circular development, the common lack of collaboration between disciplines/subjects reported by Summers et al. (2005) weakens the distribution of benefits. This results in broken or separate insight acquisition from one discipline/subject perspective.

In other words, even though each tradition (fact-based, normative, or pluralistic) individually contributes to ESD pedagogy, so to the education for (urban) circular development, with its specific tradition, methods, and content, an interdisciplinary –holistic approach is necessary to cover sustainable development as a whole. The holistic approach steps natural learning up toward multi-

dimensional learning in order to help learners to link systems (Eilam & Trop, 2010, Step#3 in **Table 2**); they are either discipline/subject-based, such as ecological, social, and economic domains of sustainable development or social and procurement systems of cities depending on the content/facts introduced at the beginning of pedagogy. Yet, scholars show that the holistic approach is not commonly applied (Summers et al., 2004, 2005; Borg et al., 2012) as it is challenging because it requires extra effort for each tradition to broaden their narrow understanding of sustainable development and engage with immense coordination work between disciplines/subjects while some subjects, such as geography and science, are seen as a potential catalyst for the interdisciplinary work (Summers et al., 2005). Also, collaboration at the school management level is required to complete the holistic approach as an enabler. On this note, the whole school approach, which is a model of school organization, puts importance on the holistic vision of the school on knowledge creation and practicalities to implement ESD as a whole (Mogren et al., 2019). It is reported that interdisciplinary work under the whole school project can cause tensions between teachers over resources and capabilities (Nordén, 2018). At the same time, it brings higher quality and coherence to support ESD pedagogy (Mogren et al., 2019) and possibilities to expand traditional teaching methods with interdisciplinary and action-based methods (Borg et al., 2012), such as debates, interviews, and planning community activities, expanding the learning process with teamwork and collaboration (Eilam & Trop, 2010, Step#4 in **Table 2**).

Through a holistic approach and support for inter-disciplinary collaboration, the methods mentioned above work well upon building on competency to take action comprehensively. The concept of action competence accordingly supports this comprehensiveness and explores the ability of learners/students to acknowledge social factors through a conflict of interest perspective on sustainable development, putting attention to critical thinking (Lundegård & Wickman, 2007). This perspective is advised to be seen from a context that sustainable development is not solely about the relationship between nature and humans but mostly about the relationship between humans (Schnack, 1998). More importantly, building a comprehensive approach through being aware of conflicts of interest, in fact, interprets the competence and differs itself from those linked to individualistic versions, promoting democratic ideas and participatory approaches in teaching /learning (Mogensen & Schnack, 2010).

Awareness of the whole picture of sustainable development supports learners/students in working together for outcomes of shared action if this is furthered by action-based or solution-based learning, pointing out that learners/students can influence their very own future (Gyberg et al., 2020). According to Andersen (2018), action-based learning consists of a thinking process grounded in practical doing through symbolic or real actions to achieve a specific result. This can be achieved through a given task, or learners/students can be encouraged to imagine one. Yet, scholars indicate that the action-oriented approach does not find a prominent space in the ESD context even though it helps students develop skills, such as critical thinking, shaping their personality, and their ideas on sustainable development (Mogensen & Schnack, 2010; Kowasch, 2017; Andersen, 2018). This supports the justification of the necessity of action-based approaches like in the Circular City Challenge project, yet potentially gestates another view of necessary skills not only for learners/students but also for teachers. Therefore, the next section explores the challenges and barriers to ESD in general and, specifically, to the action-based approach in the form of competition in ECD.

- **Challenges to ECD/ESD Experienced by Educators (RQ#3)**

The challenges experienced by teachers are heavily affecting their willingness/effort to implement sustainable development into their curriculum. These challenges can be grouped under four sub-titles; personal, theoretical, pedagogical, and logistical **(Table 3)**.

It was discussed earlier that Interdisciplinary collaboration within an educational institution is required to melt domains of sustainable development (environmental, social, and economic) into one pot. Yet, it is a challenge for different disciplines (Summers et al., 2004). That being the case, challenges may differ between various disciplines/ subjects (Borg et al., 2012), which thickens the barrier against interdisciplinary collaboration. Additionally, next to personal, theoretical, and pedagogical challenges, logistical challenges outweigh others as this involves further collaboration and support. On this note, the management within schools to provide teachers with training and opportunities to work collaboratively is critical (Borg et al., 2012). Furthermore, educators are challenged by time constraints (Kim & Fortner, 2006; Borg et al., 2012), the lack of real-life experiment opportunities (Kim & Fortner, 2006), and the lack of material/adequate textbooks and inspiring examples of how to incorporate sustainable development into the curriculum (Borg et al., 2012; Kim & Fortner, 2006).

Table 3: Challenges and Barriers to ECD/ESD experienced by teachers

Personal Challenges	• lack of perception of the aims of the course adopting sustainability issues (Borg et al., 2012) • lack of willingness (Borg et al., 2012) • worries about not bringing positive emotions (Summers et al., 2003)
Theoretical Challenges	• lack of vision for a sustainable society (Gyberg et al., 2020). • lack of knowledge/understanding about SD topics (Kim & Fortner, 2006; Borg et al., 2012) • different understanding/acknowledgment/beliefs of SD by different disciplines/subjects (Corney, 2006; Kim & Fortner, 2006; Borg et al., 2012, 2014) •
Pedagogical Challenges	• lack of collaboration between disciplines/subjects (Summers et al., 2004, 2005) • lack of necessary expertise/ instructional strategies, such as inquiry-based learning in applying ESD pedagogy (Kim & Fortner, 2006; Borg et al., 2012) • lack of how to handle emotions (Rickinson & Lundholm, 2008; Summers et al., 2003)
Logistical Challenges	• lack of material/adequate textbooks/ inspiring examples on how to incorporate sustainable development into the curriculum (Kim & Fortner, 2006; Borg et al., 2012) • time constraints (Kim & Fortner, 2006; Borg et al., 2012) • no natural environment (real-life experiment) readily available (Kim & Fortner, 2006) • lack of support from the school management or the dominant school climate regarding the use of certain teaching methods (Borg et al., 2012)

Appendices

Appendix 1

Circular Cities				
#	Authors	Title	Year	Source
1	Williams J.	Circular cities	2019	Urban Studies
2	Prendeville S., Cherim E., Bocken N.	Circular Cities: Mapping Six Cities in Transition	2018	Environmental Innovation and Societal Transitions
3	de Ferreira A.C., Fuso-Nerini F.	A framework for implementing and tracking circular economy in cities: The case of Porto	2019	Sustainability
4	Paiho S., Mäki E., Wessberg N., Paavola M., Tuominen P., Antikainen M., Heikkilä J., Rozado C.A., Jung N.	Towards circular cities—Conceptualizing core aspects	2020	Sustainable Cities and Society
5	Williams J.	Circular cities: What are the benefits of circular development?	2021	Sustainability
6	Williams J.	Circular cities: planning for circular development in European cities	2022	European Planning Studies
7	Marin J., De Meulder B.	Interpreting circularity. Circular city representations concealing transition drivers	2018	Sustainability
8	Papageorgiou A., Henrysson M., Nuur C., Sinha R., Sundberg C., Vanhuyse F.	Mapping and assessing indicator-based frameworks for monitoring circular economy development at the city-level	2021	Sustainable Cities and Society
9	Girard L.F., Nocca F.	Moving towards the circular economy/city model: Which tools for operationalizing this model?	2019	Sustainability
10	Gravagnuolo A., Angrisano M., Girard L.F.	Circular economy strategies in eight historic port cities: Criteria and indicators towards a circular city assessment framework	2019	Sustainability
Education for Sustainable Development				
#	Authors	Title	Year	Source
1	Biström, E., & Lundström, R.	Textbooks and action competence for sustainable development: An analysis of Swedish lower secondary level textbooks in geography and biology.	2021	Environmental Education Research
2	Borg, C., Gericke, N., Höglund, H.-O., & Bergman, E.	The barriers encountered by teachers implementing education for sustainable development: Discipline bound differences and teaching traditions	2012	Research in Science & Technological Education
3	Borg, C., Gericke, N., Höglund, H.-O., & Bergman, E.	Subject- and experience-bound differences in teachers' conceptual	2014	Environmental Education Research

		understanding of sustainable development		
4	Summers, M., Childs, A., & Corney, G.	Education for sustainable development in initial teacher training: Issues for interdisciplinary collaboration	2005	Environmental Education Research
5	Eilam, E., & Trop, T.	ESD Pedagogy: A Guide for the Perplexed	2010	The Journal of Environmental Education
6	Roegholt, S., Wardekker, W., & Van Oers, B.	Teachers and pluralistic education	1998	Journal of Curriculum Studies,
7	Kopnina, H., & Cherniak, B.	Neoliberalism and justice in education for sustainable development: A call for inclusive pluralism.	2016	Environmental Education Research,
8	Englund, T	Deliberative communication: A pragmatist proposal.	2006	Journal of Curriculum Studies
9	Mogren, A., Gericke, N., & Scherp, H.-Å.	Whole school approaches to education for sustainable development: A model that links to school improvement.	2019	Environmental Education Research,
10	Summers, M., Corney, G., & Childs, A.	Student teachers' conceptions of sustainable development: The starting-points of geographers and scientists.	2004	Educational Research
11	Nordén, B.	Transdisciplinary teaching for sustainable development in a whole school project.	2018	Environmental Education Research
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