



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

## Educational Research Review

journal homepage: [www.elsevier.com/locate/edurev](http://www.elsevier.com/locate/edurev)

# Early childhood environmental education: A systematic review of the research literature

Nicole M. Ardoin<sup>a,\*</sup>, Alison W. Bowers<sup>b</sup>

<sup>a</sup> *Stanford University, Stanford, CA, USA*

<sup>b</sup> *Virginia Tech, Blacksburg, VA, USA*

## ARTICLE INFO

### Keywords:

Early childhood  
Environmental education  
Systematic reviews  
Nature preschools  
Forest schools

## ABSTRACT

Environmental education focused on the early-childhood years is experiencing dynamic growth in research and practice due to persistent environmental challenges coupled with burgeoning interest in the documented benefits of nature-rich experiences for infants and children. To better understand the landscape of early childhood environmental education (ECEE) pedagogical practices and expected outcomes, we undertook a systematic review of empirical studies of ECEE programs. Focusing on a 25-year span, we surfaced 66 studies that met our inclusion criteria. We found that participants in such programs spanned the early-childhood age range (birth through age eight) with the majority involving three- to six-year-olds in teacher-led, formal (school-like) programs. The primary outcomes documented in our sample studies included environmental literacy development, cognitive development, and social and emotional development. To a lesser extent, the studies addressed physical development and language and literacy development. On balance, our sample of ECEE studies reported strongly positive findings associated with the aforementioned outcomes. The majority emphasized the effectiveness of play-based, nature-rich pedagogical approaches that incorporated movement and social interaction. We include a visualization that synthesizes cross-sample findings with the intention of assisting ECEE practitioners in developing, implementing, and evaluating programs as well as encouraging researchers to further study elements, processes, and theoretical assumptions inherent in them.

## 1. Introduction

Environmental conditions across the globe continue to deteriorate at an alarming pace due to a complex web of social-ecological challenges including, but not limited to, climate change, air and water pollution, ocean acidification, land degradation, and biodiversity loss (Barnosky & Hadly, 2016). Scientists focused on these declining planetary conditions emphasize the importance of healthy, functioning, and resilient ecosystems as essential to all living beings, including humans (UN Environment, 2019). Many note that protecting and restoring the global environment will require transformative changes in human production and consumption-related behaviors, reflecting on individual choices as well as larger-scale, culturally mediated collective action (Mastrangelo et al., 2019; UN Environment, 2019).

\* Corresponding author. Graduate School of Education and Stanford Woods Institute for the Environment, Stanford University, 485 Lasuen Mall, Stanford, CA, 94305, USA.

E-mail address: [nmardoin@stanford.edu](mailto:nmardoin@stanford.edu) (N.M. Ardoin).

<https://doi.org/10.1016/j.edurev.2020.100353>

Received 7 November 2019; Received in revised form 8 June 2020; Accepted 15 June 2020

Available online 10 July 2020

1747-938X/© 2020 Published by Elsevier Ltd.

### 1.1. Environmental education as an approach to address global change

Environmental education represents “an approach, a philosophy, a tool, and a profession” (Monroe, Andrews, & Biedenweg, 2008, p. 205), with the aim of creating an environmentally literate citizenry well-suited to address environment and resource sustainability issues (UNESCO, 1978; Wheaton, Kannan, & Ardoin, 2018a). Through developing attitudes, values, knowledge, dispositions, and skills to undertake pro-environmental actions, environmental education fosters engagement in enhancing the sustainability of human-nature interactions over time (Mastrángelo et al., 2019; Monroe, 2003; UNESCO, 1978). Environmental education is relevant throughout the life course, from infancy through senior citizenship, in formal and nonformal venues (Leal Filho, Mifsud, & Pace, 2018; UNESCO, 1978). Lifelong engagement is particularly important as the scientific and social conditions around environmental and sustainability issues shift, requiring continued critical thinking, engagement, and decisionmaking not only as individuals, but also within communal settings.

### 1.2. Early childhood environmental education

Environmental education has a lifelong impact (Gough, Walker, & Scott, 2001; Otto & Kaiser, 2014; Wals & Benavot, 2017). Yet environmental education researchers and practitioners identify early childhood, defined as ages birth to eight (Copples & Bredekamp, 2009), as a particularly crucial time for developing environmental literacy (North American Association for Environmental Education [NAAEE], 2016; Samuelsson & Kaga, 2008; Wilson, 1996). Numerous studies have associated positive childhood experiences in nature with the nascence of adult environmental concern and participation in environmental behaviors (e.g., Cagle, 2018; Chawla, 2007, 2009; James, Bixler, & Vadala, 2010; Rosa, Profice, & Collado, 2018; Wells & Lekies, 2006). Researchers have also investigated how environmental behavior more broadly (Evans, Otto, & Kaiser, 2018)—as well as its antecedents, such as ecological awareness (Corraliza & Collado, 2019), environmental attitudes (Ewert, Place, & Sibthorp, 2005; Otto, Evans, Moon, & Kaiser, 2019), environmental consciousness (Jørgensen, 2016), and nature relatedness (Phenice & Griffiore, 2003)—begin to develop and form in early childhood.

Given the importance of early childhood in creating a foundation for environmental sensitivity, interest, and behavior later in life, early childhood environmental education (ECEE) is envisioned as a unique form of environmental education, influencing the emergence of various approaches and philosophical orientations (Ernst & Burcak, 2019). Nature-based early childhood programs, for example, can provide direct, nature-rich experiences with a range of objectives, including developing basic appreciation for the natural world (Larimore, 2016; Sobel, 2016; Wilson, 2018) and supporting developmental benefits associated with exposure to nature in young children (Chawla, 2015; Gill, 2014). The latter may include physical benefits, such as increased activity and improved health (cf. Gray et al., 2015; Kondo, Fluehr, McKeon, & Branas, 2018; Müller et al., 2017; Twohig-Bennett & Jones, 2018); cognitive benefits, such as enhanced executive functioning and memory (cf. Dadvand et al., 2015; Schutte, Torquati, & Beattie, 2017); and social-emotional benefits, such as those related to emotional regulation and improved social skills (cf. Bang, Kim, Song, Kang, & Jeong, 2018; Tillmann, Tobin, Avison, & Gilliland, 2018), among others.

Additional approaches and definitions differ slightly in emphasis. Play-based learning emphasizes pedagogical forms of ECEE that extend the educational value of outdoor play experiences (Cutter-Mackenzie & Edwards, 2013; Cutter-Mackenzie, Edwards, Moore, & Boyd, 2014). Other practitioners and researchers have advocated for a transformative and participatory approach, frequently encapsulated by the term “early childhood education for sustainability,” which prioritizes action-taking and children as agents of change (Davis & Elliott, 2014; Samuelsson & Kaga, 2008; Årlemalm-Hagser & Sandberg, 2017). In a report on an international, UNESCO-sponsored workshop on early childhood education and sustainability, Samuelsson and Kaga describe ECEE as “simply taking children outdoors to discover the beauty of nature and speaking about the natural environment” (2008, p. 3).

This review adopts a broader conceptualization, aligning more closely with the NAAEE consortium’s definition of ECEE as an “appropriate and positive process whereby educators can start young children on their journey toward becoming environmentally responsive youth and adults” (NAAEE, 2016, p. 3). We therefore acknowledge and value multiple variants of and approaches to ECEE, including, but not limited to, nature-based early childhood education and early childhood education for sustainability. We believe these, and related approaches, share a common aim of developing a local, regional, and global community of environmentally active people through engaging young children in meaningful, relevant environmental learning experiences (Davis & Elliott, 2014; Wilson, 1996).

### 1.3. Reviews of research in ECEE

Recent reviews of ECEE-related research harbor delimitations and limitations. In line with the nature-based education movement, several of them (e.g., Adams & Savahl, 2017; Chawla, 2015; Gill, 2014) have examined children’s connection to and/or contact with nature, yet have done so considering a broader age range than examined here. Additionally, these reviews have focused on children and nature broadly, including experiences such as exposure to green spaces or free play in neighborhood parks and backyards, rather than planned and/or structured programming.

Other related reviews have examined ECEE programs, although they primarily draw on sustainability terminology. Davis (2009), for example, addressed early childhood education for sustainability; Hedefalk, Almqvist, and Östman (2015) and Bascopé, Perasso, and Reiss (2019) focused on education for sustainable development; and Somerville and Williams (2015) emphasized sustainability education. Green’s (2015) review discusses ECEE and early childhood education for sustainability as distinct, yet related fields, and includes both ECEE- and early childhood education for sustainability-related research with a focus on research methods used with young children.

Despite varying scopes and foci, perspectives and findings from these reviews guided our work, especially with regard to where the “blank, blind, bald, and bright spots” exist in this intersectional area (Reid, 2019, p. 151; Reid & Scott, 2013). Our appraisal of these existing ECEE-related reviews highlighted a need to examine the research base using a broadened conceptualization of ECEE, an early childhood lens, and a focus on ECEE practices and outcomes.

Motivated by the gaps that other reviews highlighted—and in light of persistent questions from practitioners, funders, and collaborators—we undertook a systematic review of the ECEE literature with the intention of researching empirical outcomes related to ECEE programs and practices. In particular, we sought to identify major outcomes and practices of interest in ECEE studies and contextualize our findings in light of broader environmental education trends. The primary research question guiding our review was: In ECEE (focusing on children ages zero to eight), which program practices does the published literature suggest are linked with positive environmental education-related outcomes? To address this question, we first identified intended program practices and outcomes reported in published ECEE research, which led to the identification of two supporting research questions: (a) What *program outcomes* and *associated findings* have been reported in published ECEE research? and (b) What *practices* have been reported in published ECEE research?

## 2. Methods

We adopted a broad conceptualization of ECEE as encompassing those early childhood programs and learning experiences designed with the goal of creating environmentally aware, engaged community members. Throughout our review, our goal was not to emphasize differences and categorizations among a diverse set of ECEE programs, but rather to seek shared ground in the form of practices and outcomes. The perspective that many types of ECEE programs and approaches are effective—and that this diversity affords a range of early childhood experiences globally—guided the design, implementation, and analysis of our review (Adams & Savahl, 2017; Samuelsson & Kaga, 2008).

### 2.1. Systematic review design and search process

We followed internationally recognized guidelines developed by a nonpartisan scientific body, PRISMA, which describes criteria for conducting and reporting systematic reviews and meta-analyses (Moher, Liberati, Tetzlaff, & Altman, 2009; Shamseer et al., 2015). To augment the PRISMA process and account for field-specific perspectives, we incorporated techniques that social science researchers Cooper (2010) and Gough, Oliver, and Thomas (2017) recommend.

We initially used two sets of search terms in seven EBSCOhost academic databases: Academic Search Premier, Africa-Wide Information, British Education Index, Education Full Text, Environment Index, ERIC, and GreenFILE. The first set of terms narrowed the scope to studies focused on early childhood and the second set identified environmental education-related studies (see Table 1). We selected the search terms through review of titles, abstracts, and keywords of articles already identified as relevant; consultation with expert advisors in early childhood and environmental education; and results of exploratory searches. The search terms within each set were separated by the operator “OR” and the two search terms sets were combined using the operator “AND.” We searched for studies published between January 1995 and December 2018, a period aligned in length with published reviews and corroborated by our panel of expert advisors (Table 1 and Fig. 1 detail the process; the latter includes the PRISMA Flow Diagram for the search and screening processes).

We reviewed the publications indexed by the EBSCOhost databases to confirm inclusion of key journals that regularly publish ECEE research. Finding that the database searches did not consistently return results from two journals, *International Journal of Early Childhood Environmental Education* and *Children, Youth and Environments*, we conducted manual table-of-contents reviews for those two journals. Through the manual search process, we added 529 citation records and removed 25 duplicates, leaving a total of 504 unique citation records identified via manual searches of the two journals. The combined results from both search strategies (database and manual journal searching) yielded 1629 total citation records.

### 2.2. Study screening and eligibility

To screen the 1629 citation records, at least two research team members read each abstract and used a decision tree to identify relevant studies based on the following inclusion criteria:

- Focused on early childhood/young children, birth through age eight and/or through third grade within the U.S. educational system;

**Table 1**  
Search terms used in database searches.

Early childhood search terms	Operator	Environmental education search terms
(childcare OR “day care*” OR “early childhood” OR “early elementary” OR “early primary” OR infants OR kindergarten OR “nursery school*” OR preschool* OR “primary grade*” OR toddler* OR “young child” OR “young children”	AND	(“conservation education” OR “education for sustainability” OR “education for sustainable development” OR “environmental education” OR “forest kindergarten*” OR “forest school*” OR gardening OR “nature preschool*” OR “nature-based preschool*” OR “outdoor classroom*” OR “school garden*” OR “sustainability education”)

Note. The asterisk “\*” is a truncation symbol, which directs the search engine to find all forms of a given word. The term *forest school\**, for example, returns results containing “forest school” or “forest schools.”

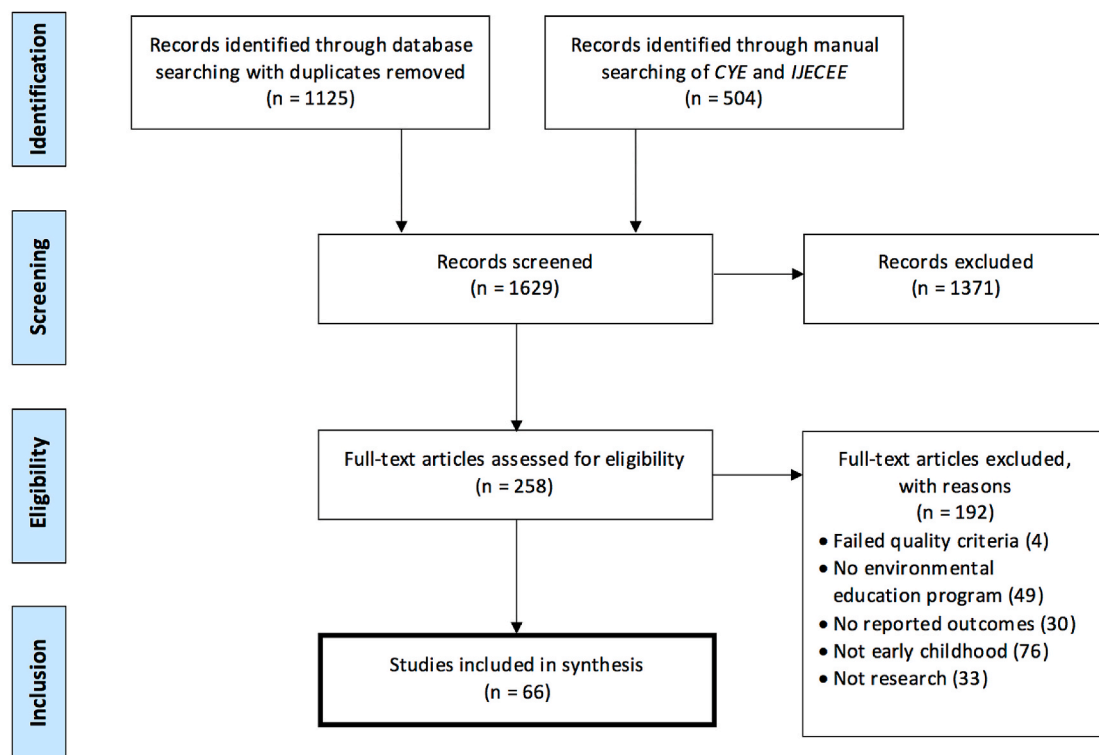


Fig. 1. PRISMA flow diagram, based on Moher et al. (2009).

- Reported on an environmental education experience and/or program. Throughout the review, we included sustainability and conservation education as nearly synonymous with environmental education; we also were broad in our definitions around early childhood-specific terms, such as nature preschools and forest schools; and
- Designed as empirical research or evaluation. This criterion was designed to exclude other reviews as well as long-form discussion pieces focused primarily on theoretical perspectives.

During the first review round, we excluded articles in practitioner-oriented journals, which resulted in eliminating articles intended for classroom teachers, that described classroom activities, or that included detailed lesson plans. We also excluded dissertations, textbooks, and conference presentations unavailable as published resources.<sup>1</sup> Based on reviewing the abstracts, we excluded 1371 citation records, many of which involved children outside of the designated age range, focused on educators rather than children, and/or did not meet other review criteria. We then located the full-text versions for the remaining 258 citations. Next, we focused on eligibility for final inclusion in the review. At least two team members reviewed the full text of those 258 records to confirm that the

<sup>1</sup> Mixed perspectives exist on including dissertations in systematic reviews (e.g., Hartling et al., 2017; Moyer, Schneider, Knapp-Oliver, & Sohl, 2010). Upon weighing these perspectives and based on our past systematic-review experience, we did not include dissertations for several reasons: First, the databases we searched did not consistently include dissertations thus indicating that any inclusion would require inconsistent decision-making on the part of the review team. Second, dissertations are often composed of previously published journal articles or later transformed into journal articles; thus, a review risks double-counting a particular study or including it in its penultimate state.

articles met the previously described first-round inclusion criteria. After reviewing full-text versions of the 258 citation records, we excluded 192 for failing to meet the initial inclusion criteria.

### 2.3. Quality appraisal

We devised and applied a generic framework (i.e., we did not apply different quality criteria for quantitative, qualitative, or mixed-methods studies), which relied on expert judgement and a set of predefined quality criteria. This quality-appraisal approach was informed by several review factors: The search process identified studies with varied research designs (i.e., qualitative, quantitative, and mixed-methods approaches). We employed an expert panel to provide external feedback throughout the process; our review team included research methodologists and members with prior experience conducting systematic reviews. Our predefined quality criteria included ensuring that studies provided relevant program descriptions, basic information about research methods and data, and sufficiently detailed findings. We selected these criteria as our review was designed to be configurative, rather than aggregative, focusing on identifying common practices and outcomes in ECEE.<sup>2</sup> Additionally, although we recognize that the peer-review process is at times inconsistent, we chose to include only peer-reviewed studies in our final sample, as that process suggests that some level of quality appraisal had been conducted.

Using a decision-tree process similar to that of the screening-and-eligibility process described above, at least two research team members reviewed each of the 70 studies, addressing quality-related elements; in this manner, all studies were assessed at least twice (National Institute for Health and Clinical Excellence, 2012). In addition to asking each reviewer for an overall impression of study quality, we applied two study-quality-related eligibility criteria. Specifically, we sought studies that: (1) sufficiently described research methods and measures as well as data-collection tools/instruments, and (2) presented clear-cut data to support claims. The research team met to discuss opinions and evaluation of quality for each study and ensure consistent application of the quality criteria. During the quality review, team members agreed on four studies that did not meet the quality criteria. The final sample included 66 studies (65 peer-reviewed articles and 1 peer-reviewed conference paper).

### 2.4. Data analysis

The 66 studies in our final sample represented a variety of research designs that produced qualitative and quantitative data; thus, we employed a mixed research synthesis review approach (Heyvaert, Hannes, & Onghena, 2017; Sandelowski, Voils, & Barroso, 2006). To guide data extraction, we developed a codebook that named and described the major coding categories of interest and provided sample codes (Miles, Huberman, & Saldaña, 2014; see Table 2). When possible, we used *in vivo* coding, extracting exact wording, leading to the development of new codes (Saldaña, 2016). This inductive technique did not limit coders to predetermined codes and facilitated capturing unexpected data (Charmaz, 2014).

Team members pilot-tested the codebook, resolved discrepancies through group discussion, and reached 100% agreement on coding decisions before proceeding to fully code the comprehensive set of studies. To do so, we used an iterative process, facilitated through NVivo 12 (a qualitative data analysis software), modifying the codebook based on emergent trends. We added, revised, and rearranged codes until reaching a saturation point (i.e., no new codes were generated). In initial rounds of coding, for example, we assigned codes to describe the program setting, such as a preschool or local park. In subsequent rounds, we noticed patterns related to whether the setting included an outdoor component; we therefore revised the setting category to note inclusion of an outdoor component.

Where appropriate, we used counting to aggregate the data, which allowed us to identify trends in the data (Miles et al., 2014). With publication year, for example, we coded and counted the data categories by year (e.g., 2000, 2001, and so on), using a combination of NVivo and Excel to manage the process across the dataset. We also used counting for publication outlet, research type, country, participant age(s), facilitator, program length, program travel, program setting, and overall findings. Those data provided a general description of the programs included in the final sample.

To analyze data in the remaining categories of outcomes and practices, we used a modified grounded theory approach (Corbin & Strauss, 2015) to identify core categories. In initial coding rounds, we identified all reported outcomes and practices. As coding progressed, we grouped outcomes and practices into broader categories. For coding outcomes, we used a combined inductive and deductive approach, first allowing codes to emerge, then applying a five-outcome framework based on the U.S.-based National Association for Education of Young Children (NAEYC; Copple & Bredekamp, 2009) and NAAEE's (2016) ECEE outcomes. Four of the outcomes (physical development, social and emotional development, cognitive development, and language and literacy development) are delineated in NAEYC's *Developmentally Appropriate Practice in Early Childhood Programs* (Copple & Bredekamp, 2009) and the fifth outcome of environmental literacy development was drawn from the NAAEE's ECEE guidelines. Later rounds of coding of practices remained inductive as we privileged emergence over predefined practices associated with specific ECEE approaches. To illustrate, we coded specific participant outcomes of science learning and mathematical concepts more broadly as *Cognitive Development*. For practices, we created an emergent category of *Social Interaction*, to which we coded small group work and group discussion. In this way, broader categories emerged from what were initially small groupings.

<sup>2</sup> A configurative approach to systematic reviews often translates to researchers emphasizing and being more concerned about "the richness of data than bias" (Gough, Oliver, & Thomas, 2012, p. 67).



**Table 2**  
Selected initial coding categories.

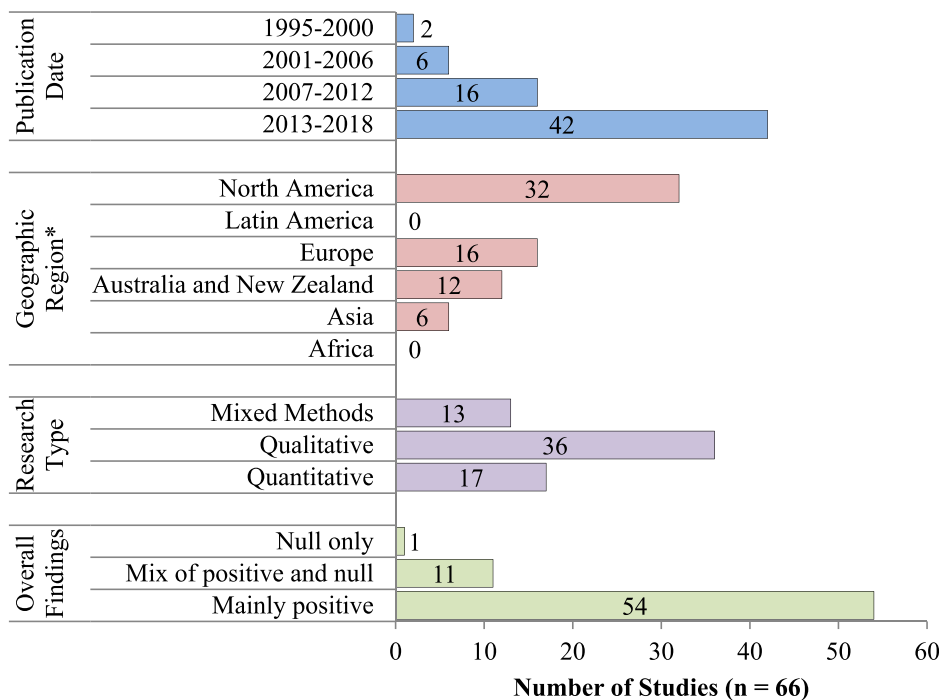
Coding category	Explanation	Examples (codes)
Country	Name of country where the study takes place	Australia, Finland
Facilitator	Description of who led or guided the program	preschool teacher, museum staff
Participant ages	Description of the ages of the participants.	six-year-olds, second graders
Program length	Description of how long the program lasted	30 min, 1 h each day for two weeks, unknown
Program setting	Type of locale where the program took place	preschool, park, museum
Publication outlet	Journal in which study was published	<i>Journal of Environmental Education, Early Childhood Education Journal</i>
Publication year	Year in which study was published	2000, 2016
Reported outcomes	Type of student outcomes reported by the authors	environmental knowledge, attitudes
Research type	Type of research conducted based on methods and data	quantitative, qualitative, mixed methods
Overall findings	Overall general level of outcomes reported	positive, mixed, null

### 3. Results

#### 3.1. Study characteristics

The 66 studies in the final review sample were published in 26 journals and one set of conference proceedings, all but three of which (*International Journal of Environmental Health Research; Urban Forestry & Urban Greening; and Water, Air, and Soil Pollution*) had an education, environmental education, or child-development focus. (Appendix A lists each of the 66 final-sample studies, including full bibliographic information and selected coding details; it also contains a table with the 27 publication outlets of the 66 studies.) Within our 24-year search period (1995–2018), none of the papers in our sample were published before 2000 and only eight (12%) were published in the first half of that time span (1995–2006). Fifty-eight studies (88%) were published between 2007 and 2018, with over half of the final sample (42 studies, 64%) published in the most recent six-year period of 2013–2018. (See Fig. 2 for a summary of study characteristics.)

Of the 66 studies, North America was the most heavily represented in the geographic distribution with 25 (38%) examining programs that occurred in the United States and seven (11%) in Canada. A substantial number of European countries also appeared in the sample (16 studies, 24%), although each individual country (namely, the Czech Republic, Greece, Iceland, Norway, Sweden, United Kingdom) was addressed in four or fewer studies. Australasia was heavily represented in the sample, with 8 (12%) studies highlighting programs in Australia and 4 in New Zealand (6%). Six studies (9%) reported on programs in Asian countries (Turkey,



**Fig. 2.** Study characteristics of the reviewed studies.

\*For geographic region, we followed the United Nations Statistics Division (2020) categories, although we separated North and Latin America for enhanced granularity of comparison.

Jordan, Laos, and Taiwan). None of the sample studies described programs in Latin America or Africa. (See Section 4.1 for discussion of this finding.)

We coded 36 of the studies (55%) as primarily focusing on qualitative data, 17 (26%) on quantitative data, and 13 (11%) used mixed-methods approaches to produce both qualitative and quantitative data. With regard to valence of overall findings, we coded 54 studies (82%) as reporting mainly positive findings, 11 (17%) as reporting a mix of positive and null findings, and 1 (2%) as reporting only null findings (i.e., no change in the measured outcomes). We did not code any studies as reporting mainly negative findings.

### 3.2. Program characteristics

The 66 studies in our sample involved programs whose participants spanned the early childhood age range. Although the

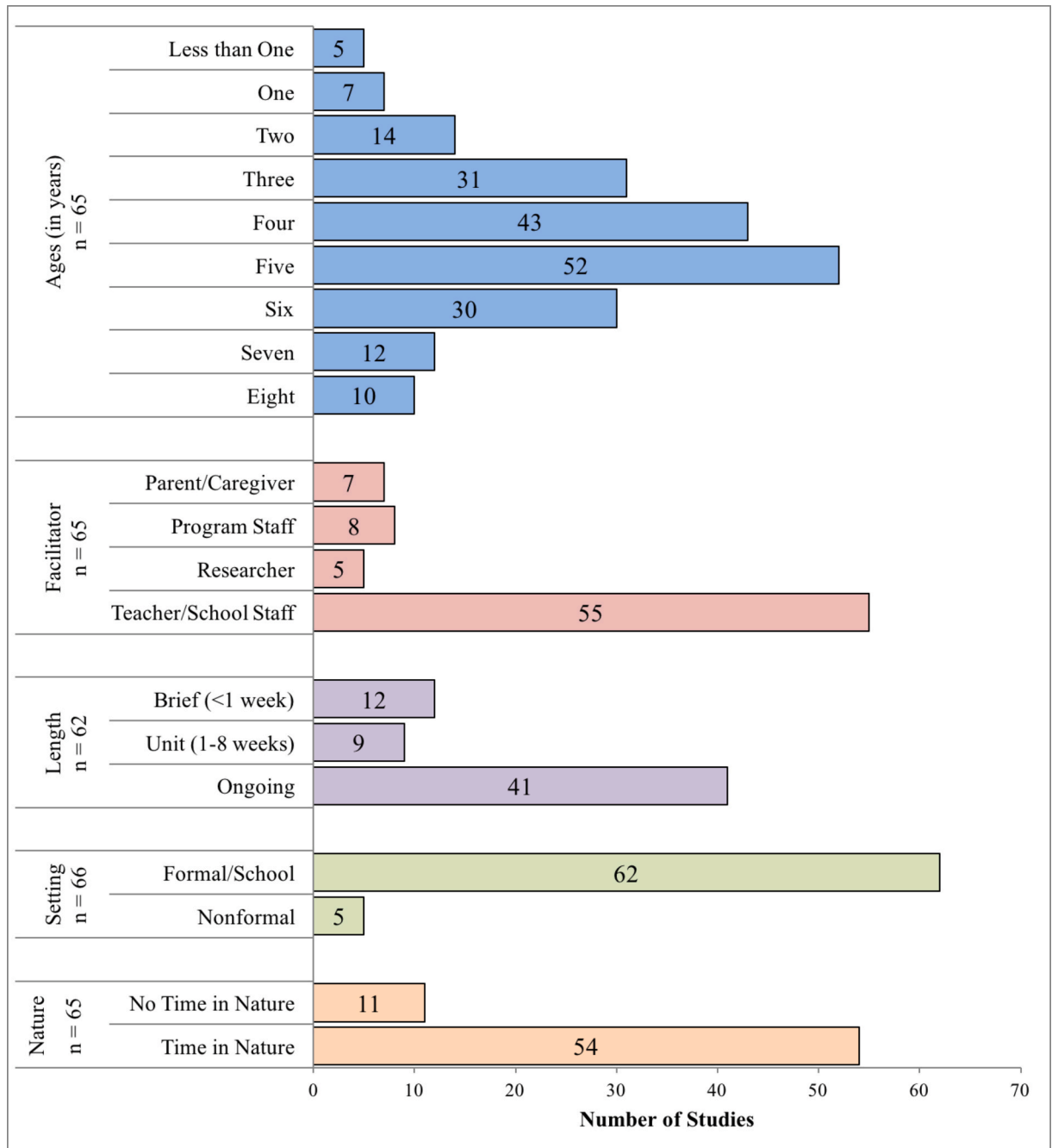


Fig. 3. Program characteristics of the reviewed studies.



distribution across studies approximated a normal curve, the most common age of focus was four- and five-year-olds. (See Fig. 3 for a summary of characteristics associated with the programs investigated in the 66 final-sample studies.)

Nearly all of the studies included information about who facilitated, or led, the environmental education programs. In some cases, programs included multiple types of facilitators, such as teachers working alongside parents and researchers. The largest proportion of programs (55 studies, 85%) were led by teachers and other school staff. Eight studies (12%) described programs in which environmental education program staff either came to the early childhood center to present a program, or the students and their teachers traveled to participate in a program led by program-provider staff. In seven of the studies (11%), researchers reported that parents or other caregivers participated as facilitators. In five studies (8%), researchers assisted with implementing the program.

Of the 66 studies, 62 provided information about program length. Twelve (19%) focused on one-time programs that ranged in length from 30 minutes to 6 hours. Nine studies (15%) focused on programs implemented over a one- to eight-week period, often as part of a curricular unit. Forty-one studies (66%) involved environmental education programs that were ongoing throughout the school year and described as an integral part of the formal curriculum, such as schools with daily outdoor play programs, forest schools, nature kindergartens, or an integrated environmental curriculum.

To the extent possible, we extracted data about program setting, such as whether the program occurred as part of a school or daycare experience (formal setting) or related to a museum, park, or visit not otherwise included in a structured school/daycare experience (nonformal setting). The majority of studies (62, 94%) examined a formal ECEE program that occurred onsite at a school, daycare, or early childhood education center; only five studies (8%) described programs occurring in a nonformal setting.

We considered whether programs under study involved the children spending time outside and/or in nature-rich settings. Of the 66 studies, the majority (54, 83%) examined programs that included time outside in a natural environment, a nature-rich setting, or an environment with a preponderance of nature-inspired features. Eleven of the studies (17%) described primarily indoor programs.

### 3.3. Reported outcomes and practices

We developed five broad coding categories for participant outcomes based on NAEYC (Copple & Bredekamp, 2009) and NAAEE (2016) frameworks: *Environmental Literacy Development*, *Cognitive Development*, *Social and Emotional Development*, *Physical Development*, and *Language and Literacy Development* (see Table 3). In the articles we reviewed, the most frequently reported outcomes were related to the category of *Environmental Literacy Development*, which was evident in 50 (76%) studies. Examples in this area include outcomes such as environmental cognition, attitudes, and behaviors. Thirty-five studies (53%) reported outcomes other than, or in addition to, those emphasizing *Environmental Literacy Development*, such as *Cognitive Development* (25 studies, 38%), which included cognitive functioning, academic content, and creativity; *Social and Emotional Development* outcomes (25 studies, 38%), which included social-skills development, self-regulation, and sense of autonomy; and *Physical Development* outcomes (14 studies, 21%), such as increases in level of physical activity and physical skills. Only six studies (9%) reported *Language and Literacy Development* outcomes, including language skills and language concepts.

During the initial coding process, we found that researchers described evidence of more than 150 pedagogical practices associated with effective ECEE programs among the 66 studies. Researcher-described effective pedagogical practices included a range of engagement types and settings from highly active and immersive (e.g., hiking outdoors), to reflective (e.g., creating drawings), to analytical and synthetic (e.g., guided in-class discussions). We organized the 150 coded practices into nine thematic codes that described ECEE strategies supporting development of the desired outcomes. These emergent codes were: *Time in Nature*; *Play and Movement*; *Knowledge and Skill Development*; *Social Interaction*; *Creative Arts*; *Time to Reflect, Think, and Observe*; *Action Taking*; *Family Connection*; and *Personal Connection* (see Table 4).

## 4. Discussion

We systematically reviewed the ECEE research literature guided by the following parameters: the time frame between 1995 and 2018, studies published in English, and an age range of birth through age eight. The process surfaced 66 peer-reviewed studies (65 journal articles and 1 conference paper), which reported on empirical examinations of outcomes associated with such programs. After reviewing our sample's literature, we synthesized the findings and, in this section, discuss resulting trends and implications emerging from that synthesis. We emphasize relevance to researchers and practitioners working at the nexus of early childhood and environmental education, connecting our findings with prior research in this domain.

### 4.1. Overview of ECEE research

Historically, environmental and sustainability education scholars, as well as practitioners, have noted a paucity in the ECEE space, leading to calls for additional emphasis in this area (Davis, 2009). Perhaps in response, more recently a documented uptick has occurred in the number of ECEE programs overall and in related research (Hedefalk et al., 2015; NAAEE, 2017; Somerville & Williams, 2015). Our findings confirm both the initial dearth of published, empirical ECEE research and the more recent upswing in research and practice. Although our search examined the timeframe for studies published between 1995 and 2018, our final sample retained no studies published prior to 2000 as none met our overall analytic inclusion criteria. The earliest studies in our review sample were published in 2000 ( $n = 2$ ), with the majority of the 66 studies ( $n = 42$ , 64%) being published between 2013 and 2018, representing the most recent six-year period of our date range.

This increase in published ECEE research may reflect an expansion in practice as well as in research. Nature-based preschools and

**Table 3**  
Outcomes reported in ECEE studies.

Outcome category and definition <sup>a</sup>	Number of studies reporting (% of overall sample) <sup>b</sup>	Sample subcategories
<i>Environmental Literacy Development</i> : Development of environmental knowledge; understanding, attitudes, skills, and behaviors to inform decisionmaking processes related to active care-taking of the environment	50 (76%)	Environmental cognition Environmental attitudes Environmental behavior Civic-related skills
<i>Cognitive Development</i> : Development of thinking and executive functioning skills as well the acquisition of declarative knowledge (e.g., math and science learning)	25 (38%)	Cognitive functioning Math and science learning Creativity
<i>Social and Emotional Development</i> : Development of social skills, self-regulation skills (e.g., emotional and behavioral control), and emotional understanding and empathy	25 (38%)	Social skills Self-regulation Sense of autonomy
<i>Physical Development</i> : Development of fundamental fine and gross motor skills, as well as attitudes, competencies, and habits to support physical health and wellbeing	14 (21%)	Physical skills Physical activity
<i>Language and Literacy Development</i> : Development of language and communication skills, including acquisition of vocabulary and listening, speaking, reading, and writing skills	6 (9%)	Language concepts Language skills

<sup>a</sup> Category names and definitions adapted from Copple and Bredekamp (2009) and NAAEE (2016, 2019).

<sup>b</sup> In order of decreasing frequency ( $n = 66$ ).

**Table 4**  
Thematic categories of pedagogical practices reported in ECEE studies.

Practice category	Number of studies (% of overall sample) <sup>a</sup>	Example of practices associated with category
<i>Time in Nature</i>	50 (76%)	Visiting a natural area Gardening Playing with natural materials
<i>Play and Movement</i>	38 (58%)	Allowing children to play freely Engaging in imaginary play Incorporating movement
<i>Knowledge and Skill Development</i>	28 (42%)	Collecting and analyzing data Working within a theme Solving problems
<i>Social Interaction</i>	24 (36%)	Working in small groups Discussing with classmates Sharing findings
<i>Creative Arts</i>	21 (32%)	Creating artwork Watching a puppet show Singing songs
<i>Time to Reflect, Think, and Observe</i>	20 (30%)	Observing nature Journaling Reflecting on feelings
<i>Action Taking</i>	11 (17%)	Recycling Making an action plan Planting trees
<i>Family Connection</i>	11 (17%)	Sharing experiences with family Conducting a family project Suggesting family activities
<i>Personal Connection</i>	11 (17%)	Connecting to existing knowledge Sharing personal experiences Emphasizing local ways of knowing

<sup>a</sup> In order of decreasing frequency ( $n = 66$ ).

kindergartens have proliferated in the last two decades, at least in the U.S. context (NAAEE, 2017). Relatedly, a review of the represented journals indicates increased scholarly focus and interest from both the early childhood education (e.g., *Early Child Development and Care* and *Early Childhood Education Journal*) and environmental education (e.g., *Environmental Education Research* and *Journal of Environmental Education*) angles. We also noted a growing number of studies published in intersectional journals representing the nexus of these fields, such as the *International Journal of Early Childhood Environmental Education and Children, Youth, and Environments*. Such trends in practice and research may reflect expanded recognition of the importance of early childhood developmentally, as well as the importance of environmental education behaviorally and societally, in addition to a growth of the overlapping space between the two.

In previous environmental education research reviews focused on K–12 audiences, scholars found that a majority of the studies examined U.S.-based programs (Ardoin, Bowers, Roth, & Holthuis, 2018; Stern, Powell, & Hill, 2014). Yet ECEE research indicates a more international focus in this sector of the field: fewer than half of the final-sample studies address U.S.-based programs (38%, 25 studies), while many focus on ECEE programs in Europe (16, 24%) or English-speaking countries with a European educational legacy (Canada, 7, 11%; Australia and New Zealand, 8, 12%; see Fig. 2). This geographic distribution likely reflects the European continent's lengthy history of play-based, outdoor, and nature-focused education. Numerous researchers have documented the philosophy of, for example, forest schools, which are grounded in the Scandinavian *friluftsliv* tradition (cf. Bentsen & Jensen, 2012; Knight, 2013; Maynard, 2007). Related educational structures, such as open-air schools, built on philosophical orientations of health and wellness, gained in popularity as a way to escape illness in the early 20th century (Bryder, 1992). Thus, the preponderance of research derived from and grounded in the European context is not surprising.

In terms of research design, more than half of the studies ( $n = 36$ , 55%) in our sample were coded as primarily qualitative in nature. Although Ardoin et al.'s (2018) review of environmental education with K–12 students reported more quantitative studies throughout the grade range, Green's (2015) review, which specifically focused on the early childhood range, documented more studies with a qualitative focus, aligning with our finding in this sample. Other early childhood researchers also corroborate this emphasis, acknowledging that approaches producing qualitative data are particularly appropriate when assessing processes and measuring outcomes with younger audiences (Farrell, Kagan, & Tisdall, 2015; Greig, Taylor, & MacKay, 2013).

Overwhelmingly, researchers presented strong cases individually—and even more convincingly, collectively—for positive findings associated with ECEE programs across a range of outcomes. Those positive findings warrant some caution in interpretation, however: Other environmental education reviews have also noted a bias in terms of studies reporting positive impacts, suggesting that an overrepresentation may occur as researchers are hesitant to publish negative, or even null, findings (Ardoin et al., 2018; Stern et al., 2014; Williams & Dixon, 2013). As such, a similar overrepresentation of positive findings occurs in other disciplines and areas of study as well; this is, thus, an issue not only in the environmental education field (Dwan, Gamble, Williamson, & Kirkham, 2013; Moher et al., 2009). We therefore echo past calls for publishing null and negative findings (Franco, Malhotra, & Simonovits, 2014; Stevenson et al., 2019; Torgerson, 2006).

#### 4.2. Understudied ECEE programs

The most frequently studied ECEE programs involved children in the four- and five-year-old age ranges participating in ongoing, educator-facilitated programs that included time in nature-rich settings and occurred in a formal setting, such as a school, daycare, or early childhood center. Although this general picture emerged, diversity existed in our sample suggesting ECEE variations that may be in need of additional study; we highlight those areas below.

Examining the data concerning participant age revealed a close-to-normal distribution with children ages four and five being the most frequently studied age group (see Fig. 3). In many countries, children in this age group are attending school for the first time, either as part of a preschool or kindergarten experience, or as part of their first year in primary school. Given the importance of this age as many children are transitioning into formal schooling, it is not surprising that this is a well-studied age group; however, early childhood's early (birth through age two) and later (ages seven through eight) years represent areas in need of further environmental education-focused research. The infant and toddler stages (birth through age two) can be difficult to study using traditional research approaches because of a lack of language skills as well as their still-nascent, yet developing, psychomotor abilities. Taken together, these can greatly limit programmatic outcomes as well as measurement approaches. This age, however, also represents a foundational period for environmental identity where a lack of positive nature-rich experiences can lead to mistrust or fear of the natural environment (Green, Kalvaitis, & Worster, 2016). On the opposite end of the early childhood age spectrum, our review surfaced little research focused on those entering middle childhood (ages seven and eight). In their review of K–12 environmental education, Ardoin et al. (2018) documented a research focus on students ages nine and older, with the fewest studies examining students ages five to eight. Our review suggests that an interest in kindergarten and school readiness (ages four to six) may have led to a recent research focus on this age group, but older children (ages seven to eight) remain an understudied population.

Across our sample, teachers or other school staff were the most common facilitators of ECEE programs, with parents, program staff, and researchers also serving as program leaders. The finding that teachers and school staff served as facilitators in 83% of the studies ( $n = 55$ ) underscores the need for inclusion of ECEE content in teacher and administrator preparation programs. Our finding that 62 of the studies (94%) examined programs in a formal setting also highlights an opportunity to study ECEE programs that occur in settings where formally trained teachers are not involved. Although teacher-facilitated ECEE programs and experiences occurring in a preschool, early childhood center, or daycare are clearly important, equally deserving of attention are the day-to-day interactions that occur between children and families or other primary caregivers (Ranson & Rutledge, 2005; West, 2009). In one of the few studies involving parental interaction in a nonformal setting, Cameron-Faulkner, Macdonald, Serratrice, Melville, and Gattis (2017) investigated parent-child interactions that occurred in a park and visitor center. They found that direct experiences with nature resulted in parents and children using a wider variety of nature terms during interactions. Further research focusing on the environmental learning aspects of familial interactions in nature-rich settings provides a great opportunity to deepen understanding of ECEE in places of situated everyday-life learning, which is impactful, relevant, and immediately applicable (Jarvis, 2009).

#### 4.3. Prioritizing both environmental and non-environmental ECEE outcomes

Prior environmental education research reviews (e.g., Leeming, Dwyer, Porter, & Cobern, 1993; Stern et al., 2014; Thomas, Teel,

Bruyere, & Laurence, 2019; Zelezny, 1999) have focused nearly exclusively on environmentally related outcomes such as environmental knowledge, understanding, attitudes, and behavior; nature connection; and ecological improvement. (For exceptions, see Ardoin et al., 2018, and Williams & Dixon, 2013). The studies reviewed here certainly evidenced environmentally related outcomes, with the most popular reported outcome being that of environmental literacy development. However, more than half of the reviewed studies (53%,  $n = 35$ ) also reported on non-environmentally related outcomes of cognitive development, social and emotional development, physical development, and language and literacy development. By comparison, in a review of K–12 environmental education programs, 91% of the 119 studies reported environmental outcomes and only 34% included non-environmental outcomes (Ardoin et al., 2018). These data suggest that either (1) researchers focusing on ECEE programs are more likely to address and focus on non-environmentally related outcomes than their K-12 counterparts; or (2) ECEE programs, overall, are more likely to pursue alternative, non-environmentally related outcomes. One explanation, in light of the growing body of evidence demonstrating the social and physiological benefits of time in nature-rich environments, is that ECEE programs are leveraging critical early-childhood developmental stages and processes related to cognition, physical health, wellbeing, moral development, social skills, and more (Chawla, 2015; Jordan & Chawla, 2019; Kuo, 2015; Schutte et al., 2017; Wells & Lekies, 2012).

Holistic or whole child development is a key tenet that early childhood education (Copple & Bredekamp, 2009) and ECEE (NAAEE, 2016; Wilson, 2018) share. Early childhood educators design and implement pedagogical approaches with a goal of encouraging growth and development across multiple, interrelated domains. This can complicate ECEE program evaluation and assessment as researchers and evaluators endeavor to characterize and measure across domains. In our 66-study sample, we found some researchers attempted to measure outcomes across different categories and domains, representing a combination of the traditional early childhood focus on physical, social, emotional, and cognitive development (Copple & Bredekamp, 2009) in addition to environmental outcomes (i.e., those resulting in environmental protection and improvement). In an evaluation of U.K. forest schools for children ages five to nine, for example, researchers focused on changes in social, communication, and physical skills; self-confidence; and concentration. They also reported on changes in environmental knowledge, understanding, and attitudes (O'Brien & Murray, 2007). Other studies reported on outcomes from a single outcome category, but likely did so for reasons other than believing the ECEE program resulted in a single outcome type. In a study comparing nature-based and traditional schools in Canada, for example, researchers focused on a single domain (physical development) as they examined levels and types of physical activity among five- and six-year-olds in nature kindergartens (Meyer, Müller, & Macoun, 2017). Although the study emphasized physical development outcomes, the researchers acknowledged a range of possible nature-kindergarten benefits, including social and cognitive development.

#### 4.4. Time in Nature and Action Taking as common, unifying ECEE practices

Our main research question examined which ECEE practices were reported as being linked with positive, desired outcomes. Both the NAEYC's Position Statement on Developmentally Appropriate Practice (Copple & Bredekamp, 2009) and the NAAEE's (2016) guidelines for ECEE address and acknowledge seven of the nine identified practices: *Play and Movement*; *Knowledge and Skill Development*; *Social Interaction*; *Creative Arts*; *Time to Reflect, Think, and Observe*; *Family Connection*; and *Personal Connection*.

The practice of *Time in Nature* is a focus of NAAEE's guidelines for early childhood environmental education (2016), although NAEYC's guidelines (Copple & Bredekamp, 2009) do not emphasize the practice. Relatedly, neither the NAYEC nor NAAEE ECEE guidelines emphasize *Action Taking* as a practice. In this section, we discuss both *Time in Nature* and *Action Taking* as these are the two practices that received the most attention in the review sample.

*Time in Nature* is emphasized in certain nature-based approaches to ECEE (NAAEE, 2016; Wilson, 2018). Ernst and Burcak (2019), for example, suggest that nature play can positively contribute even to approaches such as early childhood education for sustainability, which traditionally have been less apt to embrace nature play as a pedagogical approach or core strategy. At the same time, NAEYC's position statement on developmentally appropriate practice (Copple & Bredekamp, 2009) does not emphasize time in nature, suggesting perhaps that, at least in the U.S. context, early childhood educators and researchers may not envision time in a nature-rich environment as essential to high-quality, developmentally-appropriate early childhood education. References to the outdoors in the NAEYC guidebook based on their position statement on developmentally appropriate practice (Copple & Bredekamp, 2009) are infrequent and, when made, are usually associated with outdoor play and its benefits for gross motor development. This gap suggests an opportunity for professional development and education of caregivers, policymakers, parents, and others who can impact today's ECEE infrastructure. Continuing to educate, encourage, and support decisionmakers at the macro- and micro-scales by providing high-quality, carefully designed and implemented, rigorous research that documents a range of benefits of time spent in nature-rich settings, particularly in guided learning activities, is crucial.

Concurrently, it is essential to assist key stakeholders, such as policymakers and supervisors, and influential implementers, such as educators, in understanding and embracing the complex influence of a range of nature-rich settings on young people. As Adams and Savahl (2017) noted, not all children and educators have equal access to safe, clean, nature-rich areas that provide opportunities for enriching educational experiences. In certain places, simply "going outside" or finding a proximal nature-rich context may be difficult, or may not create a platform for a universally positive experience. To address such challenges, daycare center staff in Australia, for

example, worked with researchers to develop an arts program drawing on nature-inspired themes and incorporating natural materials into ongoing activities to provide children with consistent nature exposure, even when outdoor space was lacking (Tarr, 2008). In these ways and others, the role played by nature and nature-rich experiences can be enhanced even when teaching and learning indoors, or with limited access to nature.<sup>3</sup>

*Action Taking*, another key pedagogical practice identified in many of the studies, is not emphasized in either the NAEYC (Copple & Bredekamp, 2009) early childhood guidelines or the NAAEE (2016) ECEE guidelines (although taking age and situationally appropriate action is included as an important part of ECEE approaches such as early childhood education for sustainability) (Davis & Elliott, 2014; Samuelsson & Kaga, 2008; Årlemalm-Hagser & Sandberg, 2017). The NAAEE ECEE guidelines, rather, focus on building a foundation for action-taking, even though other NAAEE guidelines highlight opportunities to develop action skills and complete action projects (e.g., NAAEE, 2019). Yet, 11 studies in the review sample (17%) described programs where action-taking was an important pedagogical practice. Researchers reported that, as part of ECEE programs, young children's actions included designing a garden plan (Cincera et al., 2017), educating others about water conservation (Davis, 2005), recycling (Duhn & Ritchie, 2014), and planting native plants (Lewis, Mansfield, & Baudains, 2010).

Just as Ernst and Burcak (2019) suggested integrating nature play into education for sustainability for young children, perhaps there is a case for incorporating components of education for sustainability into nature-based ECEE: identifying common practices that help accomplish ECEE's primary goal of developing an environmentally literate citizenry, regardless of affiliation with a particular pedagogical or strategic approach, motivated this review. *Time in Nature* and *Action Taking* represent common, emergent practices that are impactful, yet not always prioritized in existing early childhood guidelines.

#### 4.5. Limitations, delimitations, and future research

Early in the review process, we necessarily defined our research questions tightly and constrained our search, resulting in a narrowing of the study's scope to focus on outcomes associated with birth through age eight. Yet environmental education outcomes can, and often do, reach an audience far beyond the participants. In our studies, for example, we encountered measured outcomes specific to the early childhood educators, families of the young children, and the educational institutions. As those audiences were beyond this review's scope, we did not code for those outcomes, but we recognize that they, too, are important and worthy of future study.

We also note geographical limitations in this study and analysis: Our review sample did not include studies from Latin America and Africa, as our systematic approach did not uncover studies in those areas that met our criteria (i.e., empirical, participant outcomes, published in English). We necessarily limited our search to English-language studies as a practical consideration based, first, on readily available articles and papers, and second, the research team's linguistic competency. This delimitation certainly caused us to miss relevant research, and the lack of studies from areas such as Central and South America may reflect a structural barrier (e.g., linguistics), rather than the amount of research (or lack thereof) conducted in those areas.

Bascopé et al. (2019), for example, published a review of education for sustainable development with an early childhood focus. The article discusses themes, trends, and studies in Latin America and considers journal articles published in both English and Spanish. Their review, however, does not separate the reviewed articles by language or geographic location; thus, the details provided are not granular enough to include in our sample. Alternatively, our study sample represents regions where ECEE is a more frequent practice due to a variety of factors. Regardless of the particular reasons for which studies from Latin America and Africa did not surface in our review, the implication is that more ECEE research in Latin America and Africa should be encouraged and shared in a wider venue, thus developing a comprehensive understanding of ECEE research across such settings and worldwide.

Our discussion of the findings surfaced several additional areas requiring future research. More research is needed with very young children (birth through age two), as this is an underrepresented age group in our sample. Similarly, additional research with children at the opposite end of the early childhood range (ages seven through eight) shows a dearth.

We also highlighted a need for ECEE research into programs that occur in less-structured, nonformal learning environments. Moreover, we note a particularly vibrant opportunity for enhanced early childhood environmental learning in the course of everyday life, mediated by familial or caregiver-child interactions. Our search process uncovered few such studies, although this may have been a reflection of our search terms: many researchers and practitioners do not envision caregiver-child or familial interactions in the outdoors or nature-rich settings as examples of "environmental learning," *per se*, regardless of content or skills developed. Yet perhaps these socioculturally embedded interactions—reimagined to more richly contextualize, mark, and connect environmental learning with relevant daily-life activities—could become a consistent, more commonly recognized and studied aspect of the ECEE ecosystem (Jarvis, 2009; Wheaton, Kannan, & Ardoin, 2018b).

## 5. Conclusion

Our review suggests that ECEE encourages young children affectively, in terms of exploring the environment, bolstering their sense of self-confidence, and making social connections with each other; developing cognitive frameworks for understanding the natural

<sup>3</sup> During the 2020 COVID-19 "shelter-in-place" orders and quarantines, many educators, researchers, and caregivers are seeking, discussing, and celebrating opportunities to "bring the outside in," drawing on strategies long-used in various ECEE settings (see, for example, Fitzgerald, 2020). Although research has yet to document the impact of the sudden global transition of learning outdoors in large groups to learning indoors as well as in smaller groups, future studies are certain to focus on the impacts of this kind of "accessible nature."



world; and laying the groundwork for skills and dispositions related to taking action to improve and protect the environment. Our review sample studies describe programs focusing on trees, water, and nature more generally; many take place in immersive, nature-rich settings, while others bring nature-rich elements into classrooms. The programs include a range of outcomes designed to nurture children's development of action skills and encourage developmentally appropriate pro-environmental behaviors. In addition to an environmental focus, the reviewed studies indicate that ECEE programs emphasize related early childhood goals of personal development as well as academic progress (e.g., in the form of kindergarten readiness).

Our sampled studies provide evidence of strongly positive outcomes from ECEE, when measured holistically across a range of affective and cognitive dimensions, conveying how those programs often engender a sense of joy and curiosity inherent in effective early childhood educational programs. The programs encourage young participants to connect those affective elements with environmentally related knowledge, action orientation, and civic engagement, focused on the environment not only as an educational setting, but in its totality (Sauvé, 2005). As Bailie (2012) writes, "the combination of early childhood education and environmental education is more powerful together than each by itself" (p. 132). Such a synergistic relationship offers promise to enhance the quality of the human experience in the world with beneficial impacts for spaces and species, for generations to come.

### Funding statement

This review was supported by eeWORKS, a collaborative project focused on demonstrating the value and impact of environmental education, led by the North American Association for Environmental Education (NAAEE), in partnership with foundation and government partners, including the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and USDA Forest Service, as well as the Gray Family Foundation, Pisces Foundation, and George B. Storer Foundation. Although representatives from these organizations and agencies served as advisors at the conceptualization stage, they were not directly involved in the data collection, analysis, interpretation, or write-up of results.

### CRedit authorship contribution statement

**Nicole M. Ardoin:** Conceptualization, Methodology, Formal analysis, Resources, Writing - original draft, Writing - review & editing, Supervision, Project administration, Funding acquisition. **Alison W. Bowers:** Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review & editing.

### Acknowledgements

Thanks to eeWORKS advisors as well as colleagues who provided particularly helpful feedback: Judy Braus, Drew Burnett, Emilian Geczi, Cathy Jordan, Christy Merrick, Alan Reid, Bora Simmons, T'Noya Thompson, and Dilafruz Williams. Thanks also to numerous Stanford Social Ecology Lab members who provided research assistance, especially: Estelle Gaillard, Avery Hanna, Tucker Hirsch, Wendi Hoover, Marika Jaeger, Fiona Noonan, Alexandra Peers, and Indira Phukan.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.edurev.2020.100353>.

### References

- Adams, S., & Savahl, S. (2017). Nature as children's space: A systematic review. *The Journal of Environmental Education*, 48(5), 291–321. <https://doi.org/10.1080/00958964.2017.1366160>.
- Ardoin, N. M., Bowers, A. W., Roth, N. W., & Holthuis, N. (2018). Environmental education and K–12 student outcomes: A review and analysis of research. *The Journal of Environmental Education*, 49(1), 1–17. <https://doi.org/10.1080/00958964.2017.1366155>.
- Årlemalm-Hagser, E., & Sandberg, A. (2017). Early childhood education for sustainability: The relationship between young children's participation and agency—children and nature. In T. Waller, E. Årlemalm-Hagser, E. B. H. Sandseter, L. Lee-Hammond, K. Lekies, & S. Wyver (Eds.), *The SAGE handbook of outdoor play and learning* (pp. 213–228). Thousand Oaks, CA: Sage.
- Bailie, P. E. (2012). *Connecting children to nature: A multiple case study of nature center preschools* (Doctoral dissertation). Retrieved from <https://digitalcommons.unl.edu/teachlearnstudent/24>.
- Bang, K.-S., Kim, S., Song, M. K., Kang, K. I., & Jeong, Y. (2018). The effects of a health promotion program using urban forests and nursing student mentors on the perceived and psychological health of elementary school children in vulnerable populations. *International Journal of Environmental Research and Public Health*, 15(9), 1977. <https://doi.org/10.3390/ijerph15091977>.
- Barnosky, A. D., & Hadly, E. A. (2016). *Tipping point for planet earth: How close are we to the edge?* New York, NY: Thomas Dunne Books.
- Bascopé, M., Perasso, P., & Reiss, K. (2019). Systematic review of education for sustainable development at an early stage: Cornerstones and pedagogical approaches for teacher professional development. *Sustainability*, 11(3), 719. <https://doi.org/10.3390/su11030719>.
- Bentsen, P., & Jensen, F. S. (2012). The nature of udeskole: Outdoor learning theory and practice in Danish schools. *Journal of Adventure Education and Outdoor Learning*, 12(3), 199–219. <https://doi.org/10.1080/14729679.2012.699806>.
- Bryder, L. (1992). 'Wonderlands of buttercup, clover and daisies': Tuberculosis and the open-air school movement in Britain. In R. Cooter (Ed.), *In the name of the child: Health and welfare, 1880–1940* (pp. 72–91). London, UK: Routledge.
- Cagle, N. L. (2018). Changes in experiences with nature through the lives of environmentally committed university faculty. *Environmental Education Research*, 24(6), 889–898. <https://doi.org/10.1080/13504622.2017.1342116>.

- Cameron-Faulkner, T., Macdonald, R., Serratrice, L., Melville, J., & Gattis, M. (2017). Plant yourself where language blooms: Direct experience of nature changes how parents and children talk about nature. *Children, Youth, and Environments*, 27(2), 110–124. <https://doi.org/10.7721/chilyoutenvi.27.2.0110>.
- Charmaz, K. (2014). *Constructing grounded theory* (2nd ed.). Thousand Oaks, CA: Sage.
- Chawla, L. (2007). Childhood experiences associated with care for the natural world: A theoretical framework for empirical results. *Children, Youth, and Environments*, 17(4), 144–170.
- Chawla, L. (2009). Growing up green: Becoming an agent of care for the natural world. *Journal of Developmental Processes*, 4(1), 6–23.
- Chawla, L. (2015). Benefits of nature contact for children. *Journal of Planning Literature*, 30(4), 433–452. <https://doi.org/10.1177/0885412215595441>.
- Cincera, J., Kroufek, R., Simonova, P., Broukalova, L., Broukal, V., & Skalkf, J. (2017). Eco-School in kindergartens: The effects, interpretation, and implementation of a pilot program. *Environmental Education Research*, 23(7), 919–936. <https://doi.org/10.1080/13504622.2015.1076768>.
- Cooper, H. M. (2010). *Research synthesis and meta-analysis: A step-by-step approach* (4th ed.). Thousand Oaks, CA: Sage.
- Copple, C., & Bredekamp, S. (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8* (3rd ed.). Washington, DC: National Association for the Education of Young Children.
- Corbin, J., & Strauss, A. (2015). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (4th ed.). Thousand Oaks, CA: Sage.
- Corraliza, J. A., & Collado, S. (2019). Ecological awareness and children's environmental experience. *Psychologist Papers*, 40(3), 190–196. <https://doi.org/10.23923/pap.psciol2019.2896>.
- Cutter-Mackenzie, A., & Edwards, S. (2013). Toward a model for early childhood environmental education: Foregrounding, developing, and connecting knowledge through play-based learning. *The Journal of Environmental Education*, 44(3), 195–213. <https://doi.org/10.1080/00958964.2012.751892>.
- Cutter-Mackenzie, A., Edwards, S., Moore, D., & Boyd, W. (2014). *Young children's play and environmental education in early childhood education*. New York, NY: Springer. <https://doi.org/10.1007/978-3-319-03740-0>.
- Daadvand, P., Nieuwenhuijsen, M. J., Esnaola, M., Fornis, J., Basagaña, X., Alvarez-Pedrerol, M., et al. (2015). Green spaces and cognitive development in primary schoolchildren. *Proceedings of the National Academy of Sciences*, 112(26), 7937–7942. <https://doi.org/10.1073/pnas.1503402112>.
- Davis, J. (2005). Educating for sustainability in the early years: Creating cultural change in a child care setting. *Australian Journal of Environmental Education*, 21, 47–55. <https://doi.org/10.1017/S08140626000094X>.
- Davis, J. (2009). Revealing the research “hole” of early childhood education for sustainability: A preliminary survey of the literature. *Environmental Education Research*, 15(2), 227–241. <https://doi.org/10.1080/13504620802710607>.
- Davis, J., & Elliott, S. (2014). *Research in early childhood education for sustainability: International perspectives and provocations*. New York, NY: Routledge.
- Duhn, I., & Ritchie, J. (2014). Making “eco-waves”: Early childhood care and education sustainability practices in Aotearoa New Zealand. *Children, Youth, and Environments*, 24(2), 123–145. <https://doi.org/10.7721/chilyoutenvi.24.2.0123>.
- Dwan, K., Gamble, C., Williamson, P. R., & Kirkham, J. J. (2013). Systematic review of the empirical evidence of study publication bias and outcome reporting bias—an updated review. *PLoS One*, 8(7), Article e66844. <https://doi.org/10.1371/journal.pone.0003081>.
- Ernst, J., & Burcak, F. (2019). Young children's contributions to sustainability: The influence of nature play on curiosity, executive function skills, creative thinking, and resilience. *Sustainability*, 11(15), Article 4212. <https://doi.org/10.3390/su11154212>.
- Evans, G. W., Otto, S., & Kaiser, F. G. (2018). Childhood origins of young adult environmental behavior. *Psychological Science*, 29(5), 679–687. <https://doi.org/10.1177/0956797617741894>.
- Ewert, A., Place, G., & Sibthorp, J. (2005). Early-life outdoor experiences and an individual's environmental attitudes. *Leisure Sciences*, 27(3), 225–239. <https://doi.org/10.1080/01490400590930853>.
- Farrell, A., Kagan, S., & Tisdall, E. (2015). *The SAGE handbook of early childhood research*. Thousand Oaks, CA: Sage.
- Fitzgerald, M. (2020, May 12). *Kids indoor play: Bringing outside in..* Tinkergarten. Retrieved from: <https://tinkergarten.com/blog/how-to-bring-the-outdoors-home-even-when-youre-stuck-inside>.
- Franco, A., Malhotra, N., & Simonovits, G. (2014). Publication bias in the social sciences: Unlocking the file drawer. *Science*, 345(6203), 1502–1505. <https://doi.org/10.1126/science.1255484>.
- Gill, T. (2014). The benefits of children's engagement with nature: A systematic literature review. *Children, Youth, and Environments*, 24(2), 10–34. <https://doi.org/10.7721/chilyoutenvi.24.2.0010>.
- Gough, D., Oliver, S., & Thomas, J. (2012). *An introduction to systematic reviews* (1st ed.). Thousand Oaks CA: Sage.
- Gough, D., Oliver, S., & Thomas, J. (2017). *An introduction to systematic reviews* (2nd ed.). Thousand Oaks, CA: Sage.
- Gough, S., Walker, K., & Scott, W. (2001). Lifelong learning: Towards a theory of practice for formal and non-formal environmental education and training. *Canadian Journal of Environmental Education*, 6, 178–196.
- Gray, C., Gibbons, R., Larouche, R., Sandseter, E. B. H., Bienenstock, A., Brussoni, M., et al. (2015). What is the relationship between outdoor time and physical activity, sedentary behaviour, and physical fitness in children? A systematic review. *International Journal of Environmental Research and Public Health*, 12(6), 6455–6474. <https://doi.org/10.3390/ijerph120606455>.
- Green, C. J. (2015). Toward young children as active researchers: A critical review of the methodologies and methods in early childhood environmental education. *The Journal of Environmental Education*, 46(4), 207–229. <https://doi.org/10.1080/00958964.2015.1050345>.
- Green, C., Kalvaitis, D., & Worster, A. (2016). Recontextualizing psychosocial development in young children: A model of environmental identity development. *Environmental Education Research*, 22(7), 1025–1048. <https://doi.org/10.1080/13504622.2015.1072136>.
- Greig, A., Taylor, J., & MacKay, T. (2013). *Doing research with children: A practical guide*. Thousand Oaks, CA: Sage.
- Hartling, L., Featherstone, R., Nuspl, M., Shave, K., Dryden, D. M., & Vandermeer, B. (2017). Grey literature in systematic reviews: A cross-sectional study of the contribution of non-English reports, unpublished studies and dissertations to the results of meta-analyses in child-relevant reviews. *BMC Medical Research Methodology*, 17(1), 64. <https://doi.org/10.1186/s12874-017-0347-z>.
- Hedefalk, M., Almqvist, J., & Östman, L. (2015). Education for sustainable development in early childhood education: A review of the research literature. *Environmental Education Research*, 21(7), 975–990. <https://doi.org/10.1080/13504622.2014.971716>.
- Heyvaert, M., Hannes, K., & Onghena, P. (2017). *Using mixed methods research synthesis for literature reviews*. Thousand Oaks, CA: Sage.
- James, J. J., Bixler, R. D., & Vadala, C. E. (2010). From play in nature, to recreation then vocation: A developmental model for natural history-oriented environmental professionals. *Children, Youth, and Environments*, 20(1), 231–256.
- Jarvis, P. (2009). Learning from everyday life. In P. Jarvis (Ed.), *The Routledge international handbook of lifelong learning* (pp. 19–30). New York, NY: Routledge.
- Jordan, C., & Chawla, L. (2019). A coordinated research agenda for nature-based learning. *Frontiers in Psychology*, 10, 766. <https://doi.org/10.3389/fpsyg.2019.00766>.
- Jørgensen, K.-A. (2016). Bringing the jellyfish home: Environmental consciousness and ‘sense of wonder’ in young children's encounters with natural landscapes and places. *Environmental Education Research*, 22(8), 1139–1157. <https://doi.org/10.1080/13504622.2015.1068277>.
- Knight, S. (2013). The impact of Forest School on education for sustainable development in the early years in England. In S. Knight (Ed.), *International perspectives on Forest School: Natural spaces to play and learn* (pp. 1–11). Thousand Oaks, CA: Sage.
- Kondo, M., Fluehr, J., McKeon, T., & Branas, C. (2018). Urban green space and its impact on human health. *International Journal of Environmental Research and Public Health*, 15(3), 445. <https://doi.org/10.3390/ijerph15030445>.
- Kuo, M. (2015). How might contact with nature promote human health? Promising mechanisms and a possible central pathway. *Frontiers in Psychology*, 25. <https://doi.org/10.3389/fpsyg.2015.01093>, 2015.
- Larimore, R. (2016). Defining nature-based preschools. *International Journal of Early Childhood Environmental Education*, 4(1), 32–36.
- Leal Filho, W., Mifsud, M., & Pace, P. (Eds.). (2018). *Handbook of lifelong learning for sustainable development. World Sustainability Series*. Berlin: Springer International Publishing. <https://doi.org/10.1007/978-3-319-63534-7>.
- Leeming, F. C., Dwyer, W. O., Porter, B. E., & Cobern, M. K. (1993). Outcome research in environmental education: A critical review. *The Journal of Environmental Education*, 24(4), 8–21. <https://doi.org/10.1080/00958964.1993.9943504>.



- Lewis, E., Mansfield, C., & Baudains, C. (2010). Going on a turtle egg hunt and other adventures: Education for sustainability in early childhood. *Australasian Journal of Early Childhood*, 35(4), 95–100. <https://doi.org/10.1177/183693911003500412>.
- Mastrángelo, M. E., Pérez-Harguindeguy, N., Enrico, L., Bennett, E., Lovorel, S., Cumming, G. S., et al. (2019). Key knowledge gaps to achieve global sustainability goals. *Nature Sustainability*, 1–7. <https://doi.org/10.1038/s41893-019-0412-1>.
- Maynard, T. (2007). Forest schools in Great Britain: An initial exploration. *Contemporary Issues in Early Childhood*, 8(4), 320–331. <https://doi.org/10.2304/ciec.2007.8.4.320>.
- Meyer, J., Müller, U., & Macoun, S. (2017). Comparing classroom context and physical activity in nature and traditional kindergartens. *Children, Youth, and Environments*, 27(3), 56–77. <https://doi.org/10.7721/chilyoutenvi.27.3.0056>.
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Thousand Oaks, CA: Sage.
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *PLoS Medicine*, 6(7), Article e1000097. <https://doi.org/10.1001/jama.2015.3656>.
- Monroe, M. C. (2003). Two avenues for encouraging conservation behaviors. *Human Ecology Review*, 10(2), 113–125.
- Monroe, M. C., Andrews, E., & Biedenweg, K. (2008). A framework for environmental education strategies. *Applied Environmental Education and Communication*, 6(3–4), 205–216. <https://doi.org/10.1080/15330150801944416>.
- Moyer, A., Schneider, S., Knapp-Oliver, S. K., & Sohl, S. J. (2010). Published versus unpublished dissertations in psycho-oncology intervention research. *Psycho-Oncology*, 19(3), 313–317. <https://doi.org/10.1002/pon.1561>.
- Müller, U., Temple, V. A., Smith, B., Kerns, K., Eycke, K. T., Crane, J., et al. (2017). Effects of nature kindergarten attendance on children's functioning. *Children, Youth, and Environments*, 27(2), 47–69. <https://doi.org/10.7721/chilyoutenvi.27.2.0047>.
- National Institute for Health and Clinical Excellence. (2012). *Methods for the development of NICE public health guidance* (3rd ed.) Retrieved from. In: <https://www.nice.org.uk/process/pmg4/resources/methods-for-the-development-of-nice-public-health-guidance-third-edition-pdf-2007967445701>.
- North American Association for Environmental Education. (2016). *Early childhood environmental education programs: Guidelines for excellence*. Washington, DC: Author.
- North American Association for Environmental Education. (2017). *Nature preschools and forest kindergartens: 2017 national survey*. Washington, DC: Author.
- North American Association for Environmental Education. (2019). *K–12 environmental education: Guidelines for excellence*. Washington, DC: Author.
- Otto, S., Evans, G. W., Moon, M. J., & Kaiser, F. G. (2019). The development of children's environmental attitude and behavior. *Global Environmental Change*, 58, Article 101947. <https://doi.org/10.1016/j.gloenvcha.2019.101947>.
- Otto, S., & Kaiser, F. G. (2014). Ecological behavior across the lifespan: Why environmentalism increases as people grow older. *Journal of Environmental Psychology*, 40, 331–338. <https://doi.org/10.1016/j.jenvp.2014.08.004>.
- O'Brien, L., & Murray, R. (2007). Forest School and its impacts on young children: Case studies in Britain. *Urban Forestry and Urban Greening*, 6(4), 249–265. <https://doi.org/10.1016/j.ufug.2007.03.006>.
- Phenice, L. A., & Griffone, R. J. (2003). Young children and the natural world. *Contemporary Issues in Early Childhood*, 4(2), 167–171. <https://doi.org/10.2304/ciec.2003.4.2.6>.
- Ranson, S., & Rutledge, H. (2005). *Including families in the learning community: Family centres and the expansion of learning*. York: Joseph Rowntree Foundation.
- Reid, A. (2019). Blank, blind, bald and bright spots in environmental education research. *Environmental Education Research*, 25(2), 157–171. <https://doi.org/10.1080/13504622.2019.1615735>.
- Reid, A., & Scott, W. (2013). Identifying needs in environmental education research. In J. D. Stevenson, & A. E. J. Wals (Eds.), *International handbook of research on environmental education* (pp. 518–528). New York, NY: Routledge.
- Rosa, C. D., Profice, C. C., & Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: The role of connectedness to nature and childhood nature experiences. *Frontiers in Psychology*, 9, Article 1055. <https://doi.org/10.3389/fpsyg.2018.01055>.
- Saldaña, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). Thousand Oaks, CA: Sage.
- Samuelsson, L., & Kaga, Y. (2008). *The contribution of early childhood education to a sustainable society*. UNESCO. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000159355>.
- Sandelowski, M., Voils, C. L., & Barroso, J. (2006). Defining and designing mixed research synthesis studies. *Research in the Schools*, 13(1), 29–40.
- Sauvé, L. (2005). Currents in environmental education: Mapping a complex and evolving pedagogical field. *Canadian Journal of Environmental Education*, 10(1), 11–37.
- Schutte, A. R., Torquati, J. C., & Beattie, H. L. (2017). Impact of urban nature on executive functioning in early and middle childhood. *Environment and Behavior*, 49(1), 3–30. <https://doi.org/10.1177/0013916515603095>.
- Shamseer, L., Moher, D., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., et al. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: Elaboration and explanation. *BMJ*, 349, g7647. <https://doi.org/10.1136/bmj.g7647>.
- Sobel, D. (2016). *Nature preschools and forest kindergartens: The handbook for outdoor learning*. St. Paul, MN: Redleaf Press.
- Somerville, M., & Williams, C. (2015). Sustainability education in early childhood: An updated review of research in the field. *Contemporary Issues in Early Childhood*, 16(2), 102–117. <https://doi.org/10.1177/1463949115585658>.
- Stern, M. J., Powell, R. B., & Hill, D. (2014). Environmental education program evaluation in the new millennium: What do we measure and what have we learned? *Environmental Education Research*, 20(5), 581–611. <https://doi.org/10.1080/13504622.2013.838749>.
- Stevenson, K. T., Peterson, M. N., Carrier, S. J., Strnad, R. L., Olson, R. A., & Szczytko, R. E. (2019). Making the case for a null effects framework in environmental education and K–12 academic outcomes: When "just as good" is a great thing. *Frontiers in Communication*, 3, 59. <https://doi.org/10.3389/fcomm.2018.00059>.
- Tarr, K. (2008). Enhancing environmental awareness through the arts. *Australian Journal of Early Childhood*, 33(3), 19–26. <https://doi.org/10.1177/183693910803300304>.
- Thomas, R. E. W., Teel, T., Bruyere, B., & Laurence, S. (2019). Metrics and outcomes of conservation education: A quarter century of lessons learned. *Environmental Education Research*, 25(2), 172–192. <https://doi.org/10.1080/13504622.2018.1450849>.
- Tillmann, S., Tobin, D., Avison, W., & Gilliland, J. (2018). Mental health benefits of interactions with nature in children and teenagers: A systematic review. *Journal of Epidemiology & Community Health*, 72(10), 958–966. <https://doi.org/10.1136/jech-2018-210436>.
- Torgerson, C. J. (2006). Publication bias: The Achilles' heel of systematic reviews? *British Journal of Educational Studies*, 54(1), 89–102. <https://doi.org/10.1111/j.1467-8527.2006.00332.x>.
- Twohig-Bennett, C., & Jones, A. (2018). The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environmental Research*, 166, 628–637. <https://doi.org/10.1016/j.envres.2018.06.030>.
- UN Environment. (2019). *Global environment outlook—GEO-6: Healthy planet, healthy people*. Cambridge, UK: Cambridge University Press.
- UNESCO. (1978). *Intergovernmental conference on environmental education: Final report*. Paris, France: Author.
- United Nations Statistics Division. (2020). *Methodology: Standard country or area codes for statistical use (M49)*. Author. Retrieved from: <https://unstats.un.org/unsd/methodology/m49/>.
- Wals, A. E. J., & Benavot, A. (2017). Can we meet the sustainability challenges? The role of education and lifelong learning. *European Journal of Education*, 52(4), 404–413. <https://doi.org/10.1111/ejed.12250>.
- Wells, N. M., & Lekies, K. S. (2006). Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children, Youth, and Environments*, 16(1), 1–24.
- Wells, N. M., & Lekies, K. S. (2012). Children and nature: Following the trail to environmental attitudes and behavior. In J. L. Dickinson, & R. E. Bonney, Jr. (Eds.), *Citizen science: Public participation in environmental research* (pp. 201–213). Ithaca, NY: Cornell University Press.
- West, L. (2009). Lifelong learning and the family: An auto/biographical imagination. In P. Jarvis (Ed.), *The Routledge handbook of lifelong learning* (pp. 67–79). London: Routledge.
- Wheaton, M., Kannan, A., & Ardoin, N. M. (2018a) (Environmental Literacy Brief), *Volume 1. Environmental literacy: Setting the stage*. Stanford, CA: Social Ecology Lab, Stanford University.

- Wheaton, M., Kannan, A., & Ardoin, N. M. (2018b) (Environmental Literacy Brief), *Volume 2. Pathways in environmental literacy*. Stanford, CA: Social Ecology Lab, Stanford University.
- Williams, D. R., & Dixon, P. S. (2013). Impact of garden-based learning on academic outcomes in schools: Synthesis of research between 1990 and 2010. *Review of Educational Research*, 83(2), 211–235. <https://doi.org/10.3102/0034654313475824>.
- Wilson, R. A. (1996). Environmental education programs for preschool children. *The Journal of Environmental Education*, 27(4), 28–33. <https://doi.org/10.1080/00958964.1996.9941473>.
- Wilson, R. A. (2018). *Nature and young children: Encouraging creative play and learning in natural environments* (3rd ed.). New York, NY: Routledge.
- Zelezny, L. C. (1999). Educational interventions that improve environmental behaviors: A meta-analysis. *The Journal of Environmental Education*, 31(1), 5–14. <https://doi.org/10.1080/00958969909598627>.