

Nature-Based Learning Interventions and Their Impact on Early Childhood: A Scoping Review

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Abstract

Background:

Nature-Based Learning is a growing approach in education. However, the intervention-base of empirical research has not been reviewed to give future researchers the direction for appropriate actions. The rationale for this scoping review is embedded in the fact that nature-based learning interventions are very much adopted in many countries of the world and the review of their findings in the empirical research can guide educational psychologists to install the same practices in the other countries of the world. In past, some reviews are done on nature-based learning but not specifically on interventions' effectiveness early years and not very recently.

Objective:

The aim of this scoping review is to summarize and disseminate the widespread international investigation into Nature-Based Learning interventions and its impact on early childhood.

Inclusion Criteria

All those original research studies, that reported the account of interventions done earlier or during research on children aged two-nine years, were part of this review. The major concepts that were kept in mind while selecting the studies were nature-based learning/nature-based education/outdoor learning and educational outcomes. Studies from all over the world were a part of the inclusion criteria.

Methodology

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for scoping review (PRISMA-ScR) Criteria were used to conduct the literature review of the effects of nature-based learning interventions on educational and developmental outcomes in early years. The scoping review searched for studies across Google Scholar which measure the educational and developmental outcomes of Nature-Based Learning interventions, with a focus on early childhood care and educational settings. Using the inclusion criteria set out in this paper, relevant studies were identified then

summarized to provide a synthesis of the current literature on Nature-Based Learning intervention. Just to keep it to recent years, the search was conducted for articles since January 2017 to date and for primary research studies (review articles were excluded). For the identification of the articles Google Scholar was repeatedly approached with different keywords combination so that the maximum articles could be identified. Once the articles were identified, repeated articles were deleted from the search. Then the inclusion criteria was applied for the eligible articles then those only were reviewed and data extraction was done. Once the basic data was extracted, then the same was analyzed and presented in the tables and organizational charts.

Results

The results of this review depicted that the nature-based learning is inevitable for child's holistic development that include academic achievement, psychological well-being and towards stewardship. Anecdotal evidence and formal research suggest the significant educational outcomes are received out of nature connection. Offering low-cost, non-invasive pedagogical solutions to educational challenges—particularly around academic achievement, personal development and stewardship—the educational outcomes of Nature-Based Learning in early years are yet to be fully articulated.

There are number of interventions for installing nature-based learning in early years that proved to be effective as those were successful in bringing out positive learning and educational outcomes such as nature walk, setting up nature pre-schools, apprenticeship of school to zoo or forest side or park.

Conclusions

The scoping review provides insights for educational psychologists, curriculum developers, teacher-training institutions, educational policy makers, and frontline teachers to improve the learning experiences of future students.

Implications for research: this review showed a very positive outcome of nature-based learning interventions of the educational outcomes of early learners even longitudinal studies have shown residual effects of these interventions on adults. So in light of these findings, more research should be done in other countries as researches were mostly from the developed countries.

Implications for practice: the findings revealed strong evidences for the effectiveness of nature-based learning interventions so educational psychologists and curriculum developers should started proposing nature-based interventions as a compulsory feature of education system so that holistic development of children could be ensured.

Keywords: nature-based learning, early childhood, educational outcomes, developmental outcomes, intervention-base studies

Nature-Based Learning Interventions and Their Impact on Early Childhood: A Scoping Review

Largely regarded by the media as a reaction to the lockdown in response to the Covid-19 pandemic, the nature-based learning approaches have become a topic of inquiry in the scientific community due to the psychological, educational, instructional and environmental issues at stake. A study showed that less than 50 forests kindergartens or nature preschools were in operation in 2012, but as of 2017, over 250 such schools have emerged in 43 states in the United States, with estimations for continuous growth over the next decade (NAAEE, 2017). In comparison to the popularity of nature-based learning, hardly any reviews are written for exploring the educational and developmental outcomes of early learners enrolled in these programs.

Introduction

In the fast paced and technology driven world there are several consequences facing society. One major repercussion is the loss of connectedness children have with nature (Grimwod et al., 2018; Kawas et al., 2019; Louv, 2012). As a result, Louv (2008) has coined the term "nature-deficit disorder." Louv (2012) explained nature-deficit disorder is not a medical diagnosis, although Louv believes it should be, it is simple the gap between children and nature.

Conceptualization of Nature-Based Learning

The umbrella term nature-based education has been defined as "an educational practice that takes place in near or distant outdoor and/or extracurricular environments, whether natural or artificial, where students have the opportunity to engage in a multitude of learning activities" (Dabaja, 2022, p.3). Within the perimeter of outdoor education, various approaches such as nature-based education and/or nature-based learning or the notion of the forest school – all of which we group together as "educating through nature" – refer to what the environmental education (EE) movement defined in the 1990s as "an educational perspective in which the environment constitutes one of three spheres of interaction that are the foundation of personal and social development: the psychosphere (self), the sociosphere (others), and the ecosphere (environment), [these three spheres being] closely related to each other" (Sauvé, 1997, p. 20). In this perspective, the individual child's psychological development (autonomy, self-esteem, self-reflection, responsibility, etc.) is accompanied by an awareness of others and otherness (social belonging, relatedness, cooperation, citizenship, etc.), as well as the development of the child's relationship to the living environment (ecological awareness, naturalistic knowledge, feeling part of the global ecosystem, etc.). Educating through nature thus differs from a strictly "environmental" educational approach in which "nature" as subject matter would be considered both the means and the end of learning.

Rationale of the study

Children and youth all over the world are spending less time out-doors compared to previous generations. Increased use of technology, lack of green space, and concerns for risk and safety have contributed to a generation of children spending too much time indoors. A

disconnection between children and nature has occurred. According to Sobel (2022), the disturbing trends in the lives of children in their early years came due to indoorification, digitalization and academification. Pandemic even exaggerated these trends. It is high time for a solution to all this.

A practical way of re-engaging children and youth with the natural world could be through nature-based education. Nature-Based Learning is a growing approach in education. However, the intervention-base of empirical research has not been reviewed to give future researchers the direction for appropriate actions. The rationale for this scoping review is embedded in the fact that nature-based learning interventions are very much adopted in many countries of the world and the review of their findings in the empirical research can guide educational psychologists to install the same practices in the other countries of the world. In past, some reviews are done on nature-based learning (Kuo et al., 2018; Dabaja et al., 2022; Jordan & Chawla, 2019; Abd Talib, 2022) but not specifically on nature-based learning interventions' effectiveness and not specifically for early childhood.

Objectives

The aim of this scoping review is to summarize and disseminate the widespread international investigation into Nature-Based Learning interventions and its educational outcomes for early learners.

The primary goal is to provide an overview of existing research. This involves describing the prevailing assumptions, characterizing themes, and the theoretical and methodological approaches. The secondary goal is to identify the interventions' modes of actions in terms of nature-based learning, as well as to describe educational and developmental outcomes.

Review question

Hence, the initial search in databases was guided by the following three research questions:

- 1) What are the nature-based learning interventions used during early childhood?
- 2) How effective the nature-based learning interventions are for teaching in early childhood, care and education?
- 3) What are the educational and developmental outcomes in early years that have been strengthened by education through nature?

Nature-based Learning: Key Literature

The literature on Nature-Based Learning, as we have defined above, is generally sparse, however four examples stand out. Firstly, Scottish outdoor educators Beames et al., (2012) wrote a seminal book titled *Learning Outside the Classroom*, with the aim of helping mainstream teachers incorporate more meaningful Nature-Based Learning opportunities into their daily teaching activities. Elsewhere in the UK, the Natural Connections Demonstration Project (2016) used a distributed model of brokerage to recruit 125 schools in southwest England to develop Out-door Learning programs. School surveys reflected that students found Nature-Based Learning enjoyable and engaging, and that it had positive impacts on their connection with nature, social skills, health and wellbeing, and academic attainment. Although teachers' lack of confidence to teach outside was initially a challenge, teachers reported positive impacts on their professional practice, health and wellbeing, and

job satisfaction. The third landmark for Nature-Based Learning is Denmark's concept of 'udeskole' (outdoor school), where students spend regular hours every week learning outside (irrespective of the weather). Denmark is often recognised as a world leader in Nature-Based Learning (Gray, 2018), and its recent national TEACHOUT pilot has provided research evidence of Nature-Based Learning benefits to primary school students': physical activity (Schneller et al., 2017), motivation for school (Bølling et al., 2018), prosocial behaviour (Bølling et al., 2019), and even reading performance (Otte et al., 2019). The Forest School movement in the UK was initially inspired by the Danish practice of Nature-Based Learning (Kemp, 2017), and emphasises child-centred learning for early learning and primary school aged children in a forest environment (Harris, 2015). In terms of a comprehensive overview of Nature-Based Learning research around the world, the final highlight is a systematic review of 'regular classes in outdoor settings' (Becker et al., 2017).

Efficacy of Nature-Based Learning

The international scientific community seems to agree (Dabaja, 2021) that children's participation and engagement in activities taking place in so-called "natural" environments, i.e., where humans are surrounded by plants, minerals, and animals, could contribute to improving their knowledge of (a) different curricular subjects, including social studies, language arts, mathematics and/or science (Avci & Gümüş, 2020; Becker et al, 2017) and (b) the natural environment (ibid.; Marchant et al., 2019; Purc-Stephenson et al., 2019). In addition, there is evidence for children's improved physical skills and mental health (Finn et al., 2018; Heras et al., 2020; Marchant et al., 2019) as well as benefits for their social and collaborative skills (Waite & al., 2016).

Method

Recent decades have seen a marked growth in the quantity and range of literature reviews published on various aspects of ecopsychology, environmental psychology and early childhood education. However, critical assessment of these reviews suggests common challenges for authors and readers, the core of which concern distinct but related aspects of naming, assessing, and applying literature review methods.

Study Design and Review Protocol

This review assumes that teachers use nature experiences to facilitate learning by firsthand learning to promote meaning-making. Therefore, the review selects studies seeking nature experiences to enrich the learning episode by sustaining relevant associations of embodied and conceptual processes (Eva & Rehman, 2022; Ernst et al., 2021; Traynor et al., 2022; Kuo & Jordan, 2019; Camasso & Jagnathan, 2018). Accordingly, "nature experience" is used in this strict sense, which refers to the embodied cognition literature not usually implied by the nature-based learning literature (Jordan and Chawla, 2019).

Article Screening through Search Strategy

The literature review process consisted of the following parts that were conducted in order. Firstly, a selection of past literature review and meta-analysis to understand the previous state of the nature based learning literature. These papers were collected prior to the nature

based learning literature review that consist of a variety of papers related to the wide range of Nature based learning approaches and contexts. Then, based upon the informal review process of the meta-analyses and review papers, a search strategy was devised to collect new research papers. These papers focused on updating and expanding upon findings from the previous meta-analyses and review papers. Finally, once the initial studies to be included were found and assessed two processes occurred.

- a) An additional targeted literature search occurred on topics that were lacking depth
- b) Foundational papers and/or reviews that connected nature, the proposed mechanism, and learning were gathered

Eligibility or Inclusion criteria

The review papers included were chosen based upon two main criteria. First, in terms of timeliness the articles had to be relatively recent compared to the date of this review. In other words, primary research articles were prioritized by most recent date of publication from the start of the current review (May, 2022). The second criteria is related to relevance. Primary research articles were supposed to be intervention-based or experimental in nature. Having said that the age of the children (i.e. 2-9 years) taking part in these interventions was another criteria. This excluded articles that were exclusively focused on a specific area (e.g. environmental studies) as the current studies takes the broader approach. This literature review articles included Eva and Rahman (2022), Abd Talib, N., Mee, and Ne'Matullah, (2022), Dabis et al., (2022), Sobol, (2022), Sari et al., (2022), Barrette et al., (2022).

Criteria for selection of articles

1. Journal limitations: no journal limitations were imposed for the current review. Nature-based learning literature spans over several disciplines and therefore there are many journals.
2. Date range: articles were prioritized for inclusion starting from the most recent articles from the date the current review began (May 2022) and working backwards as to avoid including articles previously reviewed as part of existing meta-analyses.
3. Articles types: original peer-reviewed research articles were of primary interest, if such articles could be found within a topic area. If not then dissertations with specific areas of focus were included to supplement materials.
4. Methodological limitations: no methodological limitations were placed in conducting this review. Original research articles using a variety of qualitative and quantitative methodologies are all acceptable and represent the broad range of approaches within the nature-based learning literature
5. Location: no limitations were placed on the country in which research took place as we were interested in assessing geographic areas (hubs) of the research.
6. Final selection for analysis: articles were selected by an overall combination of the above criteria and then where possible to sample a diversity of literature as a whole based on location, approach and sample type.

Article evaluation Criteria for selection of articles

Specific keywords were used to target specific concepts, mechanisms or areas in which there

was a perceived lack of depth. Such as early-childhood education, nature-preschools "nature-based education," "education through nature," "outdoor education," "forest schools," or "outdoor classrooms."

Operational definitions of key terminology

Nature: nature is an outdoor environment with natural elements that may include rocks, soil, sand, water, vegetation, animals, insects and other natural materials and elements. This nature may be found in built and unbuilt environments, from city parks to gardens to native landscapes. Nature-based learning occurs outdoors in cities, towns, neighborhoods, wilderness areas, farms, rural settings, museums, school and any other places that afford such opportunities.

Learning: the acquisition and development of knowledge, attitudes, behaviours, values, and skills through experience, study, being taught or self-directed exploration. We recognize that learning involves component functions (e.g. attention and retention) and is related to other physical, emotional and cognitive processes (e.g. sense of agency, motivation, regulation and engagement in learning)

Table 1: Search terms Keywords for master literature search

Topic	Key terms
General	place-based learning, out-door learning, nature-based learning, learning context,
Nature	Nature, natural environment, garden, park, trees, green space, forest, farm, plants, wildlife outdoor/s, yards, classroom, schoolyard, forest school, school gardens, outdoor learning environment, outdoor education, educational setting
Learning and Component s of learning	learningeducationstudyexperienceexplorationattentionretentionstressimpulse control, impulsivity, inhibitory control, creativity, creative
Early Childhood	Preschoolers, bush kinder, kindergarteners, early years

Keyword searches used combinations of the keywords listed above in each category, often however, keywords were excluded from the searches due to terms proving to be too broad to be meaningfully searched in the current context.

Data extraction and analysis

The method of extracting the data for this review was based empirical grounds as all the areas of the research were extracted such as sample, sampling method, data tools, duration of the study, analytical tools, results, recommendations and limitations

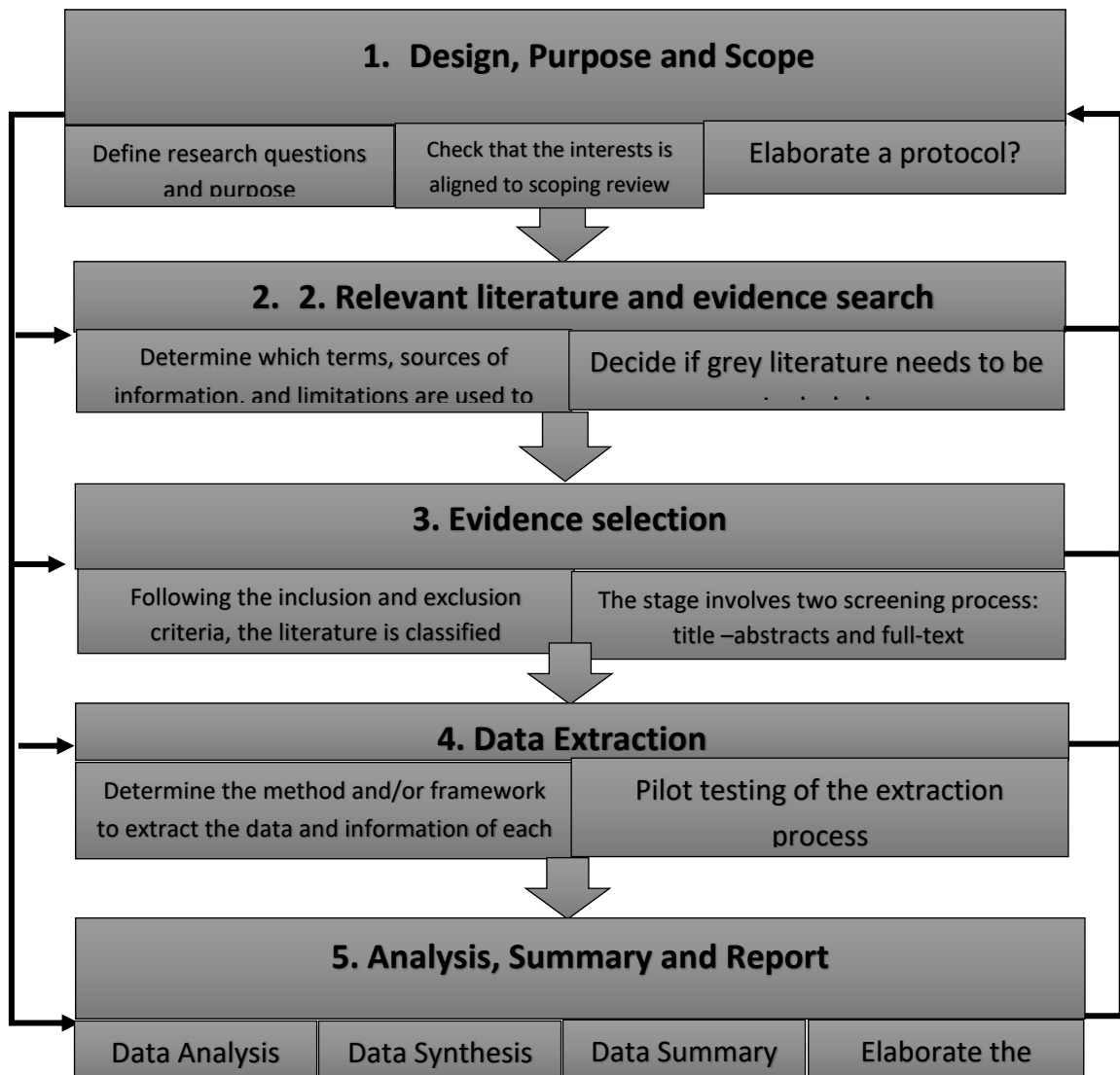


Figure 1: Steps of the Scoping Review

Data synthesis

Data was synthesized in form of tables and checklists so that at a glance, the pattern and deviations of the data can be detected. In the result section, table 2 is showing the findings from the review of the initial literature that guided the present review. For detailed view see appendix 1

Results

The results of this review depicted that the nature-based learning is inevitable for child’s holistic development that include academic achievement, psychological well-being and towards stewardship. Anecdotal evidence and formal research suggest the significant

educational outcomes are received out of nature connection. Offering low-cost, non-invasive pedagogical solutions to educational challenges—particularly around academic achievement, personal development and stewardship—the educational outcomes of Nature-Based Learning in early years are yet to be fully articulated.

There are number of interventions for installing nature-based learning in early years that proved to be effective as those were successful in bringing out positive learning and educational outcomes such as nature walk, setting up nature pre-schools, apprenticeship of school to zoo or forest side or park.

This review was conducted on 25 primary research studies. Initial search started with Google Scholar where the key terms were searched repeated with different combinations of key words. Through this process, 499 records were identified and from other sources like ERIC database and bibliography and references of the identified records, 201 more records were identified. Then the screening of these $499+201=700$ records was done and 280 records left after removing the duplicates ones. Out of these 280 records, the next level of screening was done while screening books, blogs, web pages and other such documents, 100 records were excluded.

Keeping eligibility criteria in view out of 180 only 34 full-text articles were eligible. Out of these also some were reviews of different sorts, 9 articles were excluded. However, 25 articles were included in this study (see Figure 2).

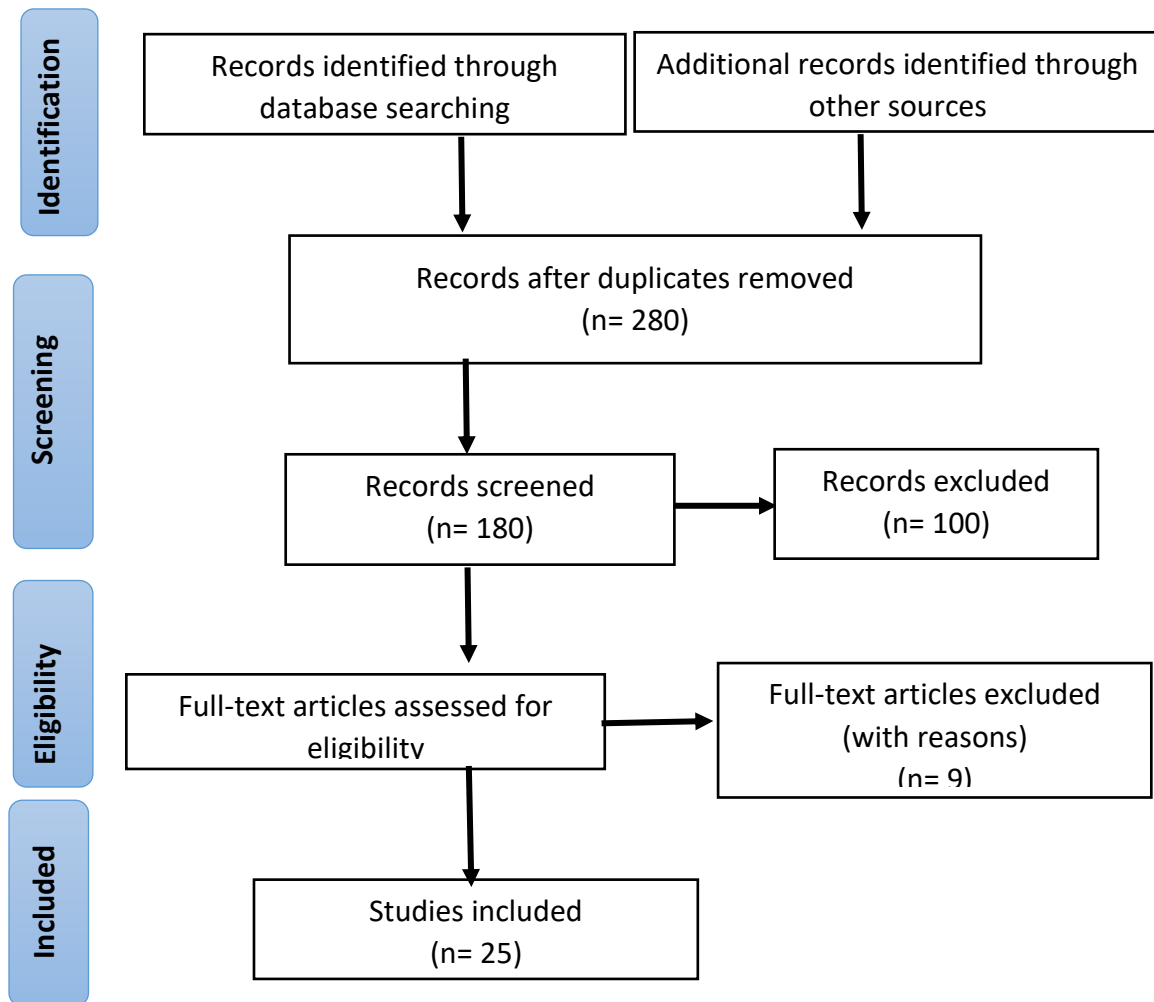


Figure 2: Showing the flowchart of the articles selection

These 25 selected articles were fitting under the objective of this review i.e. to summarize and disseminate the widespread international investigation into Nature-Based Learning interventions and its impact on early childhood. That is why only those articles that had study population as children aged between 2-9 years were included. The concept of nature-based learning has been the focus of the study so these studies were addressing this concept in one way or the other. At the same time, results were also giving answers to three review questions:

- 1) What are the nature-based learning interventions used during early childhood?
- 2) How effective the nature-based learning interventions are for teaching in early childhood, care and education?
- 3) What are the educational and developmental outcomes in early years that have been

strengthened by education through nature?

For reviewing the articles, some basic conceptual categories were classified such as “intervention type”, “study population”, “sample size”, “duration of the intervention”, “aim/s of the study”, “methodology adopted”, “key findings” (evidence established) and “gaps in the research”.

Intervention type

The review of the 25 articles showed that most of the articles were intervention based as per the inclusion criteria requirements. Out of these, majority primary researchers used qualitative researches mostly based on exploratory case studies. The second mostly used approach was quantitative field experimental pretest and posttest design. Some studies found the perception and opinion from surveys to regarding the already running projects.

Study population

Most the studies focused on preschoolers and primary students. Due to the limitations of their expression, their teachers and parents were also the part of the study population.

Sample size

As the greater bit were the qualitative studies due to which sample size was small enough. Mostly one preschool to three preschools were studies, having 15-20 students with 5-10 teachers and parents of the preschoolers.

Duration of the research

As these were intervention based studies so the duration ranged between a day to three months. Rarely the longitudinal ones went for a year.

Aims of the studies

As these researchers were of intervention and experimentation nature, most of these aimed to find the impact and explore the differences between treatment and control groups. Some of the studies aimed at the evaluation of the already running projects or the special treatment for the study.

Methodologies adopted

Due to the qualitative nature of the majority of the studies, triangulation was the most frequently adopted methodology that was reviewed in these studies. The next common was the field study method or quasi experimental method with a pretest and posttest or independent group design.

Standardized tools for assessing the outcomes such as academic performance, creativity, empathy and so on.

Key findings

The results of most of the studies showed the positive impact of the intervention and relative recommendations and suggestions were given for the future studies

Table 2: Findings of the review

Areas	Findings of this review
Nature based learning and instructions is more effective than traditional instructions	Camassao and Jagannathan (2018) showed in their research that nature adds value to the instruction
Unbiased sampling techniques	Waitlist controls being used by researchers to first identify teachers, schools and students interested in nature based learning and then randomly assigning some of them to Nature based learning and rest to the traditional instruction (Well et al., 2015) guarding against pre-existing differences between teachers, students, schools being compared lends greater confidence that any gains are due to the instructions itself.
Double blind procedure of assessment	Assessment “blind to condition” unbiased to show academic learning is real. Students assigned randomly (Ernst & Stanek, 2006) not attributing to wishful thinking
Treatment – cause and effect relationship	Dose-response relationship- nature-based learning As magnitude of the treatment increases, so does the outcome (Sivarajah et al., 2018, Well et al., 2015).
Over-arching nature of the topic	Nature learning connection holds up across topics, learners, instructors, pedagogies, places and measures of learning (Swank et al., 2017, Kuo et al., 2018, McCree, et al., 2018, Lekies et al., 2015, Sivarajah et al., 2018). A robust association persisting across different contexts lends greater confidence in a cause and effect relationship (Hill, 1965).
Relationship hold across different research designs	True experiments (Well et al., 2015) quasi experiment (faber Taylor and Kuo, 2009, Benfield et al. 2015) large scale correlational studies with statistical controls (Kuo & Faber Taylor, 2004) longitudinal studies (McCree, 2018). Finding persisting across diverse study designs strengthen the case of causality.
Extension of review	Earlier till Nature Based Learning and instruction. This review addressed setting and pedagogy. Educational psychologists found in classroom that active, hands-on, student-centered, and collaborative forms of instructions out-perform more traditional instructions (Granger et al., 2012, Freeman, et al., 2014, Kontra, 2015) environmental psychologists found learning in greener settings is better even if instructions does not incorporate the nature (Benfield et al., 2015, Kuo et al., 2018).
Distinct pathways	Earlier direct test of nature learning hypothesis – nature (IV) Learning (DV) but now nature (IV) but precursor to learning (DV) (Li and Sullivan, 2016) Nature on attention, plausibility to a cause and effect relationship between nature and learning multiple mechanism identified, consistency of the nature

	learning relationship as robust phenomena are often multiply determined
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The detailed review of the studies can be overviewed in the appendix 3. For at a glance understanding regarding the three research questions

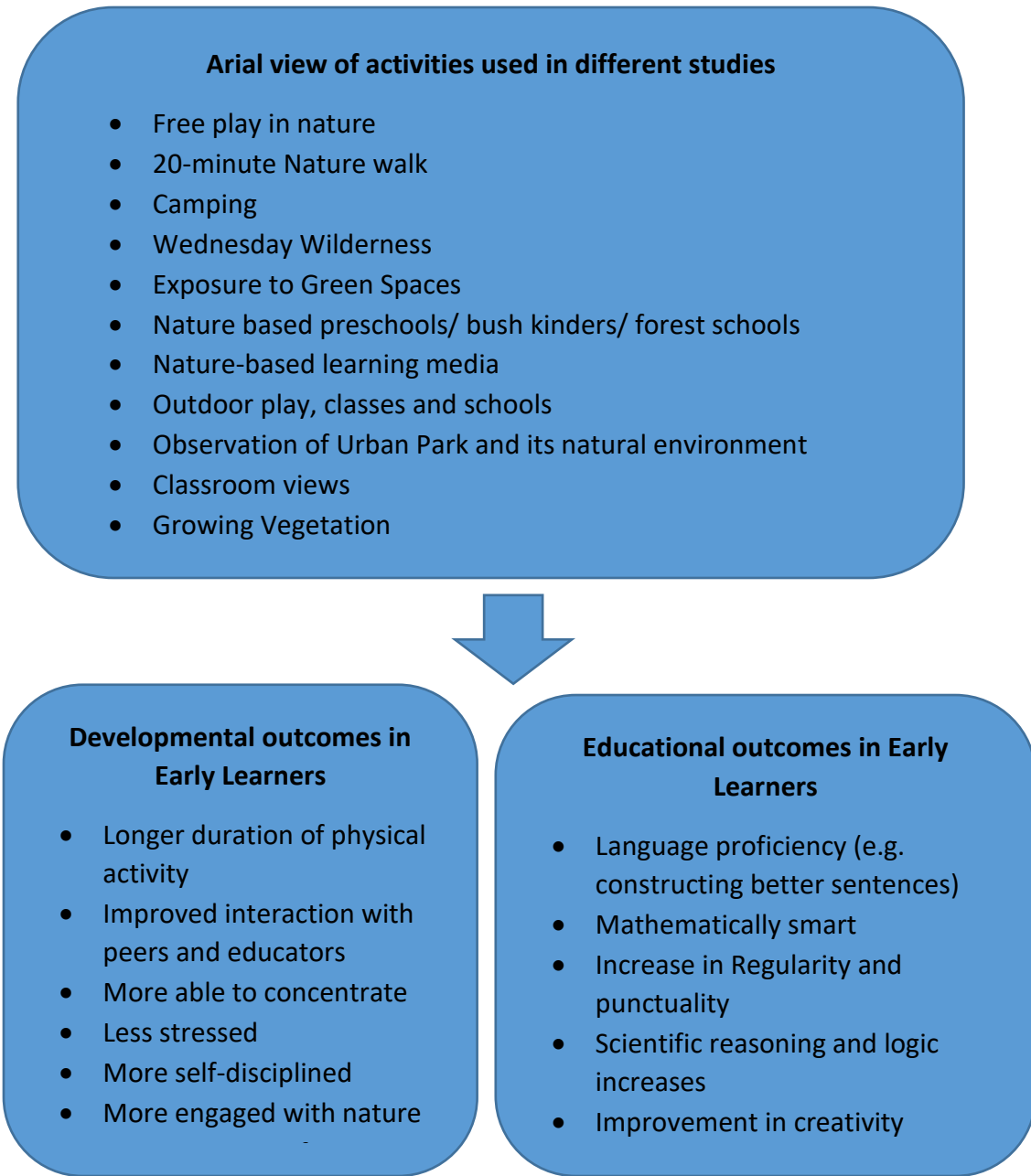


Figure 3: showing the connection between the three research questions and findings
All the selected studies were strictly selected on the inclusive criteria basis. The countries that were actively doing research on this topic are mostly USA, UK, Poland, Finland, Australia, Germany, Indonesia, Malaysia and Scotland. Since these countries have catered to this area of early childhood care and education at the same time the area of ecology and environmental education, it showed the example to other education systems worldwide to extend to nature for dual purpose: Initially to support children in their overall development and educational achievement. Secondly the same students will be the environmental steward as they are developing responsibility and empathy towards nature.

Discussion

This review was taken in response to an increasing body of cross-disciplinary research (Chawla, 2015; Ebbeling, Pawlak & Ludwig, 2002; Elliot, 2014; Elliot & Krusekopf, 2017; Gill, 2014; Harwood & Collier, 2017; Nature Canada, n.d.; Louv, R., 2008; Sobel, 2008; Strife & Downey, 2009; Torkar & Rejc, 2017; Tremblay et al., 2015) that suggests young children’s regular and repeated “access to active play in nature and outdoors - with its risk - is essential for healthy child development” (Tremblay et al., 2015, p.6476)

There is a restorative power of nature, in a human/nature reunion. And because of this reunion, life will be better (Louv, 2011). This review examines the educational outcomes of nature-based learning in early education (2–9 years) globally. From the perspective of educational psychology, the review explores the types of nature experiences used in early education. Focus is on educational outcomes when we invest in nature-based learning, such as specific academic achievements, personal development and stewardship.

Initially, 180 records were screened, with the initial screening leading to the inclusion of 34 studies. Of these articles, 25 studies forming the corpus in this review investigated the effect of using nature experiences as an intervention. These studies are divided into four themes: content understanding, environmental education, teaching scientific methods, and costs and challenges to teaching science outdoors. The review addresses the returns in terms of learning and academic achievements, the mode of action of the intervention, the investment, and costs in the form of labour, challenges, and gaps in the theoretical underpinning of the field. Based on the review, using nature experiences in education seems promising regarding increasing content knowledge, insight into methodologies and pro environmental behaviours. Interventions exploiting the schoolyard, school gardens, or nearby park areas are particularly promising due to the simultaneous strengthening of local engagement at low costs. However, using nature experiences as an alternative to traditional in-class teaching depends on profound deliberations and preparations, which are difficult for the individual teacher to address single-handedly. The review also reveals an urgent need for research that thoroughly explores the connections between teaching practices and theoretical foundations to consolidate the field. To that end, it is noteworthy that a few studies also reported on prior pilot studies demonstrating the need for testing the entire design before conducting the actual research.

Conclusions

To conclude, it is time to take nature seriously as a resource for learning and development. It is time to bring nature and nature-based pedagogy into formal education – to expand existing, isolated efforts into increasingly mainstream practices. The scoping review provides insights for educational psychologists, curriculum developers, teacher-training institutions, educational policy makers, and frontline teachers to improve the learning experiences of future students.

Action researches should assess the benefits of school gardens, green schoolyards and green walls in classrooms. Principals and school boards should support, not discourage, teachers' efforts to hold classes outdoors, take regular field trips, and partner with nearby nature centers, parks, farms, and forest preserves. Teachers who have pioneered nature-based instruction should serve as models and coaches, helping others address its challenges and take full advantage of its benefits.

The profession of school psychology should seek to expand beyond the public, K-12 realm and include non-traditional educational environments that emphasize holistic philosophies of child development. The field of school psychology should be inclusive of all area of research that concern the development of children within school settings, both traditional and non-traditional. With future research, educators may find that such alternative early education environments provide context for holistic development, necessary intervention, individualized support and/or enrichment for targeted populations of children.

Implications for research: this review showed a very positive outcome of nature-based learning interventions of the educational outcomes of early learners even longitudinal studies have shown residual effects of these interventions on adults. So in light of these findings, more research should be done in other countries as researches were mostly from the developed countries.

Implications for practice: the findings revealed strong evidences for the effectiveness of nature-based learning interventions so educational psychologists and curriculum developers should started proposing nature-based interventions as a compulsory feature of education system so that holistic development of children could be ensured.

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