REVIEW ARTICLE

Human connection with nature improves wellbeing and pro-environmental behavior: A literature review

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Abstract: Given the world's continuous environmental concerns, there is a need for increased participation in nature protection. The ecological crisis of the last decade on Earth has become one of the causes of the rupture of society's relationship with nature. Such relationships can predict diverse attitudes, concerns, intentions, and pro-environmental behavior (PEB). A systematic literature review (SLR) aims to compare, study, and analyze journal articles that relate to issues related to nature as a major factor in pro-environmental behavior. The results of selecting articles indexed by SCOPUS found as many as 1716 publications. The 50 open-access publications of articles were chosen based on specific criteria and further examined to identify eight final articles that align with the Inclusion of Nature in Self (INS) scale. Pro-environmental behavior strengthens human relationships with nature and encourages a sense of ownership and involvement with the environment. Pro-environmental behavior refers to behaviors that are beneficial to the environment, such as supporting conservation policies, recycling, and participating in nature. Research using INS scale, which focuses on connections with nature, still has significant potential and should persist in making contributions to science and humanity.

Keywords: inclusion of nature in self (INS); nature connections; pro-environmental behavior (PEB)

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Introduction

Our environment faces a variety of problems, and many of them seem to deteriorate over time, bringing us into a time of real environmental crisis. The effort to raise awareness becomes a critical measure, especially in the individual's relationship with nature. Connection with nature is an individual's sense of identity about self-relationships and nature that encompasses cognition, emotion, and behavior (Hatty et al., 2020). Schultz introduced the concept of the connection with nature to explore the psychological relationship between individuals and the natural world for the first time (Schultz, 2002). Schultz's research highlighted the importance of fostering a strong connection with nature to promote pro-environmental behaviors (Schultz, 2002). This connection can lead to a greater sense of responsibility and stewardship towards the environment, ultimately contributing to efforts to combat environmental degradation.

The concept of a relationship with nature has been interpreted in various ways. Schultz defines it as the extent to which an individual integrates nature into his cognition as a form of "self-representation" (Schultz, 2002). Connecting with nature has many benefits for human health and well-being, such as reducing stress, improving positive mood, strengthening the immune system, and improving environmentally friendly behavior (Kövi et al., 2023). Until now, it has become one of the most important

aspects of understanding the relationship between man and nature, as well as its impact on the environment and society. Several studies have been conducted on the value of humans connecting with nature, emphasizing its many advantages. In addition to contributing to individual well-being, this relationship also plays a crucial role in promoting sustainability and pro-environmental behavior. People with a strong sense of connection to the natural environment are more inclined to practice pro-environmental habits like recycling and conservation (L. Martin et al., 2020). To solve the world's environmental issues and advance sustainability, it is believed that reestablishing a connection with nature is essential (Ives et al., 2018).

Recent research in America indicates that nearly 90% of the population spends their time indoors, leading to increased feelings of isolation and depression within their communities (Bratman et al., 2012). Bratman et al. (2012) concluded that the influence of experiences interacting with nature can affect cognitive function and mental health. Research in Europe and America has also shown that the adverse effects of separating individuals from nature significantly predict the level of mental fatigue, which in turn triggers aggressive behavior. The research conducted in the past two decades has utilized various methodologies and measurements. Researchers have shown that exposure to nature can reduce the effects of, for example, aggression, anxiety, depression, and various diseases. Research conducted in Brazil to assess whether the frequency of contact with nature influences the occurrence of anxiety, stress, and depression showed that people who had minimal contact with nature had a 97.95% chance of experiencing moderate stress, and this decreased to 20.98% for people who frequent contact with nature. In addition, in the same comparison, the likelihood of anxiety was 3.6 times lower and depression 4.8 times lower. It is proven that the greater the frequency of contact with nature, the lower the occurrence of symptoms of stress, anxiety, and depression (Bressane et al., 2022). Contrary to that, it will increase the positive influence, health, and cognitive capacity. Having a connection to nature turns into a mediating factor that helps kids develop to their full potential, heals from stress, and increases their desire to exercise and socialize (Kazdin & Vidal González, 2021). Positive attitude on the mental health of children and adults (Tillmann et al., 2018).

Various awareness-raising efforts related to the importance of keeping and preserving nature to remain sustainable are often carried out, one of which is the development of pro-environmental behavior for children, students, and employees, which is felt urgent. It means that making the human environment more dignified is one of the biggest problems of the 21st century (Kollmuss & Agyeman, 2002). A high level of human-nature connectivity (HNC) is crucial for achieving sustainability as it is linked to pro-nature actions and increased sustainability (Barragan-Jason et al., 2022). Pro-environmental behavior (PEB) includes actions that aim to reduce environmental harm and improve environmental quality (Lin & Wei, 2023). Simple actions like recycling and water conservation can be included in this category, as can more substantial lifestyle choices like switching to renewable energy sources or making sustainable purchases. These actions affect many facets of social and human well-being in addition to the environment (Zawadzki et al., 2020).

The high frequency of individuals exposed to the impact of natural environmental problems and the result of acquiring nature-related stimuli will affect the perception of individuals to tend to maintain quality and generate pro-environmental behavior (Arendt & Matthes, 2016) to preserve and protect the environment for future generations. The urgency of addressing the factors that influence students' relationships with nature is evident across multiple dimensions, including cultural context, diversity, perceptions, cross-cultural differences, educational impact, health, environmental literacy, and learning outcomes (Moreno et al., 2020). By understanding and addressing these factors, educators and policymakers can develop effective strategies to foster a deeper connection to nature among students, ultimately promoting a more sustainable and healthy society.

So far, four systematic literature reviews (SLR) of connectedness with nature have been found. The first is about connectedness to nature (CNT). The concept of connectedness to nature (CNT) encompasses various dimensions and indicators explored in systematic literature reviews (SLR), including emotional, cognitive, behavioral, and well-being aspects. Which describes the current state of knowledge about CNT, evaluates any effort towards CNT spatial mapping for environmental management, and identifies the size of CNT as defined in the wider literature (Restall & Conrad, 2015). The related studies also explore the correlation between natural connections, environmental identity, and environmental self-identity (Balundė et al., 2019). Thirdly, it deals with the state of psychological knowledge of the factors that precede the connection to nature (Lengieza & Swim, 2021) and there is research that reviews how nature affects children and adolescents (Arola et al., 2023).

Therefore, it can be said that no SLR has found any focus on connections with nature that would impact the pro-environmental behavior of each individual reviewed using the INS scale. The INS scale is a widely used tool in environmental psychology for measuring an individual's connection to nature (Kleespies et al., 2021). The INS scale is used to assess the connection between humans and nature, which plays a crucial role in environmental education and psychology (Kleespies et al., 2021). Despite its simplicity, the INS scale has been found to have good reliability and validity in various studies (C. Martin & Czellar, 2016), it has been used alongside other scales like the Connectedness to Nature Scale

(CNS) and the Environmental Identity Scale (EID) to provide a comprehensive assessment of environmental identity and pro-environmental behaviors. So, this study aims to compare, analyze, and study journal articles related to the connection between nature and pro-environmental behavior, focusing on the inclusion of the Nature in Self (INS) scale.

Method

Research Framework

This review is an SLR that covers techniques for identifying, evaluating, and analyzing a variety of up-to-date information relevant to literature or references to answer research questions and examine them thoroughly (Snyder, 2019; Xiao & Watson, 2019).

Research Questions

Determining the scope of developing a clear research focus involves using research questions. These research questions are developed to respond to the needs of the chosen problem, namely: "What factors influence students with connections with nature so that they can form a pro-environmental behavior?
To understand how nature relationships influence pro-environmental behavior based on the Inclusion of Nature in Self (INS) scale, we conducted a systematic literature review. Systematic literature mapping enhances housing knowledge and theory, providing more systematic, balanced, and transparent literature reviews, identifying research gaps, and highlighting robust evidence (Soaita et al., 2020). The stringent processes we designed are shown in Figure 1. We browse the SCOPUS database using the keywords "inclusion, nature, and self" to focus the search. Search engines can locate any articles that include the phrase "inclusion nature self" in their titles, abstracts, content, or references. Scopus was selected due to its extensive data availability, making it suitable for conducting a thorough library review. With these keywords, we found 1716 articles dealing with inclusion nature.

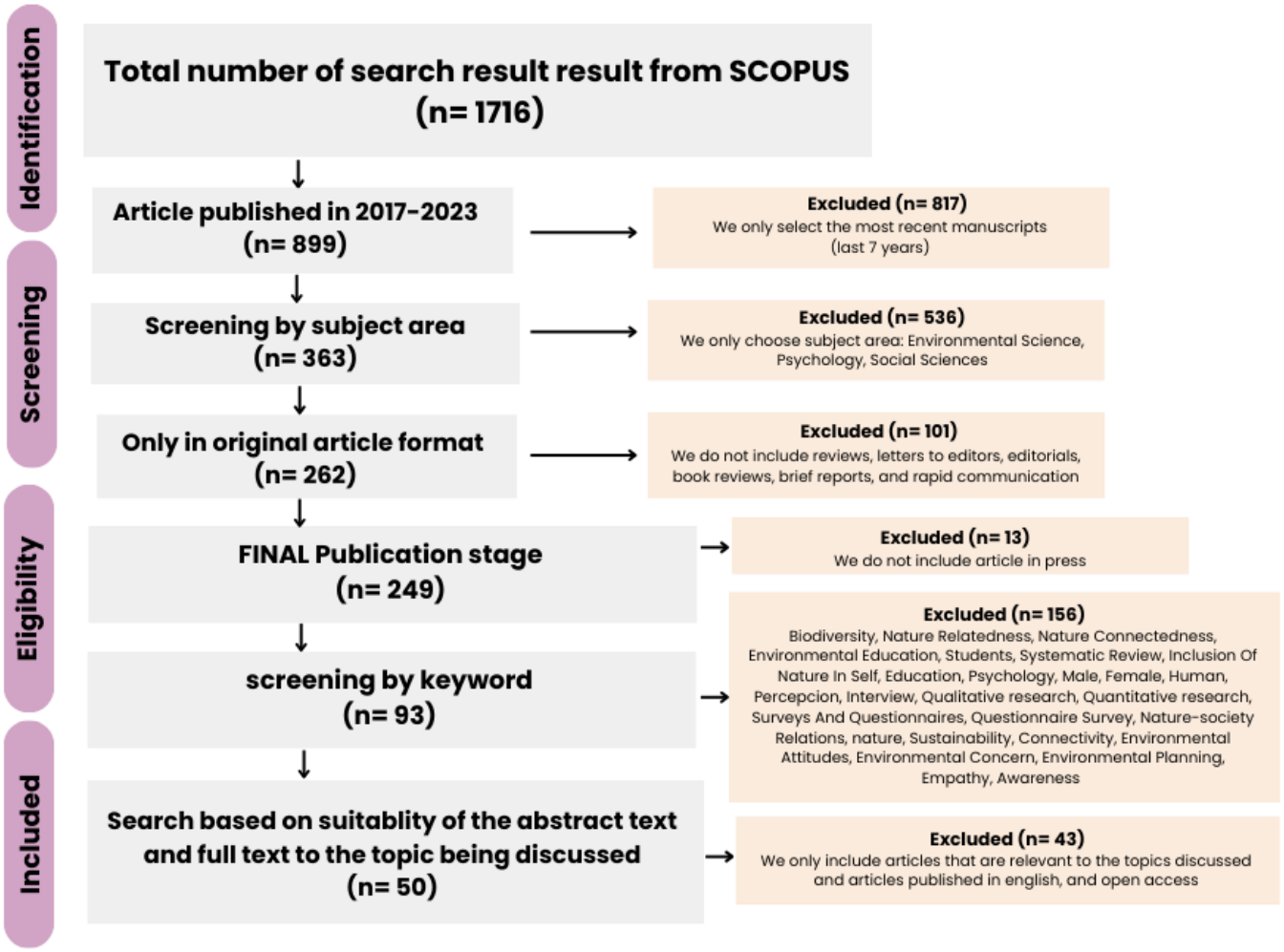

Figure 1. PRISMA flow diagram

We searched for publications from the last seven months, 2017–2023. The search was narrowed down to 363 by focusing on the subject areas of environmental science, psychology, and social sciences. We use the inclusion and exclusion model as a reporting item of a systematic survey option in line with (Hirt et al., 2022). The methodology we employ is a scoping review (Pham et al., 2014; Vythilingam et al., 2022). A scoping review aims to address inquiries related to a specific research topic by using various sources that contain similar research papers. The process involves categorizing and drawing conclusions from the gathered information (Husamah et al., 2022).
The following are the inclusion criteria used, namely: (1) articles that have a final publication stage; (2) articles that contain keywords that relate to the research topic “inclusion nature self”; (3) articles published in English; (4) articles that are open access. Based on the criteria of inclusion filed at the final publications stage as many as 249. We defined the relevant fields of science through filter by keyword, such as Biodiversity, Nature Relatedness, Nature Connectedness, Environmental Education, Students, Systematic Review, Inclusion Of Nature In Self, Education, Psychology, Male, Female, Human, Interview, Qualitative research, Quantitative Research, Surveys And Questionnaires, Questionnaire Survey, Nature-society Relations, nature, Sustainability, Connectivity, Environmental Attitudes, Environmental Concern, Environmental Planning, Empathy, Awareness until 93 meet the criteria. The researchers restricted articles that only used English, obtained 73 articles, and accessed 50 articles that met the criteria. The obtained data is CSV and RIS which is then synced into the Reference Manager (Mendeley). To visualize the data, use VOSviewer software to make the data more transparent and communicative (Husamah et al., 2022). The researchers then performed the analysis manually. Of the 50 articles examined the abstract relevance, the theme, and that uses the INS scale in its connection with nature.

Results and Discussion

Distribution Year

Figure 2 shows some articles published from 2017 to 2023. Most were published in 2019 and 2021. In 2022, there was a slight decline and a rebound in the following year, 2023. The theme of the inclusion of nature in oneself is becoming increasingly popular this year, as evidenced by the increasing re-publishing of articles by some criminals. Although there are only eight articles published in 2023, the topic will likely re-emerge in the next year.

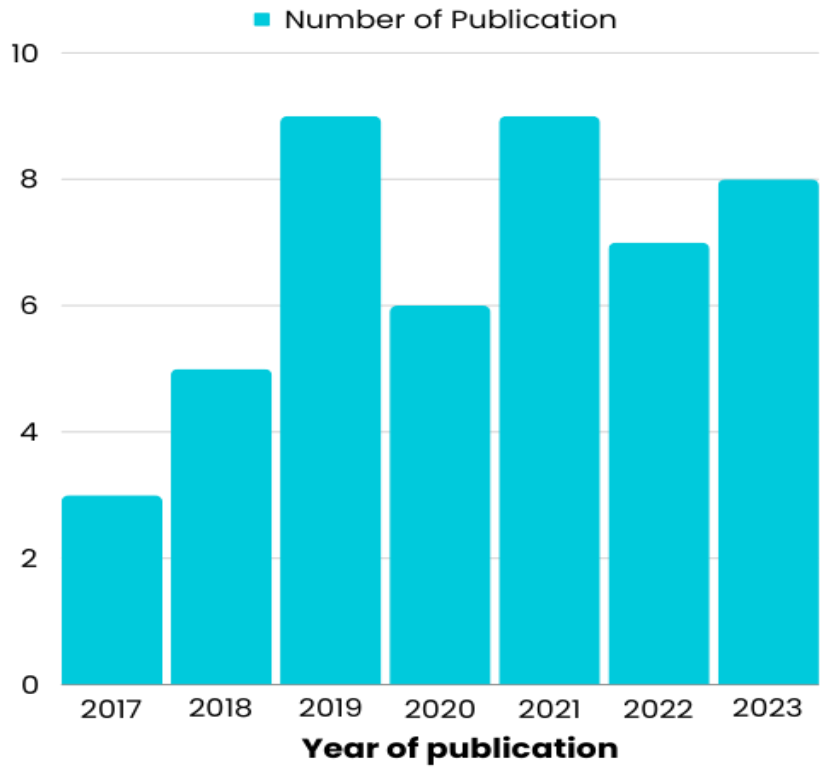

Figure 2. Year of publication of the article

The trend on the theme of “inclusion of nature in self” is becoming increasingly popular this year, as evidenced by the rise in the re-publishing of articles. The researcher's interest in this topic still exists. Research into relationships with nature, providing an insight into the extent to which a person feels included in nature and considers nature as part of himself, is an interesting topic for many fields of science, such as environmental psychology, environmental education, conservation, and mental health. One of the most common measurements used to measure relationships with nature is the inclusion of nature in self (INS) scale, developed by (Schultz, 2002). This scale is very short and easy to administer, consisting only of seven circular images showing the degree of self-inclusion with nature.

Research related to nature using the INS scale has been carried out in various countries, such as the United States, the United Kingdom, Germany, Spain, Italy, the Netherlands, Australia, India, China, Japan, and others. Some studies have found that relationships with nature are positively linked to pro-environmental behavior, subjective well-being, mental health, and positive attitudes toward biodiversity (Adiwena & Djuwita, 2022). Other studies explore factors that influence relationships with nature, such as contact with nature, environmental values, ecological identity, culture, religion, and gender. In addition, some studies have also developed or modified the INS scale for specific purposes, such as for children, and people with cognitive impairments, or to measure connections with a particular nature (Kosta et al., 2022; Kövi et al., 2023; Lanza et al., 2023).

From these studies, it can be concluded that connections with nature are constructions that have wide relevance and variation, both theoretically and empirically. The INS scale has become one of the most effective and efficient measurements for measuring relationships with nature, although it is not perfect and still needs further development. The INS scale is effective in measuring the connection to nature and has been successfully adapted for specific groups, such as children with cognitive limitations, through the Illustrated INS (IINS) (Kleespies et al., 2021). Research on relationships to nature using the INS Scale still has great potential to contribute to science and humanity. Research on relations with nature with the inclusion of nature in self (INS) scale has grown since the scale was first introduced by Schultz in 2001 (Schultz, 2002). Based on existing research such as Mayer and Frantz (2004), C. Martin and Czellar (2016), and Kurazumi et al. (2020) the following summarizes the evolution of the INS scale from year to year:

In 2004, Mayer and Frantz developed the connectedness to nature (CNS) scale, which consists of 14 items that measure emotional and cognitive feelings towards nature (Mayer & Frantz, 2004). In 2016, Martin and Czellar developed the extended inclusion of nature in self (EINS) scale, which is an extended version of the INS scale (C. Martin & Czellar, 2016). This scale adds three new items that are based on spatial metaphors, namely size, distance, and centralization. The scale shows good validity and reliability, as well as being able to overcome some of INS' scale constraints, such as low sensitivity and a lack of response variation. In 2019, Mackay and Schmitt developed the inclusion of nature in self for children scale (INS-C), which is an adaptation of the INS scale for children (Mackay & Schmitt, 2019). This scale uses images that are more attractive and easier to understand by children, such as animals, flowers, and trees. It also shows good validity and reliability and can measure children's connection to nature more accurately. In 2018, Kellert has developed the biophilia index scale (BI), which is a multidimensional scale that measures relationships with nature based on nine values of biophilia. Biophilia values are the values underlying human relations with nature, such as aesthetic, spiritual, symbolic, and so on. The scale consists of 36 items that assess the extent to which a person agrees with statements related to the biophilia value (Kellert, 2018). This scale is claimed to be more comprehensive and holistic than previous scales and can reveal the variation and complexity of connections with nature. Research related to nature using the INS scale has undergone many innovations and modifications along with the development of theory and methodology. The emerging new scales seek to improve the validity, reliability, sensitivity, and variation of measurements of relationships with nature, as well as adapt to the needs and characteristics of different populations.

Research Type/Method

In the eight revised articles, research trends related to “inclusion of nature in self” tend to use quantitative methods. However, based on the screening of data from 50 articles (including articles that do not use INS) was found that qualitative and quantitative methods were more dominant. The problems concerning average characteristics were more likely to be approached using qualitative methods. Issues related to scale or the inclusion of Nature in Self (INS) were more likely to be approached using quantitative methods. Besides, some researchers use both methods simultaneously in their research. Table 1 presents a distribution of 50 articles that are open access based on the type of research they have. Overall, fans of quantitative methods are more. Another interesting thing is that there is a tendency toward the theme of “inclusion of nature in self” through both quantitative and qualitative research.

Table 1. Types of research in screening 50 articles

No.	Types of research	Number	References
1.	Qualitative	19	(Morris, 2019); (Willis & Schmidt, 2018); (Jang & Kim, 2023); (Brunner et al., 2019); (Martela & Ryan, 2023); (Jones et al., 2021); (Kleespies et al., 2021); (Reed et al., 2022); (Biesecker & von Winterfeld, 2018); (Winter et al., 2017); (D. Hudson et al., 2023); (Thana et al., 2021); (Pérez-Ramírez et al., 2021); (Núñez-Ríos et al., 2020); (Ceatha et al., 2019); (Davidson et al., 2021); (Sadler et al., 2023); (Helbing et al., 2021); (Lövgren et al., 2023)
2.	Quantitative	26	(Bai et al., 2023); (Soboleva et al., 2020); (Gainza Perez et al., 2022); (Varao-Sousa & Kingstone, 2019); (Gkargkavouzi et al., 2019); (Al-Sahlawi et al., 2020); (P. Hudson et al., 2021); (Ong et al., 2019); (Pasca et al., 2017);(Coker & Burgoon, 1987); (Chikhi et al., 2023); (Torres-Ortuño et al., 2020); (Lanza et al., 2023); (Ambrose et al., 2021); (Uldall et al., 2022); (Baker et al., 2019); (Heszlein-Lossius et al., 2019); (Tong & Wu, 2020); (De Dominicis et al., 2017); (Scheerer et al., 2022); (Kosta et al., 2022); (Frost & LeBlanc, 2022); (Sidiropoulos, 2018); (Miller et al., 2018); (Kövi et al., 2023);(C. Martin & Czellar, 2016)
3.	Quantitative-Qualitative	4	(Junge et al., 2020); (Schwender et al., 2018); (Vythilingam et al., 2022); (Anthun et al., 2019)

Quantitative methods can be used to test the relationship between INS and other variables, such as pro-environmental behavior, subjective well-being, mental health, and attitudes toward biodiversity. The qualitative method can be applied to explore factors that influence INS, like contact with nature, environmental values, ecological identity, culture, religion, and gender (Kleespies et al., 2021; Lanza et al., 2023; Moreno et al., 2020; Pérez-Ramírez et al., 2021). INS-related research trends are more likely to use quantitative methods that may be based on the assumption that INS is an objectively and consistently measurable construction using the INS scale. However, this is not always true because the scale has some limitations, such as low sensitivity and a lack of response variation, and does not take into account the qualitative aspects of relationships with nature (Ceatha et al., 2019).

Author and Keyword

In Figure 3, there are relationships and connections between authors with the same theme of inclusion of nature in self (INS) resulting from the findings of the VOSviewer release Nisbet E.K. (Nisbet et al., 2009), Schultz P. W. (Schultz, 2002), Zelenski J. M. (Zelenski et al., 2023), and Ryan R. M. (Ryan et al., 2010) have been the leading names in the last five years discussing the theme of inclusion of nature in self (INS) in connection with nature. The authors who have published the most articles on the theme of the inclusion of nature in self are Nisbet E. K., Schultz P. W., Zelenski J. M., and Ryan R. M. In Figure 3, it is shown that of the three authors, Nisbet E.K. has the most publications of four articles. Until now, Schultz, P. W., has become an important reference in listing collaborative names, quoting each other, and developing the inclusion of nature in the self (INS) scale. INS has become a psychological concept that measures how close a person is to nature (Schultz, 2002).

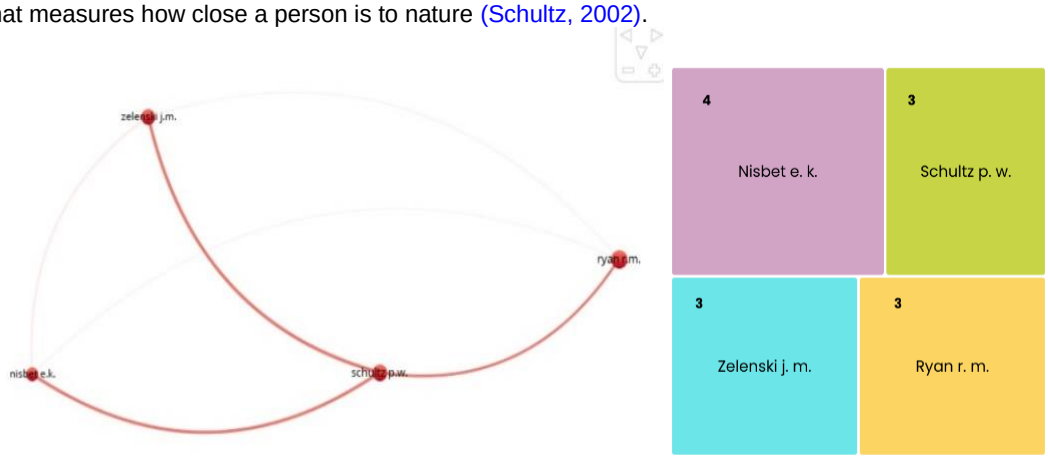

Figure 3. A writer who mostly publishes works with the theme of INS

Based on Figure 4, the spread of data on INS-related themes in some countries, it appears that the United States has the highest number of documents, citations, and total link strength among other countries. This may be due to the high interest and support in environmental psychology in the United States, as well as the availability of adequate funds and research facilities. Besides, the United States also has extensive natural diversity, which can affect the level of connectivity of its inhabitants to nature. The US has a vast scientific power backed by sophisticated human resources, advanced science, and a strong library of science. The country is home to numerous leading institutions and universities conducting research related to nature. For example, Nagasaki University has the largest number of papers in this field. On the other hand, Germany has the same number of documents as Canada but has a higher quotation. It suggests that research on INS in Germany is more qualitative or impactful than in Canada. However, the German total link strength is very low, which indicates that the research is less connected or relevant to other research in the same field. It can be influenced by different cultural, political, or social factors between Germany and other countries.

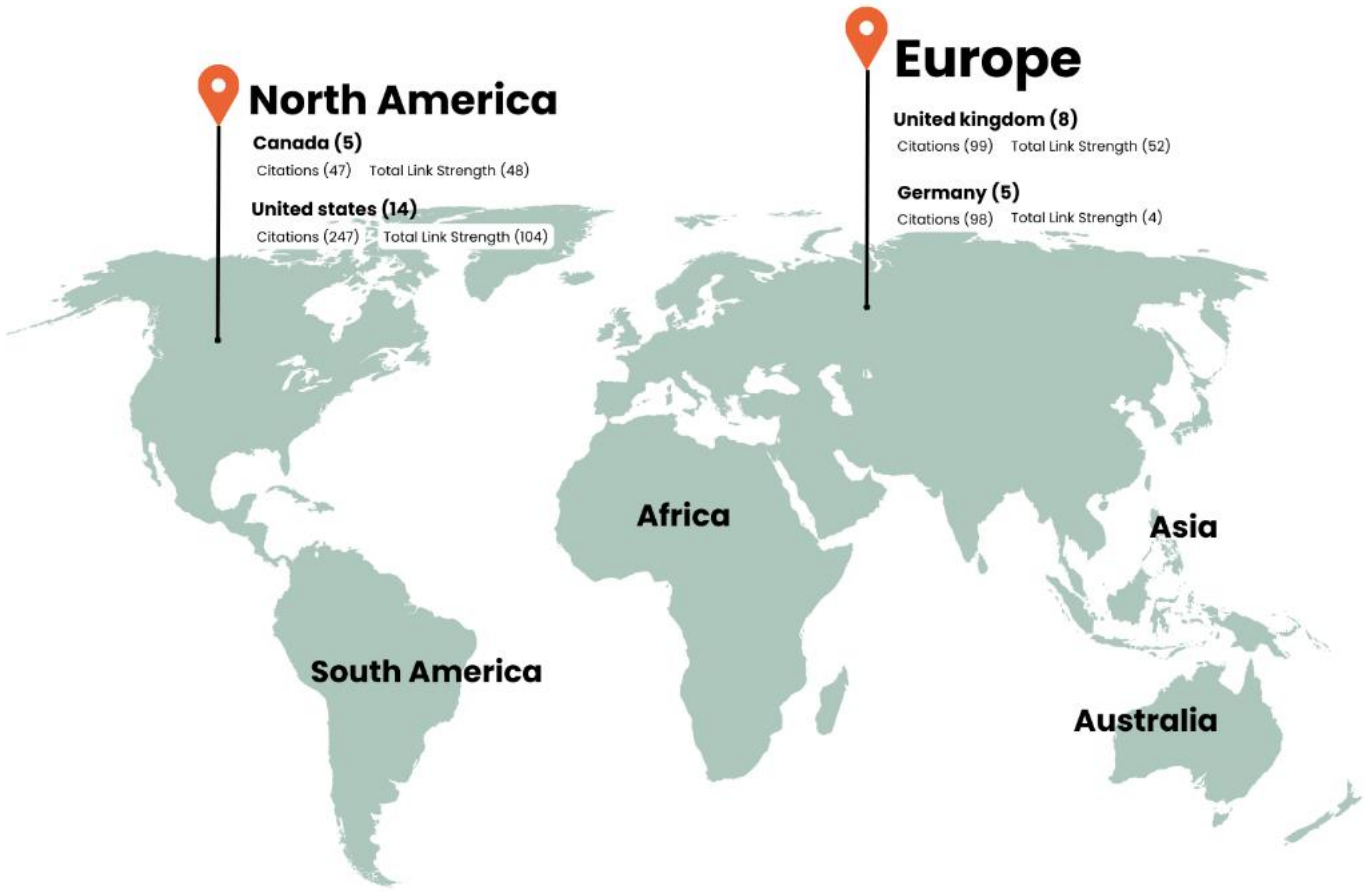

Figure 4. Number of publications spread in the Netherlands Researchers

From the bibliometric analysis carried out by the authors, it was found that the most productive authors in publishing articles related to INS were Nisbet, E. K., Schultz, P. W., Zelenski, J. M., and Ryan, R. M. Nisbet and E.K. had four publications, whereas Schultze, W. P. Zelensky, M. J., and Ryan R.M. each had three publications. In addition, it was also found that Schultz, P. W., was the most influential author in this field, as he was the first author to develop the INS scale in 2001 and also the most quoted author by other authors. Schultze, P. W., also had strong collaborations with Zelenski, J. M., and Nisbet, E. K., who were also important authors in the field. Schultz, P. W., is from the United States and is a professor of psychology at the University of California. He was interested in the INS scale because he wanted to study the implicit connections that individuals make between themselves and nature and their impact on attitudes and environmental behavior (Schultz, 2002).

Nisbet, E. K., is from Canada and is a professor of psychology at Trent University. He is interested in the INS scale to find the relationship between connections with nature and subjective well-being, mental health, and environmental behavior. He also contributed to the development of the nature-relatedness

scale, which is an alternative scale for measuring relationships with nature (Kövi et al., 2023; Nisbet et al., 2009). Zelenski, J. M., is from Canada and is a professor of psychology at Carleton University. He was interested in the INS scale because he wanted to study the relationship between connections with nature and happiness, as well as the factors that influence connections to nature, such as contact with nature, environmental values, and environmental identity (Kövi et al., 2023; Zelenski et al., 2023). Ryan, R.M. is from the United States and is a professor of psychology at the University of Rochester. He was one of the pioneers of the theory of self-motivation, which explains how humans meet their psychological needs through relationships with the environment. He was interested in the INS scale because he wanted to study the relationship between connections with nature and intrinsic motivation, as well as its impact on environmental well-being and behavior (Martela & Ryan, 2023). This impacts the choice of keywords and references, improving searchability, research quality, information validity, readability, and citations. The articles written by the authors focus on various aspects related to INS, such as its relationship with pro-environmental behavior, subjective well-being, mental health, attitudes towards biodiversity, factors affecting INS, and the development or modification of the INS scale. The INS scale itself was developed in 2001 by Schultz (Schultz, 2002) and was adapted into Indonesian in 2021 by Adiwena and Djuwita (2022). Therefore, there is still a need for socialization and wider dissemination of these concepts and measurements among academics and practitioners in Indonesia. Research on connections with nature using the INS scale also requires adequate access and contact with the natural environment, which may not be easily obtained in Indonesia, especially in urban areas. According to data from the World Bank, the urbanization rate in Indonesia reached 56.4% in 2019, which means more than half of Indonesians live in cities that tend to have limited and degraded natural environments. It can affect the level of connection with nature and interest in exploring it in Indonesia. Research on connections with nature using the INS scale may also lack the attention and support of the Indonesian government and society, which may focus more on other issues considered more urgent and relevant, such as economic development, health, education, and politics.

Research Subject

The research on the connection with nature is more focused on social groups such as activists who have an impact on society, health, and social groups. The second level that is much discussed is the level of students, as well as teachers who play a role in the field of education. The number of subjects in detail is shown in Table 2.

Table 2. Research subject

No.	Research Subject	Total
1.	Children	6
2.	Students	13
3.	Students and teachers	9
4.	Community group	22

Relationship with nature and pro-environmental behavior

Figure 5 reveals a visual representation of the keyword trends the author often uses to write related to the themes taken. Based on Figure 5, the keywords obtained relate directly to humans, adults, psychology, males, and females. Keywords such as "middle-aged, female, male, adult, and young adults" are closely linked to each other and indicate the demographic group being studied. In addition, some keywords related to research methodological terms like "controlled study, major clinical study." The article's significant contributions to the theme are outlined in Table 3. This table presents the contribution of various references, each was analyzed about the inclusion of nature in self with pro-environmental behavior. The analysis identifies five important points that pertain to the connection between nature and individual pro-environmental behavior.

1) Relationship with nature (INS) is a psychological concept that measures the extent to which a person feels included in nature and considers nature as part of himself.
2) INS is influenced by experiences of contact with nature from childhood to adulthood, as well as by spiritual, cultural, and emotional aspects related to nature.
3) INS is strongly correlated with pro-environmental behavior (PEB), which involves actions that benefit the environment, such as supporting conservation policies, recycling, reducing consumption, and participating in civil action.
4) INS can also be influenced by other factors, such as ecological worldviews, environmental values, and persuasive messages emphasizing personal and environmental benefits.
5) Environmental education interventions can enhance INS, particularly by strengthening children's psychological connections with nature and providing exposure to inspiring natural scenery.

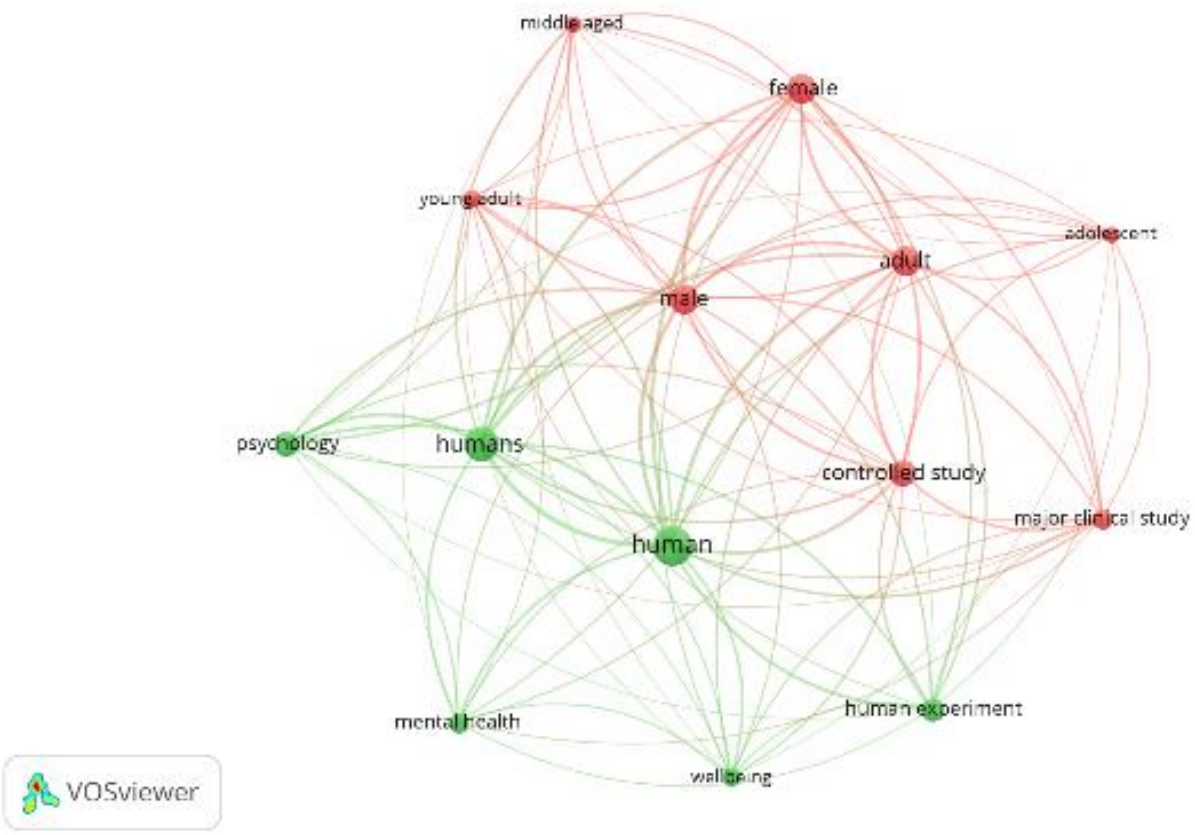

Figure 5. VOSviewer view for "keyword" type of analysis

Table 3. Important contributions of articles to the theme of connectedness to nature

No.	Aims	Main result	Contribution of each reference	Links to Connectedness with nature
1.	Measuring validity, correlation, and mediation between nature connectedness, well-being, and spiritual or emotional factors.	Cross-cultural differences were found in a number of key components of nature connectedness, as well as differences in the relationships between nature connectedness, spirituality, and well-being.	Spiritual aspects of human-nature relationships can contribute to cross-cultural well-being (Kövi et al., 2023).	There is a connection with nature because there is a connection between measuring feelings with the natural environment.
2.	Examining the influence of environmental education on participants' emotional connections with nature.	This research found that environmental education programs have a positive effect on students' knowledge and awareness of environmental issues, such as climate change, biodiversity, and pollution.	Environmental education programs increase students' connectedness to nature, as measured by the INS scale (Kosta et al., 2022).	This research is related to nature because it examines how environmental education programs can increase students' connectedness to nature and their knowledge of environmental issues.

No.	Aims	Main result	Contribution of each reference	Links to Connectedness with nature
3.	Proving that altruistic environmental concern is broader than selfish environmental concern.	The personal benefits of pro-environmental behavior are more effective in increasing pro-environmental intentions and behavior for self-interest-oriented individuals, while messages that emphasize environmental benefits are more effective for altruism-oriented individuals.	Messages that emphasize personal and environmental benefits simultaneously are no more effective than messages that emphasize either benefit alone (De Dominicis et al., 2017).	This research is related to nature because it examines how self-interested environmental concern and altruism influence pro-environmental behavior, which is behavior that has an impact on the natural environment.
4.	Describe an IoT-based shared plant factory system for enhancing human-nature connectedness in the built environment.	It was found that sharing plant plants can increase users' human-nature connectedness significantly compared with traditional plant pots.	Plant maintenance efficiency also increases with the help of plant-sharing plants (Tong & Wu, 2020).	Facilitating user contact with nature through plant factory technology in the built environment.
5.	Measuring the impact of awe of nature on self-perception and environmental attitudes.	These results indicate that exposure to awe-evoking stimuli can increase pro-environmental attitudes.	INS significantly mediated the effect of exposure to panoramic natural views (compared to neutral controls) on pro-environmental policy attitudes; however, the same effect was observed for pictures of ordinary nature and delicious food (Ambrose et al., 2021).	Facilitates the experience of awe towards nature and modulates self-concept which can influence environmental attitudes.
6.	Analyzing the influence of nature connectedness on children's SEL skills.	These results suggest that children's connectedness to nature can have a positive impact on their SEL skills.	Recommends the development of nature-based SEL interventions with an explicit focus on strengthening children's psychological connectedness to nature (Lanza et al., 2023).	Increase children's connection to nature through outdoor activities that can support their social-emotional learning.
7.	Create a measuring tool for nature connectedness that is suitable for children with special needs.	It was found that seven items had appropriate discrimination and difficulty indices, in addition to having good agreement. The other six items had inadequate discrimination indices and did not have a good fit. A second study with 321 participants showed that the seven-item scale had adequate levels of reliability and validity.	It would be more appropriate to use a shorter version of the scale after removing items indicating inappropriate behavior, as they may interfere with the results of research on connectedness to nature (Pasca et al., 2017).	Increasing individuals' connectedness to nature through subjective cognitive measures.
8.	Classify, measure, and predict environmental behavior based	Found six domains of environmental behavior: civic action, policy	Connectedness to nature and an	Discusses human behavior that has an impact on the

No.	Aims	Main result	Contribution of each reference	Links to Connectedness with nature
	on nature's interconnectedness, worldview, and environmental concern.	support, recycling, transportation choices, behavior in the home environment, and consumerism.	ecological worldview is more predictive of civic action, recycling, home behavior, and consumerism than environmental concern (Gkargkavouzi et al., 2019)	natural environment and the factors that influence it.

Researchers can formulate several important points from article contributions obtained one at a time. As presented in Table 3, the points dealing with relationships with nature become a psychological concept that measures the extent to which a person feels included in nature and considers nature as part of himself. This concept is also known as nature relatedness, nature connectedness, or inclusion of nature in self (INS) (Kövi et al., 2023; C. Martin & Czellar, 2016). The INS scale can also be used to investigate factors that influence relationships with nature, such as contact with nature and environmental values, environmental identity, culture, religion, and gender (Kosta et al., 2022). The scale can also be used to develop or modify other scales related to nature, such as the scale extended inclusion of nature in self (EINS), the inclusion scale of nature in self for children (INS-C), and the biophilia index scale (BI).

Connecting with nature can reduce stress, as nature provides an opportunity for relaxation, restoration, and recovery from daily stress and exhaustion. Nature can also stimulate human senses by providing visual, auditory, and olfactory sensations that are pleasant and soothing (Mayer & Frantz, 2004; Zelenski et al., 2023). In addition, it can enhance positive moods like feeling happy and comfortable because nature provides a source of beauty, wonder, and joy that can trigger positive emotions. Nature can also increase gratitude, appreciation, and satisfaction with life. Connecting with nature can improve mental health, as nature provides an opportunity for reflection, introspection, and meditation that can help overcome psychological problems such as depression, anxiety, and mood disorders. Nature can also improve cognitive health, such as memory, attention, and creativity (Ives et al., 2018; Pasca et al., 2017; Raja & Calvo, 2017; Restall & Conrad, 2015).

On the other hand, connecting with nature can enhance pro-environmental behavior because nature provides awareness, knowledge, and values that can motivate humans to care for and be responsible for the environment. Nature can also enhance the identity of the environment, namely the sense of ownership and involvement with the environment (Goldman et al., 2017; Robelia et al., 2011). It can also strengthen a positive attitude towards biodiversity, as nature provides an opportunity to know, appreciate, and enjoy the various kinds of life on Earth. Nature can also enhance respect, empathy, and solidarity with other living beings. When humans do not feel connected to nature, they tend to be careless and disrespectful of the environment and behave as if they have nothing to do with nature (Nisbet et al., 2009). However, when humans feel close and attached to nature, they realize that they and nature are one unity that needs each other. Environmentally friendly behavior is easier to do because destroying nature is equal to self-destruction (Brick et al., 2017; L. Martin et al., 2020; Zelenski et al., 2023).

It means that connections with nature cannot be exempt from pro-environmental behavior. There is a strong and positive correlation, according to the body of research, between a person's pro-environmental practices and their bond with nature (Mackay & Schmitt, 2019). Relative to both intentional and impulsive environmental behaviors, both implicit and explicit links to nature are important. Connections with nature positively influence environmental behaviors, with explicit connectedness leading to deliberate behaviors and implicit connectedness leading to spontaneous behavior (Lin & Wei, 2023). Positive emotions, emotional closeness, and spending time in nature all help to strengthen our bond with the environment. Previous research has shown that the strongest predictor of pro-environmental behavior is an emotional connection to nature. This connection is more common among adults, women, and people living in urban areas, as opposed to those living in rural areas (Anderson & Krettenauer, 2021). Additionally, the degree of connectivity and the actions that follow are influenced by demographic variables. Emotional connectedness to nature is the strongest predictor of pro-environmental behavior, with higher levels in adults, females, and urban versus rural Canadians (Anderson & Krettenauer, 2021). Consequently, encouraging sustainable behaviors requires the use of tactics that strengthen people's connection to nature, such as environmental education and exposure.

Pro-environmental behavior (PEB) refers to behaviors that are beneficial to the environment, such as supporting conservation policies, recycling, and participating in nature. Many elements, such as values, identity, social signals, emotions, and personality traits, might impact an individual's pro-environmental conduct. Various factors, such as misaligned interests and unequal opportunities, should be considered when developing effective ways to support PEB. It is possible to increase the efficacy of initiatives to

promote sustainable behaviors by comprehending the multifaceted character of PEB and customizing interventions to particular circumstances (Maki et al., 2019). Human beings are strongly linked to the environment, and primarily and fundamentally, pro-environmental attitudes toward human beings become an incentive to enhance their environmental identity, that is, their sense of ownership and involvement with the environment. Environmental identities can influence pro-environmental behavior because people who have a strong identity with the environment tend to have more positive and consistent attitudes and behaviors towards their environment.

Conclusion

Based on systematic surveys carried out, factors that influence pro-environmental behavior and relationships with nature, as well as various ways to measure them, have been studied and measured in various scientific articles. The results of the analysis show that connections with nature have a positive impact on pro-environmental behavior. Moreover, the most widely published authors on the inclusion of nature in self (INS) are Nisbet, E. K., Schultz, P. W., Zelenski, J. M., and Ryan, R. M., who investigate various aspects related to INS, such as its relationship to pro-environmental behavior, subjective well-being, mental health, attitudes toward biodiversity, factors affecting INS, and the development or modification of the scale of INS. In the dissemination of data on INS-related themes in some countries, the United States has the highest total number of documents, citations, and link strength among other countries.

Pro-environmental behavior becomes the main factor in the relationship with nature. Relationships with nature cannot be exempt from pro-environmental behavior because humans are strongly bound to the environment in particular and in essence, pro-environmental attitudes in human beings become an incentive to enhance the identity of the environment, that is, the sense of ownership and involvement in the environment. From the research that has been reviewed, it can be concluded that the connection with nature is a construction that has wide relevance and variation, both theoretically and empirically. The INS scale has become one of the most effective and efficient measurements of relationships with nature, although it is not perfect and still requires further development.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

D. M. Sulfa: conducting the research, collecting data, writing original article; **H. Suwono:** supervising the research, developed the methodology, revision; and **H. Husamah:** supervising the research and revision

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