Scoping Review of Environmental and Sustainability Education in Teacher Education: Historical Context of Research and Preliminary Results

Douglas D. Karrow*, Ph.D
Susan Maureen Docherty-Skippen†, Ph.D
Rob Blom‡, Ph.D(c)

*Department of Educational Studies, Brock University
†Canadian Institute for Military and Veteran Health Research
‡Department of Educational Studies, Brock University

Authors Note†

Douglas D. Karrow: https://orcid.org/0000-0001-9856-4557
Susan Docherty-Skippen: https://orcid.org/0000-0001-9705-0693
Rob Blom: https://orcid.org/0000-0003-0343-2549

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Correspondence concerning this article should be addressed to Douglas D. Karrow, Department of Educational Studies, Faculty of Education, Brock University. 1433 Headon Road, Burlington, Ontario, L7M 3Z5. The researchers (Douglas and Susan) wish to acknowledge the assistance of graduate student Robert Blom in the final preparation of this manuscript for dissemination and Brock University for financial assistance in the form of a graduate assistantship to support final manuscript preparation.

† Douglas and Susan were the original researchers and presenters at the two conferences. Susan produced the charts and graphs with Covidence software. Rob produced this repository piece and Rob and Doug updated the data and graphs in a published article in the IJSEHE.
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Preface

Since hiring me, Douglas and I (Rob) have updated the dataset and teased out errors in the csv file. We also expanded the data by incorporating Journal Names in the original dataset as we felt it pertinent to our research objectives. Extracting the data from Covidence as a CSV and working with LibreOffice Calc, we spent meticulous time ensuring the data was without errors.\(^2\) What you see below is the original data, unadulterated, that was used to present research in two conferences:


The corresponding manuscript—entitled “Environmental and Sustainability Education in Teacher Education Research: An International Scoping Review of the Literature” to which Douglas and I are the authors—will be published in the special issue *Making an Impact – UN Sustainable Development Goals and university performance* of the *International Journal of Sustainability in Higher Education* (IJSHE). We are delighted the work will be visible to our peers around the world. We really hope our way of visualisation through spatio-temporal

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\(^2\) Approximately 37+ errors were detected, including duplicates not processed correctly … which led to a final exclusion criterion of “duplicates not identified by Covidence” added onto the methodology. Ironically, while processing the updated data did change the Tables and Flourish Graphing to such and such degree (usually swapping a journal here and there between regions), it did not make too much of a dent in Figure 1 of Methodology due to some errors NOT being included when the entry was meant to be included, and some entries included as duplicates. The double error resulted in a +5-4 calculation leading to one extra paper being included in the final published form. The epistemological question then becomes: to what extent is perfectionism meaningful? To what percentage (%) is permissible and legitimised through fuzzy logic?
models becomes standard to research in the area of ESE-TE as it adds a richer dimension lost in static re-presentation of raw data alone.

Most importantly, all relevant and updated data can be found at IJSHE and not here. The data presented in our published paper is Open Access for everyone to see. The data presented here is simply for historical purposes to show where the paper came from—that is, to acknowledge the process—and to redirect readers to our published IJSHE manuscript—that is, to acknowledge the (final) product.
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Original Abstract

To identify the international trends in environmental and sustainability education in teacher education (ESE-TE) research, we (Doug and Susan) report research from a scoping literature review. Different from international literature reviews in ESE that have examined policy issues, sustainability pedagogies, and how ESE is embedded in TE curriculum, our study focuses on all aspects of ESE relevant to TE. We screened 2,142 research articles spanning over five decades and 81 countries. Of the 788 articles deemed eligible (i.e., English-language, peer-reviewed, pre-service/in-service teacher education that explicitly mentioned ESE-TE research), data from 637 studies have been included in this study. Our research analysis included quantifying the geographic, temporal, and methodological trends, and a qualitative exploration of the research problems/context themes. While 82% of the research articles we examined were empirical, the most prevalent problems investigated across all of the studies centred on the themes of TE commonplaces (34%), competencies and literacy (20%), and awareness (16%). While no definite conclusions may be drawn until the complete data set has been analysed (a forthcoming paper), preliminary findings suggest a disparity of ESE-TE research in Asia, South and Central America, and Africa. Preliminary results also suggest that more research in the context of TE praxis is needed.

Keywords: Environmental and sustainability education (ESE); teacher education (TE); international research trends, scoping review, United Nations Decade of Education for Sustainability.
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Preamble

The literature on environmentalism and sustainability in education—in particular teacher education—has gained traction in the last two decades in large part due to the UN’s 17 sustainable development goals (SDGs) implemented at the global level. In Canada we have our unique relationship and rich history with the environment. We have vast biomes and lands of forests, dare we say wilderness, coupled with our large reservoirs of fresh water and glacial water in the Rocky Mountains; we have our own temperate rainforest in British Columbia and Carolinian forests in Southern Ontario; we also have a uniqueness in river systems insofar as no one individual owns a river—or part of a river—stemming from a hybridised indigenous philosophy with the outgrowth of Western colonialism.

While we are Canadian researchers, the review of literature regarding environmental and sustainability education in teacher education (ESE-TE) was sparse, both in Canada and worldwide. We recognised, moreover, that diverse regions used diverse nomenclature regardings all aspects of ESE-TE. We speculated that studies that review only one moniker would lead to incomplete and partial analysis. Insofar as we raise our academic standard to include the entire known nomenclature set in what appears to be the same subfield, we also raise attention to the academic tensions in the field that employ such and such nomenclature. For instance, in Canada we tend toward using ESE-TE which is slightly different from EE alongside TE. Teasing apart these definitions is important for operationalisation as it relates to our own country’s standing committee: the Canadian Network for Environmental Education and Communication (EECOM). To assess the state of ESE-TE research in Canada the second action of the National Action Plan was enacted in close alliance with Dr. Charles Hopkins, UNESCO chair at York University Toronto.
Environmentalism, Sustainability, and Canada’s National Cooperation Network

Essential to the emergence and continued flourishing of any K-12 subject, and by implication, a university discipline connected to such subjects, is the role of a national cooperation network. “A national cooperation network is important because [stakeholders] can access it to gain essential information for any local or national EE study” (Yueh et al., 2010, p. 268). National networks may include various stakeholders, including but not limited to governmental agencies, research institutions, universities, educational organisations, subject associations, and profit and not-for-profit enterprises. Examples of successful national cooperation networks exist in Norway (Yueh, 2007), Austria, Switzerland, Finland (Sleurs, 2008, as cited in Yueh, 2007, p. 266), and Brazil (Haddad, 2009, as cited in Yueh, 2007, p. 267). Building on the national cooperation tradition, and within the purview of environmental learning, EECOM received national support for the inception of their 2017 Standing Committee on ESE-TE. The committee’s mission is to “advance and support the development of high-quality ESE through research [our emphasis], policy, and professional development in TE across Canada” (ESE-TE, n.d.).

To support the high quality of ESE-TE through research, it is important to identify international research gaps (Karrow & DiGiuseppe, 2019; Álvarez-García et al., 2015). Research gaps may serve as catalysts helpful to identifying and prioritising a national research agenda. A national research agenda would further galvanise the ESE-TE Standing Committee by raising its profile nationally and internationally, contribute to the emergence and flourishing of ESE in K-12 schools and faculties of education, while responding to the United Nation’s call to support sustainable development goal 4—education (Hopkins & Kohl, 2019). Thus, the purpose of our study was to identify trends in the international literature related to all environmental education and sustainable education nomenclature that relate specifically to TE research. The four questions we sought to address are as follows:
1. What topics are international ESE-TE researchers investigating?
2. What problems does this research address (i.e., the impetus behind the research)?
3. What theoretical perspectives guide this research? And
4. What research methods are used?

Our aim was to tackle questions 1 and 4 first. When time allows, I (Doug) will move to questions 2 and 3. Preliminary data on questions 1 and 4 are what follow.

**Context for the Review of Literature**

At the time of our writing, we knew of only one systematic review on ESE-TE from Jordan King and co-authors (Fischer et al, 2020) doing a smaller sample (n = 158) of research on the nomenclature teacher education for sustainable development (TESD). The primary Author (Doug Karrow) connected with Jordan King (Arizona State University) following a poster presentation at the North American Association for Environmental Education (NAAEE) conference held virtually in 2020 because of the Covid-19 pandemic (King et al, 2020). In their interpretive analysis covering 158 full-text analysis until 2019, they identified five “types” or “themes” of TESD research, indicative of a “sophistication” within the general field. These five themes were: (1) designing learning environments; (2) understanding learner attributes; (3) measuring learning outcomes; (4) promoting systems change; and (5) advancing visions for the field. Their conclusion was that TESD research was “still evolving, but has made progress addressing more complex topics such as measuring learning outcomes.” Their implications were: (1) a call for greater methodological rigour, (2) for research findings to be translated into practice, and (3) appeals for contributions to innovations in the field.

3 See Blom and Karrow in the forthcoming IJSHE special issue.
4 For their published work, see Fischer et al (2022).
Method

We conducted a scoping review of the international literature related to ESE-TE research. Different from literature reviews in ESE that have examined international policy issues, sustainability pedagogies, and how ESE is embedded in TE curriculum, our study focused on all aspects of ESE relevant to TE. Likewise, different from systematic reviews or meta-analyses which evaluate study quality and synthesise study outcomes in a highly structured way, scoping reviews are better suited for answering broader research questions related to the types of available evidence in a given field, how research is conducted, key characteristics or factors related to the research concept, and knowledge gap identification (Armstrong et al., 2011; Munn et al., 2018). After identifying the research question(s), our scoping review process was broken down into the following four stages: 1) relevant study identification, 2) study selection, 3) data collection, and 4) summarising and reporting the results (Arksey & O'Malley, 2005). We created a flowchart to illustrate the study identification and selection process (Figure 1).

Figure 1

Scoping Review Process (Study Identification and Selection)

| Initial Search | 2609 |
| Screened | 2142 |
| Full-text Review | 788 |
| Included | 637 |
| Duplicates | 467 |
| Irrelevant | 1354 |
| Excluded | 151 |

Note. These values (excluded and included) differ slightly in our updated work published in IJSHE.
Relevant Study Identification

Our data was collected between January and February 2021. Initially, we began by searching Education Source bibliographic database to identify keywords/search terms related to our topic (i.e., ESE), our population (i.e., TE, which includes both pre-service and in-service teachers,) and the education context (i.e., formal, informal and non-formal education). Using the search terms identified (Table 1), we extended our search to include Education Source, ERIC, Taylor and Francis Journals Online, Academic Search Complete, and the Environment Index bibliographic databases for relevant research articles by combining the topic search terms with the population and education context search terms. Databases selected for the literature search frequently include studies related to teacher education and environmental and sustainability education.

Table 1

Database Search Terms

<table>
<thead>
<tr>
<th>Topic</th>
<th>Population</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>“environmental education” or “education for sustainability” or “education for sustainable development” or “sustainability education” or “environmental and sustainability education” or “eco#justice education” or “land#based education” or “place#based education”</td>
<td>“teacher education” or “initial teacher education” or “pre#service teacher education” or “teacher trainee education” or “in#service teacher education” or “teacher professional development”</td>
<td>“formal education” or “non#formal education” or “informal education” or “K-12” or “early childhood education” or “elementary education” or “secondary education” or “faculty of education” or “post#secondary education” or “higher education”</td>
</tr>
</tbody>
</table>
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**Study Selection**

After completing the database searches, citations were imported into Covidence. Covidence is a primary screening and data extraction software program specifically designed to support academic literature reviews. After removing duplicate citations, a total of 2,142 articles were independently screened (by researchers DK and SDS) by title and abstract (proportional agreement = 0.78; inter-rater reliability Cohen’s Kappa = 0.56). During this process, the inclusion and exclusion criteria (Table 2) were applied. Differences were resolved through discussion and full-text reading until consensus was achieved. Initially, 788 articles were deemed eligible for study inclusion based on study title/abstract. However, 151 articles were excluded after a full-text review as they did not meet the inclusion criteria. Thus, a total of 637 articles were included in our study.

**Table 2**

*Study inclusion/exclusion criteria.*

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Teacher Education included: <em>pre-service</em> (pre-certification) and <em>in-service</em> (professional development post-certification);</td>
<td>• Research on K-12 students/classrooms without connection with TE;</td>
</tr>
<tr>
<td>• All subject-related fields that explore some aspect of ESE-TE (e.g., geography, science, the arts, physical education, Indigenous education), or under the mandate of UNESCO (e.g., peace education, humane education, citizenship education, ocean literacy, energy education, ozone layer, rural education, technical education, water education, food education, biodiversity education, conservation education, local knowledge);</td>
<td>• Research on hospitality and tourism industry, business education, health education, agriculture education, global education without connection with TE;</td>
</tr>
<tr>
<td>• Empirical/non-empirical (philosophical, theoretical, conceptual) works with explicit links to ESE-TE.</td>
<td>• Non-English articles;</td>
</tr>
<tr>
<td></td>
<td>• Program evaluations without connections with TE;</td>
</tr>
<tr>
<td></td>
<td>• Grey literature, e.g., editorials, reviews, symposium contributions, roundtable reports or proceedings, thesis/dissertations, guidelines or standards, cumulative indexes, interviews, commentaries, program descriptions, and book chapters (non-research-based);</td>
</tr>
<tr>
<td></td>
<td>• ESE policy without connection with TE.</td>
</tr>
</tbody>
</table>
**Data Extraction**

Data extraction was managed in Covidence. Covidence allowed the creation of a data extraction form. Similar to Aikens et al., (2016), our data extraction and subsequent analysis included quantifying the geographic and methodological trends and a qualitative exploration (cross-comparative analysis and inductive categorisation) of the research topic through context-based themes. Data fields included: 1) author(s), 2) publication year, 3) country(ies) where research was conducted, and research … 4) problem, 5) topic, and 6) methodology.

**Results**

Of the 637 articles analysed, publications spanned over five decades (years 1974-2021) and 81 countries (Figure 2). Although our review covered research in 11 African countries, 21 Asian countries, and five South American countries, many of these countries had one to five publications, which indicates a disparity of ESE-TE research conducted in these areas. After categorising the research into time periods relevant to the UN—i.e., 1974-1990; 1991-2003; 2004-2014 (DESD); 2015-2021 (SDGs), we saw an increasing trend in ESE-TE research with a peak occurring from 2004 to 2014—the UNESCO Decade of Sustainability (Figure 3).

Thematic analysis of the research topic/context has been illustrated by continents (Figures 4-6). A qualitative review of the research topics/context (as extracted from the studies) lead to the identification of nine themes (Table 3). While 82% of the articles we examined were empirical, the most prevalent research topics/context investigated across all articles centred on the themes of TE commonplaces (34%), TE competencies and literacy (20%), and program mainstreaming & challenges (16%). In terms of research methodology used to address these problems (Figure 7), most researchers used qualitative inquiry strategies.

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5 When I (Rob) read this word I realised we were not actually doing trends which give rise to our spatiotemporal presentation in our IJSHE manuscript.
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(41%), followed by quantitative (26%), mixed methods (20%), and philosophical/theoretical/conceptual (13%) inquiry strategies.

Table 3

ESE-TE research problem/context themes.

<table>
<thead>
<tr>
<th>Theme (# of publications)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE Commonplaces (217)</td>
<td>• Teaching, learning, curriculum, context (formal/informal/non-formal settings).</td>
</tr>
<tr>
<td>Competencies/Literacies (129)</td>
<td>• Knowledge/understanding, skills, attitudes, or dispositions.</td>
</tr>
<tr>
<td>TE Awareness (103)</td>
<td>• Attitudes, beliefs, perceptions toward ESE.</td>
</tr>
<tr>
<td>Program Mainstreaming &amp; Challenges (73)</td>
<td>• How ESE is programmed in TE (e.g., dedicated courses, electives, optional courses, integration models, and challenges thereof).</td>
</tr>
<tr>
<td>Discourse/Theory (51)</td>
<td>• Nomenclature, language/concepts, theoretical frameworks.</td>
</tr>
<tr>
<td>History/Research on the Policy of ESE-TE (18)</td>
<td>• History of the field, research on the research of ESE-TE, and policy studies.</td>
</tr>
<tr>
<td>Praxis (16)</td>
<td>• Relationship between theory and practice.</td>
</tr>
<tr>
<td>TE Educators’ Education (16)</td>
<td>• The education of TE educators.</td>
</tr>
<tr>
<td>Rationale (14)</td>
<td>• Reasons why ESE-TE is important.</td>
</tr>
</tbody>
</table>

Conclusions

We screened 2,142 research articles spanning over five decades and 81 countries. Of the 788 articles deemed eligible (i.e., English-language, peer-reviewed, pre-service/in-service teacher education that explicitly mentioned ESE-TE research), data from 637 studies have been included in this study. Our research analysis included quantifying the geographic, temporal, and methodological trends, and a qualitative exploration of the research topics/context themes. While 82% of the research articles we examined were empirical, the most prevalent problems investigated across all of the studies centred on the themes of ESE-TE commonplaces (34%), competencies and literacy (20%), and awareness (16%).
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While no definite conclusions may be drawn until the complete data set has been analysed (a forthcoming paper), preliminary findings suggest a disparity of ESE-TE research in Asia, South and Central America, and Africa. Preliminary results also suggest that more research in the context of ESE-TE praxis is needed.

Study Limitations

Two limitations to our research were recognised. First, when conducting a scoping review in only one language (i.e., English), there is a limitation to the number of articles to draw from. This may be one reason we identified so little research in most of Asia, Africa, and South America. Another limitation relates to the functionality and inclusion of relevant studies into bibliographic databases. Not all ESE-TE journals are indexed in major education bibliographic databases, and in some cases, there may be a publication “lag-time” of up to one and a half years before “current” research is made publicly available online. Therefore, to ensure that important ESE-TE research not indexed in major bibliographic databases are included in our study, we plan to conduct a “hand-search” (i.e., manual review) of key international journals.

Future Work

For future work in academia, we would love to analyse data collected with regard to Q2 and Q3. A finer analysis of the spatiotemporal data published in IJSHE is the task not only for us, but for others as well. For instance, what are the sociopolitical connections to the research? How do we address "macro-challenges" that we posited were key in our published work? What do the international results mean for EECOM and the ESE-TE Standing Committee? In general, how do our published results inform the national research agenda of Canada? Will our study invite members and stakeholders (e.g., EECOM, NAAEE, WEEC) for input on a national research strategy? What about HEIs and their implementation on future ESE-TE courses and curriculum that do in fact address macro-challenges?
Figure 2

*International Perspective: ESE-TE Research (Published 1974-2021).*
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Figure 3

*International Perspective: Temporal Trend in ESE-TE Research.*

![Graph showing temporal trend in ESE-TE research publications from 1974-1990 to 2015-2021. The graph displays an increasing trend over time, with a significant increase from 2004 onwards.]
Figure 4

North and South America: ESE-TE Research Topic Themes (Published 1974-2021).
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Figure 5

Europe & Asia: ESE-TE Research Topic Themes (Published 1974-2021).
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Figure 6

Africa & Australia: ESE-TE Research Topic Themes (Published 1974-2021)
Figure 7

International Perspective: ESE-TE Research Methodology (Published 1974-2021)
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