

## Sustainable development research in Eurasia Journal of Mathematics, Science and Technology Education: A systematic literature review

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### Abstract

Sustainable development is development that aims to improve the quality of life for all people around the world, both current and future generations. The focus and alignment of researchers on the theme of sustainable development is highly expected, as evidenced by publications in reputable journals, included in educational journals such as Eurasia Journal of Mathematics, Science and Technology Education (EJMSTE). The purpose of this Systematic Literature Review (SLR) was to review and compare investigations of researches on articles published by EJMSTE so that they are expected to have significant contributions to the topic of sustainable development. This SLR adopts five-step guidelines. The study standards that meet the requirements are, as follows: (i) the data used are from the 2005-2021 publication year; (ii) articles published in English; (iii) full paper can be accessed; and (iv) related to the theme of "sustainable" theme; and (v) only the type of research report articles. It can be concluded that EJMSTE is a pro-sustainable development journal. EJMSTE publishes 22 articles related to the theme of "sustainable". The most frequently used keywords are sustainable development and sustainability. Dominant authors were from Taiwan and China. We succeeded in formulating four important contributions made by articles published in EJMSTE related to sustainable themes, namely: (i) the urgency of science education in supporting sustainability, ESD, and SDGs funds; (ii) the need for curriculum reform and strengthening the competence of teachers in educational institutions, which are oriented towards sustainability and environmental literacy; (iii) the urgency of using technology that supports sustainability and ESD; and (iv) the urgency of energy efficiency, green marketing, green life cycle, and sustainable tourism to support sustainability. In addition, there are 22 useful educational resources that can be used as references/best practices, which can be implemented at the primary school to higher education levels.

**Keywords:** sustainable, sustainability, education for sustainable development, curriculum reform

### INTRODUCTION

Wise and responsibility development for society and life is sustainable development (Brand, 2015; Regös, 2015). Sustainable development is development that aims to improve the quality of life for all people around the world, both present and future generations (Dernbach & Cheever, 2015; Mensah, 2019; Yu et al., 2020; Yusoff, 2020). Sustainable development does not exploit or use natural resources that exceed the capacity

and carrying capacity of the earth (Bao et al., 2020; Chu & Karr, 2017; Huang et al., 2021b; Mensah, 2019; Wenhai et al., 2019). Every country must ensure that its people live sustainability-oriented (Onoshakpokaiye, 2021). Sustainable development goals (SDGs) can be achieved through four elements of objectives, namely: (1) economic growth and equity; (2) social development; (3) conservation of natural resources (environmental protection); and (4) good governance (Bárcena et al., 2018; Chan et al., 2020; Freyling et al., 2015; Lim et al.,

### Contribution to the literature

- We focus on the publication of EJMSTE in relation to the theme of “sustainable”, something that has never been done by other researchers so that it can provide self-reflection for the management of EJMSTE.
- Overview of the scope of information that we use only includes research articles; thus, providing an overview of the focus and partisanship of the researchers regarding this theme.
- We formulate the various contributions of the authors which they emphasize in their articles so that they become a complete formulation on how to develop a “sustainable” theme in the future.

2018; Shi et al., 2019). These four elements support each other, creating interrelated and SDGs.

The United Nations (UN) Conference held in Brazil in 2012 discussed a sustainable development agenda called the SDGs. SDGs are a set of goals, targets, and indicators for sustainable development that are universal (Hackmann, 2018; Streimikiene, 2013; UN DESA, 2016). The SDGs are a continuation and expansion of the millennium development goals (MDGs) that have been carried out by countries since 2001 until the end of 2015 (Kumar et al., 2016; Quarless, 2014).

Sustainability principles are general in nature, applicable to various disciplines (Hubscher-Davidson, 2020; Husamah, 2015; Wibowo & Sadikin, 2019). Sustainable development cannot be achieved solely by technological solutions, political regulation or financial development alone. However, quality education and learning for sustainable development at all levels and in society is urgently needed (Andreoni & Miola, 2016; Glavič, 2020; Kruk et al., 2018; Malik, 2018; Omisore et al., 2017; Vinuesa et al., 2020). Education for sustainable development (ESD) is an effort to encourage people to be constructive and creative in facing global challenges and to create a resilient and sustainable society (Asikainen & Tapani, 2021; del Sol, 2019; Seikkula-Leino et al., 2021; Weicht & Jónsdóttir, 2021; Zulkarnaini et al., 2020). UNESCO as an organization at the forefront globally, coordinates the implementation of the global action program (GAP) on ESD, as a follow-up to the UNs decade of ESD 2005-2014.

ESD enables every human being to acquire the knowledge, skills, attitudes and values needed to shape a sustainable future (Glavič, 2020; Holfelder, 2019; Latchem, 2018; Novidsa et al., 2020; Valencia, 2018; Violanda & Madrigal, 2021). ESD incorporates key issues of sustainable development into teaching and learning; for example, climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption (Anderson, 2012; Choi, 2018; del Sol, 2019; Glavič, 2020; UNESCO, 2012).

There are still very limited journals that focus on issues of sustainable development, and of course with international reputation (indexed by Scopus). Several journals on this theme, International Journal of Sustainable Development and Planning, Journal of Education for Sustainable Development, International

Journal of Sustainable Development & World Ecology, and Sustainable Development. These journals are managed by giant publishers such as Taylor & Francis, Wiley, Springer Nature, and several other leading publishers.

However, there are journals that also focus their articles on the theme of sustainable development. One of the journals that need to be considered is Eurasia Journal of Mathematics, Science and Technology Education or EJMSTE (e-ISSN: 1305-8223). The journal is published 12 times in a year, and strictly adheres to the principles of the peer review process. EJMSTE encourages submissions from all authors throughout the world. EJMSTE publishes high quality research articles in the following areas mathematics education, science education, engineering education, STEM education, and technology education. The aim is to advance the scholarship and the scientific knowledge base in these areas. Articles can take a variety of forms of scholarly communication. The following article types are published in EJMSTE: research articles, review articles, book reviews, interviews, and editorials.

Starting volume 13, issue 8 (2017), the journal is published by Modestum. This journal has been indexed by Scopus (coverage years: from 2006 to 2021). EJMSTE has qualified as a reputable journal Q2 (in education field) with the 2020 SJR of 0.44 (Scimagojr, 2022). The question is, is this journal pro on sustainable development issues? This systematic literature review (SLR) will review this topic.

SLR has done a lot. However, specifically for the theme of sustainable or sustainable development, as well as education for sustainable development, there are only a few SLRs. Based on a Google Scholar search, only 13 SLR articles were found on this theme over the last 30 years. These articles, which are about “sustainable development” (Lélé, 1991; Singh, 2016), “sustainability and sustainable development” (Ruggerio, 2021), “sustainable development: meaning, history, principles, pillars, and implications for human action” (Mensah, 2019), “relationships between the sharing economy, sustainability and SDGs” (Boar et al., 2020), “sustainable development and the international development, business and accounting literature” (Bebbington, 2005), “intellectual capital and sustainable development” (Alvino et al., 2021), “population, poverty, and sustainable development” (Das Gupta et al., 2011),

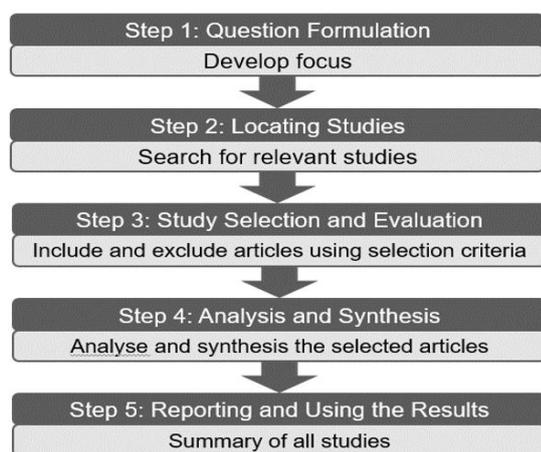


Figure 1. Five steps of an SLR, adapted from Denyer and Tranfield (2009)

“sustainable development implementation in Malaysia” (Yusof & Ariffin, 2020), “education for sustainable development” (Breßler & Kappler, 2017), “the role of indicators in implementing the sustainable development goals” (Mair et al., 2018), “the age of sustainable development” (Kahn, 2015), and “sustainable development of smart cities” (Trindade et al., 2017). SLRs focused on leading journals such as EJMSTE have yet to be found. In fact, it is important to do this as a basis for researchers to use EJMSTE as the main reference in their research or articles, given its international reputation. Therefore, the purpose of this SLR is to review and compare investigations of researches on articles published by EJMSTE so that they are expected to have significant contributions to the topic of “sustainable” and “sustainable development”.

## METHOD

### Research Framework

This study is an SLR, which is the process of identifying, evaluating and analyzing all the information in the literature/references to answer predetermined research questions (Snyder, 2019; Xiao & Watson, 2019). This SLR adopts five-step guidelines from Denyer and Tranfield (2009) (Figure 1), which are also reported to have been used by other authors like Han et al (2020).

#### Step 1: Question formulation

This first step is to define the scope to develop a clear focus for the study. This study proposes and attempts to address the following questions (from 2005 to 2021). This research question was made based on the needs of the chosen topic, namely:

1. **RQ1:** What is the trend of EJMSTE publication for 17 years?
2. **RQ2:** What are the trends in the types of research published at EJMSTE related to the “sustainable” theme?

3. **RQ3:** Where do the authors who publish related to the “sustainable” theme come from?
4. **RQ4:** What are the trends of keywords are often used in relation to the “sustainable” theme?
5. **RQ5:** What contributions and important information can be obtained from each article for the “sustainable” theme?

#### Step 2: Locating studies

This second step of SLR is to locate, select, assess, and list the core contributions related to the review questions. The target of this research is on the theme of “sustainable”. These keywords are used to track related/appropriate articles published by EJMSTE from 2005 to 2021. The search process uses the search menu at the website of the Eurasia Journal of Mathematics, Science and Technology Education or EJMSTE (<https://www.ejmste.com/archive>) and Scopus website (<https://www.scopus.com/sourceid/4400151729>) with the keyword “sustainable”. The data obtained is stored in \*CSV and \*RIS formats which are then synchronized into the reference manager (Mendeley). VOS-viewer software is used to visualize the data so that it is clearer and more communicative.

These databases were selected based on their availability in academic institutions and having been considered in other similar studies. Literatures from the articles resulted from keyword search are reviewed for the backward search. Forward search was conducted through reviewing additional sources resulted from cited references of selected studies. No further studies were located during the process.

#### Step 3: Study selection and evaluation

This stage is carried out to ensure that the data obtained is appropriate for use in research (SLR) or not. The study standards that meet the requirements are, as follows: (i) the data used are from the 2005-2021 publication year; (ii) articles published in English; (iii) full paper can be accessed; (iv) related to the “sustainable” theme; and (v) only the type of research report articles. Explicit selection criteria were applied for the inclusion and exclusion of relevant studies to maintain the transparency of the process (Figure 2).

In the first phase, titles and abstracts of 1,946 articles were read in the first screening. All of these articles were published by EJMSTE from 2005-2021 and have been indexed in the Scopus database. In the second phase, we only use manuscripts indexed in Scopus for the last 10 years, from 2012-2021. All documents that did not meet the selection criteria were excluded; 1,731 articles remained for the next process of selection (215 excluded). In the third phase, we only selected articles in the form of research articles. We omitted the types of articles that were book reviews, editorials, interviews, literature reviews, erratum, and retraction notes, so there were

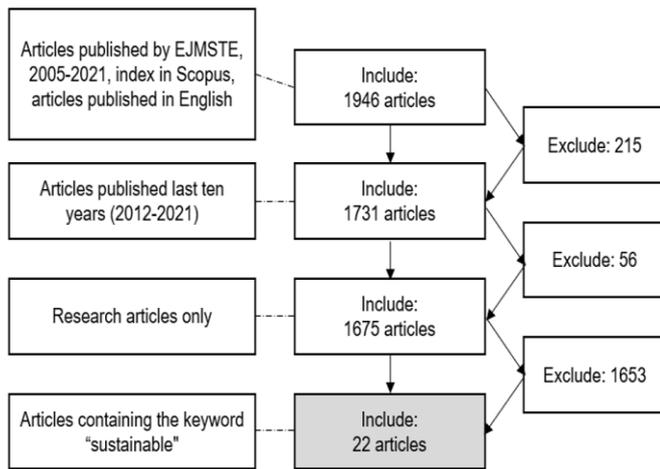


Figure 2. Review process for study selection

1,675 (56 articles excluded). In the fourth phase, we chose articles that contained the keyword “sustainable”, resulting in a drastic decrease in the number of articles, which only got 22 (1,653 articles excluded).

After finding 22 articles that fall into a predetermined category, we read the articles carefully and in depth. We carefully researched the author’s name and affiliation to find the author’s country of origin (to answer RQ3), perused the methods section to find types of research published at EJMSTE (to answer RQ2), read the abstract and used the VOS-viewer to determine trends. of keywords (to answer RQ4), as well as read and discuss “contribution to the literature” section and the contents of the article as a whole to find contributions and important information can be obtained from each article (to answer RQ5).

EJMSTE has a special format where each author must write a “contribution to the literature” section. This makes it easier for readers (and of course us as researchers) to find important contributing aspects and information from each article. In addition, we do not only refer to it, to ensure validity, we read and discuss the content components of the selected articles. Specifically, for RQ2 (types of research published) we traced (guided) what the authors stated in their articles and then we checked them carefully to see their consistency (based on what they described in the method).

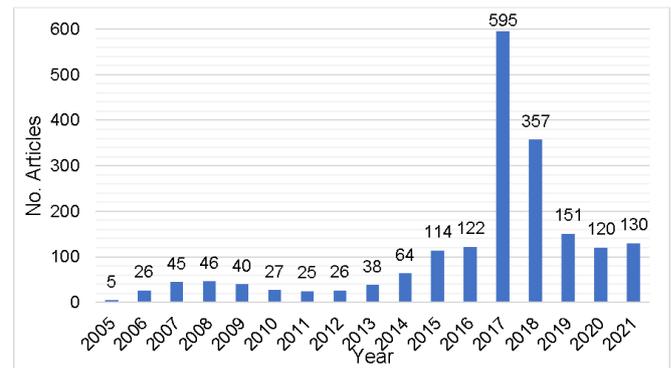


Figure 3. Trends in the number of article publications

## RESULTS

### EJMSTE Publication Trend for 17 Years

As of 2021, EJMSTE has published 17 volumes. EJMSTE published 1,931 articles from 2005 to 2021 (Figure 3). Since volume 1 issue 1, EJMSTE has been published in English as an internationalization effort, but there are still very few articles (only five articles). Since 2015 EJMSTE has experienced a significant increase in the number of articles, where articles published are >100. However, in 2017 EJMSTE published a very large number of articles, namely 595. In the same year there was a change in publishers, from iSER to Modestum. From 2019 to 2021, the number of articles published was relatively consistent, namely ±130 articles per year.

### Research Types/Methods

The results of the search process as well as inclusion and exclusion criteria were only taken 22 papers that were in accordance with the criteria for journal articles published in the period 2005-2021 and had discussions related to “sustainable” theme. Trend of research types related to “sustainable” theme is shown in Table 1.

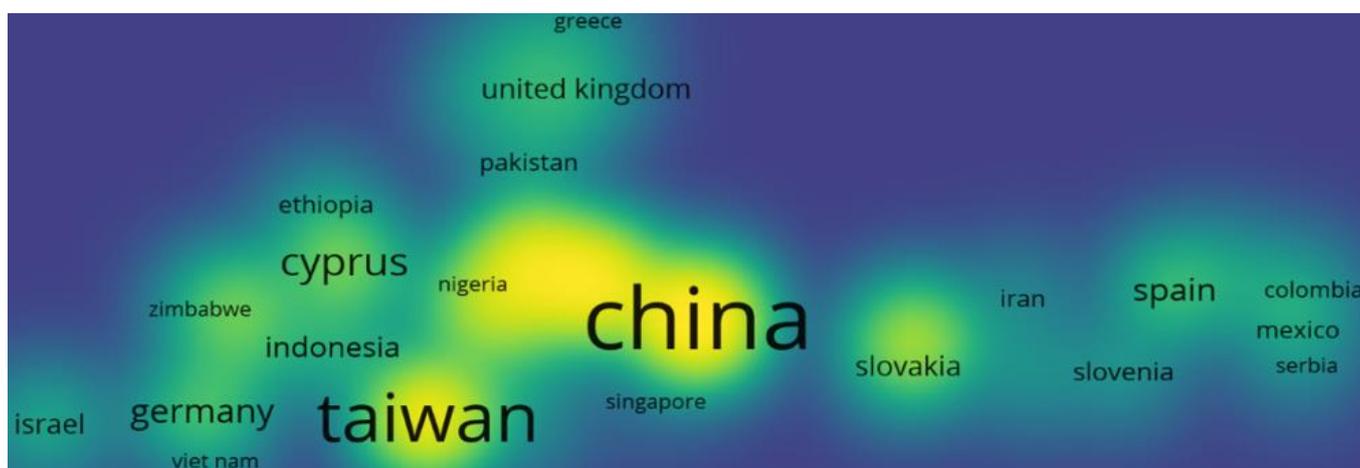
Based on Table 1, it was found that the type of research related to the theme of sustainability was dominated by qualitative studies (seven articles) and quantitative studies (six articles). The type of method that is also quite widely used is survey (three articles). Other research types used by authors are mix-methods.

Table 1. Types of research on sustainable themes at EJMSTE

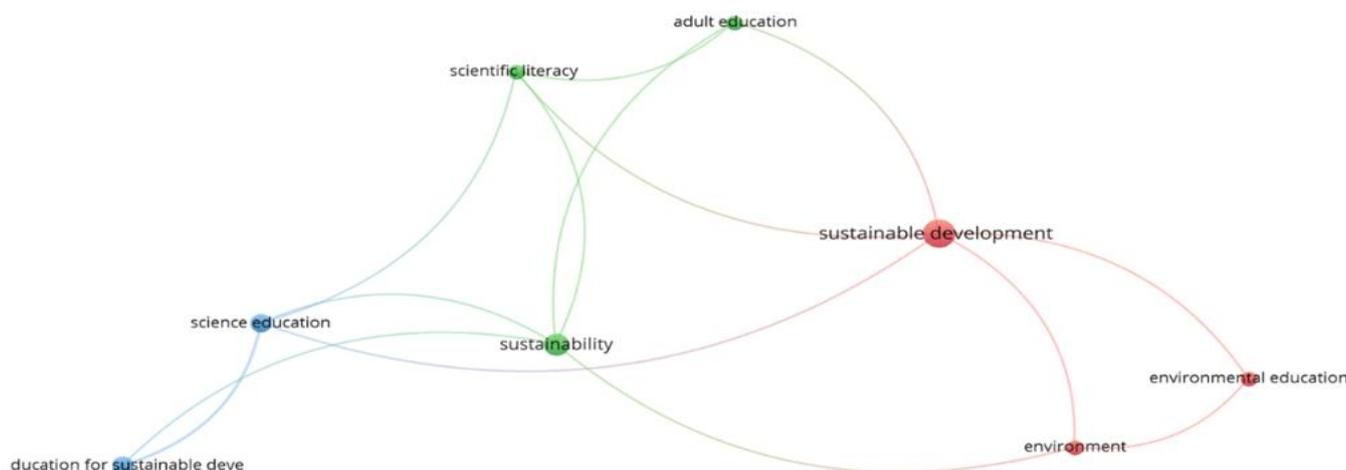
No	Type of research	Amount	References
1	Qualitative study	7	(Borreguero et al., 2018; Buchanan et al., 2019; Chin et al., 2019; de Jager, 2015; Eilks, 2015; Kuo & Perng, 2016; Miedijensky & Abramovich, 2019)
2	Quantitative study	6	(Bögeholz et al., 2014; Hsieh, 2018; Kidman & Casinader, 2019; Perng et al., 2017; Santamaría-Cárdaba et al., 2021; Zhao et al., 2017)
3	Survey	3	(Gunduz, 2017; Ozburak et al., 2018; Pan et al., 2018)
4	Mix-methods	2	(Huang et al., 2016; Wang, 2016)
5	Observation of transformative learning	1	(Chao, 2017)
6	Case study and focus group	1	(Tu et al., 2017)
7	SEM analysis	1	(Qiu & Yu, 2018)
8	Quasi-experiment	1	(Zidny et al., 2021)

**Table 2.** Country of origin of the author who wrote the theme “sustainable”

No	Country of origin		References	Amount
	One country	Collaboration between countries		
1	Taiwan		(Chao, 2017; Hsieh, 2018; Huang et al., 2016; Kuo & Perng, 2016; Pan et al., 2018; Perng et al., 2017; Tu et al., 2017)	7
2	China		(Qiu & Yu, 2018; Wang, 2016; Zhao et al., 2017)	3
3	Australia		(Buchanan et al., 2019; Kidman & Casinader, 2019)	2
4	Germany		(Bögeholz et al., 2014; Eilks, 2015)	2
5	Spain		(Borreguero et al., 2018)	1
6	Israel		(Miedijensky & Abramovich, 2019)	1
7	Cyprus		(Gunduz, 2017)	1
8	South Africa		(de Jager, 2015)	1
9		Turkey & Cyprus	(Ozburak et al., 2018)	1
10		Malaysia, Japan, & Thailand	(Chin et al., 2019)	1
11		Spain & Portugal	(Santamaría-Cárdaba et al., 2021)	1
12		Germany & Indonesia	(Zidny et al., 2021)	1



**Figure 4.** VOS-viewer display for type of analysis “co-authorship→country” based on Scopus source



**Figure 5.** VOS-viewer display for type of analysis “co-occurrence→keywords”

**Countries**

The tendency of the country of origin of the author who writes about the “sustainable” theme is presented in Table 2. The data in Table 2 is in line with the visualization of the VOS-viewer software, as presented in Figure 4. Based on Figure 4, it can be seen that the dominant author comes from institutions in Taiwan and China. Other countries that are also related to the issue of sustainability are Australia and Germany. This is in

line with Table 2 that there are seven articles written by the author, all of which come from institutions in Taiwan, and three from China.

**Keywords Trend**

Visualization of the VOS-viewer software as presented in Figure 5 shows the trend of the dominant keywords used.

Based on Figure 5, there are two keywords that stand out the most, namely sustainable development and sustainability. The keyword "sustainable development" relates to the keywords environment, environmental education, adult education, scientific literacy, and science education. Meanwhile, sustainability is related to 3 important keywords, namely education for sustainable development, science educations, scientific literacy, environment, and adult education. Based on Figure 5, there is a relationship between sustainable development and sustainability, where both meet the keywords science education, environment, scientific literacy, and adult education.

### Contributions & Important Information for the Development of a "Sustainable" Theme

We reviewed 22 selected articles. We used strict selection criteria (as we adopted the model we have described in the method), so we only got 22 articles. This is in line with the aspects of the validity of the data or information used. We read all the articles in detail and thoroughly, one by one to find the "contribution" aspect. We carry out repeated readings, taking note of the important passages, to ensure the information is appropriate and correct as the authors intended in their articles. The important information from these articles is presented in Table 3.

**Table 3.** Contributions and important information in chronological order (in order of year)

Important contribution	References
<ul style="list-style-type: none"> <li>• This article relates research approaches &amp; practices in Germany in <b>science education</b> &amp; their relationship to the international situation.</li> </ul>	(Bögeholz et al., 2014)
<ul style="list-style-type: none"> <li>• The Göttingen model presents the dimensions of competence in evaluating &amp; reflecting quantitative-economic solutions. The competency dimension focuses on the capacity of <b>environmental &amp; institutional economic concepts</b> &amp; procedures to inform systematic decision making.</li> </ul>	(Eilks, 2015)
<ul style="list-style-type: none"> <li>• This article reviews the justifications &amp; frameworks for <b>ESD</b> from the point of view of <b>science education</b>.</li> <li>• It suggests some basic strategies for linking <b>ESD &amp; science education</b> &amp; reflecting on their potential</li> </ul>	(de Jager, 2015)
<ul style="list-style-type: none"> <li>• The prescribed primary school <b>curriculum</b> &amp; practice are very far from each other. A major revision of the existing curriculum is needed to help build a sustainable future.</li> <li>• It is proposed the need for <b>compulsory subjects</b> that will educate children at a young age (primary school) on how to manage environmental issues (such as e-waste, waste, pollution, global warming, ozone depletion &amp; others) to protect the natural environment &amp; our life on earth.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Education in children</b> can promote <b>permanent behavior change &amp; the development of positive attitudes</b> &amp; values that they can use to influence negative behavior from other tools.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Tourism</b> development will produce certain economic benefits, &amp; residents also feel the <b>positive &amp; negative impacts</b> of tourism development on local construction &amp; environmental quality.</li> <li>• Most of the population has a high school &amp; university education background, but <b>tourism knowledge is clearly inadequate</b>.</li> <li>• <b>The impact of tourism accumulates permanently</b>, &amp; local residents retain the deepest perceptions.</li> <li>• <b>Participation in tourism activities allows residents to better understand</b> local history, culture, &amp; the natural environment, can increase the identity of residents towards residential areas, &amp; establish enthusiastic &amp; integrated relationships between residents.</li> </ul>	(Wang, 2016)
<ul style="list-style-type: none"> <li>• The main contribution of this study is to help the office furniture industry in Taiwan to find a suitable model for sustainable product development through <b>decision-making models</b>.</li> <li>• The <b>decision-making model</b> of the product service in this study allows companies to carry out assessments &amp; open testing during product R&amp;D. The advantage of the model lies that the assessment method tends to be used by companies to carry out an overall environmental assessment.</li> <li>• The study is based on the <b>green life cycle, tests the sustainable design &amp; development &amp; inspection</b> product servitization, selects different improvement resolutions through the LiDS life cycle design strategy, &amp; assesses &amp; compares the overall improvement of the various resolutions.</li> </ul>	(Huang et al., 2016)
<ul style="list-style-type: none"> <li>• Identification &amp; recognition of <b>educated citizens</b> is necessary for <b>sustainable urban development</b>. By revealing the potential to significantly increase tourist numbers, <b>reduce energy consumption</b>, &amp; promote economic benefits with the achievement of reshaping the urban landscape should be implemented with urban regeneration plans.</li> <li>• Implementing architectural education into <b>sustainable urban planning</b> can be formulated as a series of urban regeneration project actions that can help citizens to understand &amp; understand the importance of reshaping the urban landscape in the short term &amp; enhancing urban competitiveness, industrial renovation &amp; local economic revival, in the <b>long term</b>.</li> <li>• Local governments must gain the trust &amp; cooperation of their citizens by <b>introducing education strategies into urban development plans</b>.</li> </ul>	(Kuo & Perng, 2016)
<ul style="list-style-type: none"> <li>• Students' <b>attitudes &amp; behavior</b> towards the <b>environment &amp; sustainable development are still inadequate</b>.</li> <li>• <b>No significant difference</b> was found between educational background &amp; attitudes &amp; behavior of students from different cultures towards sustainable development &amp; the environment.</li> </ul>	(Gunduz, 2017)

Table 3 (Continued). Contributions and important information in chronological order (in order of year)

Important contribution	References
<ul style="list-style-type: none"> <li>Increasing comfort &amp; <b>energy efficiency</b>, &amp; extending the life of an existing building through renovation is not only <b>more sustainable</b> but also more cost-effective than rebuilding a new one.</li> </ul>	(Perng et al., 2017)
<ul style="list-style-type: none"> <li>In addition to the active energy consumption associated with HVAC, passive <b>energy conservation</b> techniques also need to be taken into account during the decision-making process.</li> </ul>	
<ul style="list-style-type: none"> <li>Consumers are impressed by <b>green marketing</b> activities through the Internet of Things (IoT), thereby influencing purchase rates.</li> </ul>	(Tu et al., 2017)
<ul style="list-style-type: none"> <li>The results of mathematical analysis show that the <b>level of consumer education will affect consumer attitudes towards environmental protection.</b></li> </ul>	
<ul style="list-style-type: none"> <li>Consumers will be guided by the concept of environmental education through the interaction of IoT with green marketing, so that they can change consumer values &amp; <b>choose environmentally friendly goods.</b></li> </ul>	
<ul style="list-style-type: none"> <li>"<b>Dialogue</b>" has an important influence in strengthening participants' reflection &amp; self-confidence.</li> </ul>	(Chao, 2017)
<ul style="list-style-type: none"> <li>Local communities, volunteers &amp; intermediary organizations can integrate <b>environmental education</b> systems to <b>promote sustainable environmental development.</b></li> </ul>	
<ul style="list-style-type: none"> <li>Provinces should make development a focal point, develop outstanding <b>tourism products</b> through readjustment by integrating tourism resources, &amp; then publicize their brands to the world through media.</li> </ul>	(Zhao et al., 2017)
<ul style="list-style-type: none"> <li>With establishment of a resource coordination mechanism &amp; a traffic flow mechanism, cooperation between tourism cities will be strengthened &amp; problems including disorder, repetitive development, &amp; blind competition eliminated; comparable, scale, <b>uniqueness</b>, &amp; complement of tourism products are increased.</li> </ul>	
<ul style="list-style-type: none"> <li>Emphasize awareness of <b>environmental education</b> in preschool which is divided into two, namely the "natural &amp; artificial" environment.</li> </ul>	(Ozburak et al., 2018)
<ul style="list-style-type: none"> <li>Provide an introduction to children about the built environment in the school environment through "<b>playing games</b>".</li> </ul>	
<ul style="list-style-type: none"> <li>Analysis of the concept of waste in the <b>curriculum</b> in the framework of <b>sustainable development</b> based on the analysis of the secondary education curriculum is very necessary.</li> </ul>	(Borreguero et al., 2018)
<ul style="list-style-type: none"> <li>It takes the <b>right cognitive domain</b> of the concept to be able to cultivate a responsible attitude in present &amp; future generations that enables <b>sustainable development</b> in all sectors involved.</li> </ul>	
<ul style="list-style-type: none"> <li>By comparing two cycles of national surveys of citizen science learning experiences &amp; outcomes, this study provides new insights into the changing patterns &amp; predictive effects of trends in <b>interest &amp; engagement in science learning</b> on scientific competence &amp; <b>environmental action.</b></li> </ul>	(Pan et al., 2018)
<ul style="list-style-type: none"> <li><b>Deeper involvement</b> in science learning resources can be an important place to promote <b>environmental action competence</b></li> </ul>	
<ul style="list-style-type: none"> <li>This article explores the effect of <b>investment in engineering higher education</b> &amp; technical progress on the <b>sustainable development</b> of the manufacturing industry in China</li> </ul>	(Qiu & Yu, 2018)
<ul style="list-style-type: none"> <li>Optimal change requires a <b>formal curriculum</b> that prioritizes <b>sustainability</b>, provides appropriate professional development for teachers, ensures day-to-day management in schools, &amp; includes self-examination &amp; evaluation.</li> </ul>	(Miedijensky & Abramovich, 2019)
<ul style="list-style-type: none"> <li>Successfully introducing change into schools depends on a number of factors to improve the <b>change process in the future.</b></li> </ul>	
<ul style="list-style-type: none"> <li>Illustrative sketches &amp; analysis provide insight into <b>use of digital technology in sustainability education.</b></li> </ul>	(Buchanan et al., 2019)
<ul style="list-style-type: none"> <li>Technology-based <b>science projects</b> can be used to <b>promote environmental management.</b></li> </ul>	
<ul style="list-style-type: none"> <li><b>Teacher environmental literacy</b> is important</li> </ul>	(Kidman & Casinader, 2019)
<ul style="list-style-type: none"> <li>Explore the potential of the <b>curriculum</b> as a driver of environmental literacy.</li> </ul>	
<ul style="list-style-type: none"> <li>Explore synergies between <b>environmental literacy &amp; inquiry-based practices</b></li> </ul>	
<ul style="list-style-type: none"> <li>Digital <b>social media</b> can be used to <b>support ESD</b> in the education of pre-service teachers.</li> </ul>	(Chin et al., 2019)
<ul style="list-style-type: none"> <li><b>Curriculum</b> delivery methods need to be revised to include instructional strategies such as lectures, pre-service teachers' presentations, <b>sustainability projects</b> &amp; games to suit different topics in the course to promote 'Conservation &amp; Wise Use of Resources'.</li> </ul>	
<ul style="list-style-type: none"> <li>There is potential to contribute to <b>ESD &amp; sustainability in chemistry education</b> with the support of indigenous science &amp; culture as a new perspective.</li> </ul>	(Zidny et al., 2021)
<ul style="list-style-type: none"> <li>This study focuses on whether <b>mathematics teachers teach the SDGs</b> along with their subjects in schools.</li> </ul>	(Santamaría-Cárdaba et al., 2021)
<ul style="list-style-type: none"> <li>This study aims to find out how mathematics teachers with generalist training who teach work in an <b>SDGs-oriented</b> manner.</li> </ul>	
<ul style="list-style-type: none"> <li>Mathematics teachers should pay more attention to content related to the SDGs in their subjects.</li> </ul>	

Based on Table 3, it can be formulated four important contributions made by articles published in EJMSTE related to sustainable themes, namely (i) the urgency of science education in supporting sustainability, ESD, and SDGs; (ii) the need for curriculum reform and strengthening the competence of teachers in educational

institutions, which are oriented towards sustainability and environmental literacy; (iii) the urgency of using technology that supports sustainability and ESD; and (iv) the urgency of energy efficiency, green marketing, and sustainable tourism to support sustainability.

## DISCUSSION

In the last three years (2019-2021), EJMSTE has published a relatively consistent number of articles, namely  $\pm 130$ . This shows the quality of professional journal management. This journal can be said to be a reputable and quality journal, free from suspicion of being a predatory journal. EJMSTE not only pursues the number of articles published, but also pays attention to the quality of the articles published. This is in line with the views of experts that to become a quality journal, editors or journal managers must pay close attention to each article they will publish, instead of only being oriented to article processing charges (APC) and also ignoring aspects of plagiarism or ethical approval (Shrestha et al., 2020). A good journal must pay attention to the quality, integrity, and reliability of the articles published (Shrestha, 2020). In general, predatory journals publish articles without a peer review process or without checking articles by the editorial board, fast track, high acceptance rate, often publish articles with low quality, so they only look oriented towards personal business motives (Forero et al., 2018; Shrestha et al., 2018). Due to ignorance of predatory publications and/or because of the compulsion to be published in a limited time, authors tend to become victims of predatory journals (Shrestha et al., 2019). Of course, publishing quality articles is also in line with the spirit of sustainability and efforts to build advanced science and technology, as the topic of this paper.

The results of the analysis reveal that the type of research related to the theme of "sustainable" is dominated by qualitative studies and then followed by quantitative studies (with a difference in the number of which is not too large), as well as survey research. Qualitative research related to the human dimension, namely conservation and the environment, is growing in quantity (Macura et al., 2019). Meanwhile, qualitative and quantitative research is needed to support the sustainability theme. In fact, combining qualitative with quantitative approaches in studies related to community development and sustainability is one of the main methodological issues in the field today (Scerri & James, 2010). Currently, even developing q-methodology-a mixed qualitative-quantitative method. This approach is important to measure perspectives on issues relating to sustainability and environmental (Sneegas et al., 2021). Sustainability is a vital theme that tends to attract many authors from various fields and interests (Hermundsdottir & Aspelund, 2021; Khan et al., 2021). Sustainability research trends emerge in several fields of knowledge and present a variety of methods without showing a tendency towards a qualitative or quantitative approach (Amaratunga et al., 2002; Rau & Fahy, 2012). This has a positive impact as it results in a more unified, and more diverse theme (Storopoli et al., 2019).

On the other hand, survey research is needed for the theme of sustainability. To contribute to the discussion on sustainability, survey research needs to be carried out with the involvement of many parties around the world (Aminpour et al., 2020). Survey research is very appropriate to explore perceptions, understandings, and attitudes towards sustainable development and related concepts and issues. Survey research seeks to fill the gap by providing insights for those focused on ESD (Kagawa, 2007). Sustainability education is included in the curriculum to integrate sustainable development principles, values and practices into education. This can be investigated through a survey research (Uitto & Saloranta, 2017). Survey research better understands the relative importance of respondents regarding sustainability-themed factors (Ken-Giami et al., 2022).

Other types of research used by the authors in their articles in EJMSTE were mix-methods. Mixed methods research is becoming increasingly articulated, embedded in research practice, and recognized as the third major research approach or research paradigm, along with qualitative research and quantitative research (Johnson & Onwuegbuzie, 2007). Mixed methods research has been defined as a methodological approach in the social and behavioral sciences and is now well accepted and commonly used in various fields (Regnault et al., 2018), including in terms of education and its relation to environmental and sustainability issues (Baglibel et al., 2018; Dencer-Brown et al., 2021; Sáiz-Manzanares et al., 2020).

The tendency of authors to write about the theme of "sustainable" comes from institutions in Taiwan. This is very reasonable considering the sustainable development becomes a very important issue in Taiwan (Sun, 2014). Taiwan has focused their research studies on the issue of sustainability (Lo et al., 2020; Shih et al., 2019; Tsai, 2021). Sustainable development has become the main theme of a number of international and world conferences in Taiwan (Lan, 2005), and includes ESD. This is a response to the achievement of SDGs (Chung, 2021). ESD is promoted as one important component in the endeavor toward sustainable development (Berglund et al., 2020). In fact, in Taiwan there is recognized strong national support for ESD, although this finding has important implications for future initiatives aimed at reforming education policy and implementing compulsory curriculum in ESD (Huang et al., 2021a). Related to ESD, there was mainstreamed into the national policy framework within the country (Huang & Asghar, 2021). Meanwhile, during the last two decades, many approaches to corporate and industrial environmental management as well as tools and sustainability programs have been created and implemented in Taiwan (Chen et al., 2011; Rock, 1996).

Other countries that are also related to the issue of sustainability are China, Australia, and Germany. Sustainable development is a fundamental issue in

China, and ESD has been integrated into the existing curriculum (Min & Dongying, 2007). China has developed a number of policies and initiatives relating to ESD and climate change education (Han, 2015). China has also organized large-scale national environmental education projects, which have generated wide international and national visibility (Lee, 2010). On the other hand, Australia and Germany are two countries that are concerned with the issue of sustainable development and its relation to education. Environmental education and sustainable development incorporates the latest trends and recent national initiatives which are playing a significant role in developing frameworks in ESD nationally in Australia (Tilbury, 2004). The education system implemented allows teachers to instill continuing education more explicitly. The role of teachers in Australia is very important to teach aspects of sustainability (Dyment & Hill, 2015). Meanwhile, Germany have also shown their alignment with the issue of sustainable development and its relation to education. It was emphasized that ESD in Germany is not only desirable but also effective for transformative action. The implication is to emphasize the emotional dimension of education and link didactic “controversial issues” to ESD (Grund & Brock, 2020). Similar to Australia, in Germany the active inclusion of teachers is a key success factor in the intrinsic process of developing ESD (Christoforatu, 2021).

Based on the data, there is a relationship between the keywords sustainable development and sustainability, where both meet the keywords: science education, environment, and scientific literacy, and adult education. This is in line with the formulation of the first contribution (based on Table 3) that there is an urgency for science education in supporting sustainability, ESD, and SDGs funds. Science education is one of the tools to facilitate or succeed in achieving sustainable development targets (Chowdhury et al., 2020; Kyle, 2020; Trott & Weinberg, 2020), for example in terms of promoting the status of the global environment in terms of the imminent dangers of climate change (Akpan, 2017). High-quality science education is required not only for sustaining a lively scientific community that is able to address global problems like global warming and pandemics, but also to bring about and maintain a high level of scientific literacy in the general population (van Eijck & Roth, 2007). A good understanding of students/prospective teachers about environmental aspects in sustainable development, and the interrelationships between environmental, economic and social dimensions related to sustainable development is very important (Velázquez & Rivas, 2020). They describe and link ESD with environmental education and environmental awareness. It is important for students to know some of the pedagogical principles of ESD, such as active learning and transformative education (Bezeljak et al., 2020). All educational domains

and levels, including adult science education, have been working to contribute to education enabling generations to become responsible citizens and promote sustainable development in our world (Eilks, 2015). ESD approach could be implemented in science education to give students valuable insights into the environment (Wilujeng et al., 2019), and this includes universities that produce prospective teachers or universities in the field of education/teacher training (Helmerts & Ilchmann, 2019; Horta, 2022).

In terms of contribution to literature, three other important points are formulated. The second formulation is the need for curriculum reform and strengthening teacher competence in educational institutions, which are oriented towards sustainability and environmental literacy. Today, combining sustainable development with education has become one of the missions of education (Yue & Ji, 2012). Education as a catalyst for change and sustainable development (Didham & Ofei-Manu, 2015; Redman et al., 2021; Valencia, 2018). Sustainable development has so far been the topic of many studies focusing on individual segments of this broad area: including curriculum and teacher competency development (Anđić, 2020). “The curriculum framework: Education for sustainable development plays an important role in the formulation of subject-specific learning goals and their implementation” (Lohmann et al., 2021). In addition, teaching and learning needs to change in all contexts when curricula include sustainability content, and ESD promotes the perspectives and values necessary to foster a sustainable society (Laurie et al., 2016). Learning can be aligned with the main goal of achieving quality education for sustainable development, through the implementation of a well-developed curriculum (Didham & Ofei-Manu, 2020). Curriculum development at the national and local levels and teacher competency development programs will result in progress towards the application of twenty-first century competencies (Lavonen, 2020).

The third formulation, namely the urgency of using technology that supports sustainability and ESD. Technology has for a long time been recognized as one of the main drivers behind productivity increases and a key long-term lever for economic growth and prosperity (Giovannini & Roure, 2017). “ESD has to respond to the opportunities and challenges brought about by technological advances. Some ‘old’ problems will be resolved through technology, but new challenges and risks may be will arise. Critical thinking and sustainability values become ever more relevant, as the task of teaching ESD may become more challenging with the illusion that technologies can resolve the majority of sustainability problems” (UNESCO, 2020). Consequently, it is necessary to ensure that the possible impact of technological innovations aimed at supporting SDGs (Olfe-Kräutlein, 2020).

The fourth formulation is energy efficiency, green marketing, and sustainable tourism to support sustainability. Sustainable development and energy efficiency are positively related (Liu et al., 2021; Rosen, 1995; Ziolo et al., 2020), suggesting that sustainable economic development is associated with increased energy efficiency (Zakari et al., 2022). Energy plays a key role for the development of the countries. Countries need to use energy efficiently to be advantageous in the global competition and ensure the sustainable development (Turkoglu & Kardogan, 2018).

Green marketing is a tool for sustainable development, used by many companies in various industries to follow the trend of green revolutions, going green, environmental protection, sustainable life style, sustainable development, protecting our earth and many more (Bhaskar, 2016). Green marketing is a philosophy which primarily advocates sustainable development. Marketers are aware of the importance of public concern for a healthy environment to live in and they prefer products and services that are environmentally friendly for consumption. Marketers also use the same issue to ensure sustainable development and use these concepts in developing their marketing strategies (Choudhary & Gokarn, 2013).

On the other hand, the relationship between tourism and the environment has many facets, as some types of tourism have been associated with negative impacts on environmental sustainability. The concept of sustainable tourism appears opposite to mass tourism. Sustainable tourism development has been promoted in various ways as a framing concept in contrast to economic, environmental and social impacts (Richardson, 2021). Sustainable tourism development requires stakeholder participation and strong political leadership to ensure participation and consensus (Hieu et al., 2021; Kantsperger et al., 2019; Mihalic, 2020). Sustainable tourism is a continuous process and requires continuous monitoring of its impacts, and can include preventive and corrective measures if necessary.

Based on the study, 22 selected articles were educationally useful-other than those shown in Table 3. The educational usefulness was related to (in order of year) the concept of *gestaltungskompetenz*, the core concept of German ESD (Bögeholz et al., 2014), the qualitative study proposed curricula for a subject on environmental sustainability (grades four to seven) (de Jager, 2015), decision model for sustainable development (Huang et al., 2016), encourage the residents spontaneously changing the behaviors so as to promote the residents' concepts about environmental education and ecological preservation (Wang, 2016), tourism sustainable development model (Zhao et al., 2017), simulation using eQUEST model (Perng et al., 2017), consumer green education (Tu et al., 2017), environmental attitudes and behaviors of the university students (Gunduz, 2017), citizen participation for

environmental education (Chao, 2017), comprehensive online education competitive evaluation model (Hsieh, 2018), sustainable development within the framework of environmental education (Borreguero et al., 2018), sustainable environmental education at early ages (Ozburak et al., 2018), how adults' interest and engagement in learning science are related to their scientific competency and environmental action (Pan et al., 2018), and the influence of higher engineering education investment and technical progress on the sustainable development (Qiu & Yu, 2018). Besides that, there are the process of educational change as demonstrated in three elementary schools implementing education for sustainability (Miedijensky & Abramovich, 2019), environmental education for primary school-aged students using digital technologies (Buchanan et al., 2019), promoting ESD integrating blended learning and digital tools (Chin et al., 2019), teachers' environmental literacy through inquiry-based (Kidman & Casinader, 2019), whether mathematics teachers teach SDGs alongside with their subject (Santamaría-Cárdaba et al., 2021), and teaching on the sustainability-oriented chemistry issue of pesticides (Zidny et al., 2021). These educational benefits can be used as references and best practices that can be implemented at the education level, from the primary school level to higher education.

## CONCLUSION

Through SLR which adopts five-step guidelines from Denyer and Tranfield (2009) we can conclude that EJMSTE has published 17 volumes, published 1,931 articles from 2005 to 2021, and has been published in English as an internationalization effort. In a span of seventeen years, EJMSTE has demonstrated its position as a pro-sustainable development journal. There are 22 articles that have been published related to the theme of sustainable. The most prominent or frequently used keywords, namely sustainability and sustainable development. The articles published by EJMSTE have an important contribution to the sustainable theme, in particular the contribution to the literature of education, as follows: (i) The urgency of science education in supporting sustainability, educational for sustainable development (ESD), and sustainable development goals (SDGs). This shows that science education has an important position in encouraging the implementation of sustainable development. Science education is essential in supporting the implementation of the sustainable development agenda, and its importance for human development is well recognized in sustainable development goal 4 on education. Across the targets of all of the sustainable development goals (SDGs), education can provide a valuable means in supporting their implementation and achievement. Articles published on EJMSTE have provided an overview of how ESD policies may be advanced to support the

implementation and achievement of the SDGs, and ultimately help empower a learning society for sustainability. (ii) The need for curriculum reform and strengthening the competence of teachers in educational institutions, which are oriented towards sustainability and environmental literacy. Articles in EJMSTE need curriculum reforms that encourage the integration of critical issues, such as climate change, waste reduction, preserving biodiversity, disaster risk reduction, and sustainable consumption and production. This can be realized through strengthening sustainability and environmental literacy. (3) The urgency of using technology that supports sustainability and ESD. ESD must answer the opportunities and challenges of technological progress. Technology can help us solve problems, but new challenges and risks may arise, so critical thinking based on sustainability values is becoming increasingly relevant. ESD may become more challenging going forward with the view that technology can solve most of the sustainability problems. The world of education needs to ensure that the possible impact of technological innovation is aimed at supporting the implementation of sustainable development. (4) The urgency of energy efficiency, green marketing, green life cycle, and sustainable tourism to support sustainability. Sustainable economic development is related to energy efficiency. Efficient use of energy is an effort to ensure sustainable development. On the other hand, green marketing is a marketing tool for sustainable development, based on the philosophy that public concern for the environment is the basis for consumers to choose environmentally friendly products and services. Meanwhile, the concept of sustainable tourism is the right alternative to support sustainable development, but it must be realized that its implementation requires a joint commitment from all stakeholders.

### Limitation of the Study

This SLR has limitations, namely, this research is generally based on limited keywords, namely only EJMSTE, and only the Scopus indexer (Web of Science/WoS is not included in the source used). For further research, it is recommended to use a larger sample of leading journals by expanding the keywords used and other databases that can be accessed, both PubMed, NCBI, ERIC, Scopus, and WoS. The database allows a deeper search of published articles. WoS, for example, can provide the most in-depth citations by source. Another advantage of using WoS is the availability of a large amount of scientific literature published in the past. WoS is considered more selective and stricter so that it will certainly affect the validity of the information used. The use of various databases gives us an advantage as they offer functionality which allows the user to accomplish the given task without any difficulty. The specific choice directly depends on the

goals pursued by the researcher. This, can also be used as a comparison of the results of different analyzes of SLR related to the themes of sustainable, sustainability, sustainable development, and education for sustainable development which is able to provide a more detailed description, so that it can inspire researchers in this field.

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### REFERENCES

- Akpan, B. (2017). Science education for sustainable development. In K. S. Taber, & B. Akpan (Eds.), *Science education. New directions in mathematics and science education* (pp. 493-504). Sense Publishers. [https://doi.org/10.1007/978-94-6300-749-8\\_36](https://doi.org/10.1007/978-94-6300-749-8_36)
- Alvino, F., Di Vaio, A., Hassan, R., & Palladino, R. (2021). Intellectual capital and sustainable development: A systematic literature review. *Journal of Intellectual Capital*, 22(1), 76-94. <https://doi.org/10.1108/JIC-11-2019-0259>
- Amaratunga, D., Baldry, D., Sarshar, M., & Newton, R. (2002). Quantitative and qualitative research in the built environment: Application of "mixed" research approach. *Work Study*, 51(1), 17-31. <https://doi.org/10.1108/00438020210415488>
- Aminpour, P., Gray, S., Richardson, R., Singer, A., Castro-Diaz, L., Schaefer, M., Ramlan, M. A., & Chikowore, N. R. (2020). Perspectives of scholars on the nature of sustainability: A survey study. *International Journal of Sustainability in Higher Education*, 21(1), 34-53. <https://doi.org/10.1108/IJSHE-05-2019-0161>
- Anderson, A. (2012). Climate change education for mitigation and adaptation. *Journal of Education for Sustainable Development*, 6(2), 191-206. <https://doi.org/10.1177/0973408212475199>
- Anđić, D. (2020). Continuing professional development of teachers in education for sustainable development—case study of the Republic of Croatia. *Teacher Development*, 24(2), 143-164. <https://doi.org/10.1080/13664530.2020.1719877>
- Andreoni, V., & Miola, A. (2016). Competitiveness and sustainable development goals. *European Commission*. <https://doi.org/10.2788/64453>
- Asikainen, E., & Tapani, A. (2021). Exploring the connections of education for sustainable development and entrepreneurial education—A case study of vocational teacher education in Finland. *Sustainability*, 13(21), 11887. <https://doi.org/10.3390/su132111887>
- Baglibel, M., Samancioglu, M., & Crow, G. M. (2018). Factors affecting the sustainability of educational

- changes: A mixed method research. *Cogent Education*, 5(1), 1-14. <https://doi.org/10.1080/2331186X.2018.1502395>
- Bao, H., Wang, C., Han, L., Wu, S., Lou, L., Xu, B., & Liu, Y. (2020). Resources and environmental pressure, carrying capacity, and governance: A case study of Yangtze River Economic Belt. *Sustainability*, 12(4), 1576. <https://doi.org/10.3390/su12041576>
- Bárcena, A., Cimoli, M., García-Buchaca, R., Yáñez, L. F., & Pérez, R. (2018). The 2030 agenda and the sustainable development goals—An opportunity for Latin America and the Caribbean: Thank you for your interest in this ECLAC publication. *United Nations*. [https://repositorio.cepal.org/bitstream/handle/11362/40156/25/S1801140\\_en.pdf](https://repositorio.cepal.org/bitstream/handle/11362/40156/25/S1801140_en.pdf)
- Bebbington, J. (2005). Sustainable development: A review of the international development, business and accounting literature. *SSRN Electronic Journal*, 0(0), 1-46. <https://doi.org/10.2139/ssrn.257434>
- Berglund, T., Gericke, N., Boeve-de Pauw, J., Olsson, D., & Chang, T. C. (2020). A cross-cultural comparative study of sustainability consciousness between students in Taiwan and Sweden. *Environment, Development and Sustainability*, 22(7), 6287-6313. <https://doi.org/10.1007/s10668-019-00478-2>
- Bezeliak, P., Scheuch, M., & Torkar, G. (2020). Understanding of sustainability and education for sustainable development among pre-service biology teachers. *Sustainability*, 12(17), 6892. <https://doi.org/10.3390/SU12176892>
- Bhaskar, H. L. (2016). Green marketing: A tool for sustainable development. *International Journal of Research in Commerce & Management*, 4(6), 142-145. <https://doi.org/10.2139/ssrn.2739324>
- Boar, A., Bastida, R., & Marimon, F. (2020). A systematic literature review. Relationships between the sharing economy, sustainability and sustainable development goals. *Sustainability*, 12(17), 6744. <https://doi.org/10.3390/SU12176744>
- Bögeholz, S., Böhm, M., Eggert, S., & Barkmann, J. (2014). Education for sustainable development in German science education: Past-present-future. *Eurasia Journal of Mathematics, Science and Technology Education*, 10(4), 231-248. <https://doi.org/10.12973/eurasia.2014.1079a>
- Borreguero, G. M., Jiménez, J. M., & Correa, F. L. N. (2018). The concept of waste within the framework of sustainable development through the analysis of the secondary education curriculum. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(1), 255-264. <https://doi.org/10.12973/ejmste/79654>
- Brand, K.-W. (2015). *Sustainable development*. Elsevier. <https://doi.org/10.1016/B978-0-08-097086-8.91094-8>
- Breßler, J., & Kappler, S. (2017). A systematic review of education for sustainable development. *Chemnitz Economic Papers*, 7.
- Buchanan, J., Pressick-Kilborn, K., & Maher, D. (2019). Promoting environmental education for primary school-aged students using digital technologies. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(2), 1-15. <https://doi.org/10.29333/ejmste/100639>
- Chan, K. M. A., Boyd, D. R., Gould, R. K., Jetzkowitz, J., Liu, J., Muraca, B., Naidoo, R., Olmsted, P., Satterfield, T., Selomane, O., Singh, G. G., Sumaila, R., Ngo, H. T., Boedihartono, A. K., Agard, J., de Aguiar, A. P. D., Armenteras, D., Balint, L., Barrington-Leigh, C., ... Brondízio, E. S. (2020). Levers and leverage points for pathways to sustainability. *People and Nature*, 2(3), 693-717. <https://doi.org/10.1002/pan3.10124>
- Chao, R. F. (2017). Using transformative learning theory to explore the mechanisms of citizen participation for environmental education on the removal of invasive species: The case of Green Island, Taiwan. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(6), 2665-2682. <https://doi.org/10.12973/EURASIA.2017.01246A>
- Chen, Y. C., Chang, D., & Huang, C. E. (2011). Sustainable development of IT industry in Taiwan. *Advanced Materials Research*, 255-260, 2111-2115. <https://doi.org/10.4028/www.scientific.net/AMR.255-260.2111>
- Chin, C. K., Munip, H., Miyadera, R., Thoe, N. K., Ch'ng, Y. S., & Promsing, N. (2019). Promoting education for sustainable development in teacher education integrating blended learning and digital tools: An evaluation with exemplary cases. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(1), 1-17. <https://doi.org/10.29333/ejmste/99513>
- Choi, M. Y. (2018). *Sub-education policy review report: Education for sustainable development (ESD)*. UNESCO. [https://en.unesco.org/sites/default/files/education\\_for\\_sustainable\\_development\\_final\\_-\\_january\\_2021\\_1.pdf](https://en.unesco.org/sites/default/files/education_for_sustainable_development_final_-_january_2021_1.pdf)
- Choudhary, A., & Gokarn, S. (2013). Green marketing: A means for sustainable development GREEN. *Journal of Arts, Science & Commerce*, 4(3), 26-32.
- Chowdhury, T. B. M., Holbrook, J., & Rannikmäe, M. (2020). Addressing sustainable development: Promoting active informed citizenry through trans-contextual science education. *Sustainability*, 12(8), 3259. <https://doi.org/10.3390/SU12083259>
- Christoforatu, E. (2021). Teacher education for sustainable development within national frameworks: Squaring the circle from a German perspective. *International Journal of Development*

- Education and Global Learning*, 13(1), 1-15. <https://doi.org/10.14324/ijdegl.13.1.01>
- Chu, E. W., & Karr, J. R. (2017). Environmental impact: Concept, consequences, measurement. *Reference Module in Life Sciences*, 2017, B978-0-12-809633-8.02380-3. <https://doi.org/10.1016/b978-0-12-809633-8.02380-3>
- Chung, H. S. (2021). Taiwan's offshore wind energy policy: From policy dilemma to sustainable development. *Sustainability*, 13(18), 10465. <https://doi.org/10.3390/su131810465>
- Das Gupta, M., Bongaarts, J., & Cleland, J. (2011). Population, poverty, and sustainable development: A review of the evidence. *The World Bank*. <https://doi.org/doi:10.1596/1813-9450-5719>
- de Jager, T. (2015). A proposal to integrate the management of electronic waste into the curriculum of primary schools. *Eurasia Journal of Mathematics, Science and Technology Education*, 11(3), 443-454. <https://doi.org/10.12973/eurasia.2015.1340a>
- del Sol, P. A. E. (2019). Education for sustainable development: Strategies and key issues. In W. L. Filho, A. M. Azul, L. Brandli, P. G. Ozuyar, & T. Wall (Eds.), *Quality education, encyclopedia of the UN sustainable development goals*. Springer. [https://doi.org/10.1007/978-3-319-69902-8\\_3-1](https://doi.org/10.1007/978-3-319-69902-8_3-1)
- del Sol, P. A. E. (2019). *Education for sustainable development: Strategies and key issues BT-Quality education*. Springer. [https://doi.org/10.1007/978-3-319-69902-8\\_3-1](https://doi.org/10.1007/978-3-319-69902-8_3-1)
- Dencer-Brown, A. M., Jarvis, R. M., Alfaro, A. C., & Milne, S. (2021). The mixed methods practical sustainability research framework: An illustration from research on the creeping problem of coastal complexity and mangrove management. *Journal of Mixed Methods Research*, 15586898211014422. <https://doi.org/10.1177/15586898211014422>
- Denyer, D., & Tranfield, D. (2009). Producing a systematic review. In *The SAGE handbook of organizational research methods* (pp. 671-689). SAGE.
- Dernbach, J. C., & Cheever, F. (2015). Sustainable development and its discontents. *Transnational Environmental Law*, 4(2), 247-287. <https://doi.org/10.1017/S2047102515000163>
- Didham, R. J., & Ofei-Manu, P. (2015). The role of education in the sustainable development agenda. In *Achieving the sustainable development goals: From agenda to action* (pp. 94-129). Institute for Global Environmental Strategies.
- Didham, R. J., & Ofei-Manu, P. (2020). Adaptive capacity as an educational goal to advance policy for integrating DRR into quality education for sustainable development. *International Journal of Disaster Risk Reduction*, 47(101631), 1-9. <https://doi.org/10.1016/j.ijdr.2020.101631>
- Dyment, J. E., & Hill, A. (2015). You mean I have to teach sustainability too? Initial teacher education students' perspectives on the sustainability cross-curriculum priority. *Australian Journal of Teacher Education*, 40(3), 21-35. <https://doi.org/10.14221/ajte.2014v40n3.2>
- Eilks, I. (2015). Science education and education for sustainable development-justifications, models, practices and perspectives. *Eurasia Journal of Mathematics, Science and Technology Education*, 11(1), 149-158. <https://doi.org/10.12973/eurasia.2015.1313a>
- Forero, D. A., Oermann, M. H., Manca, A., Deriu, F., Mendieta-Zerón, H., Dadkhah, M., Bhad, R., Deshpande, S. N., Wang, W., & Cifuentes, M. P. (2018). Negative effects of "predatory" journals on global health research. *Annals of Global Health*, 84(4), 584-589. <https://doi.org/10.29024/aogh.2389>
- Freyling, V., Brekke, K., Arikan, Y., & Zimmermann, M. (2015). The importance of all sustainable development goals (SDGs) for cities and communities. *ICLEI: Urban Issues*, 4, 1-24.
- Giovannini, E., & Roure, F. (2017). The inclusion of science, technology and innovation (STI) in the financing of the 17 sustainable development goals (SDGs). *Annales Des Mines-Responsabilité et Environnement [Responsibility and Environment]*, 88(4), 40. <https://doi.org/10.3917/re1.088.0040>
- Glavič, P. (2020). Identifying key issues of education for sustainable development. *Sustainability*, 12(16), 6500. <https://doi.org/10.3390/su12166500>
- Grund, J., & Brock, A. (2020). Education for sustainable development in Germany: Not just desired but also effective for transformative action. *Sustainability*, 12(7), 2838. <https://doi.org/10.3390/su12072838>
- Gunduz, S. (2017). A research about attitudes and behaviors of university students with having different cultures towards the environment through sustainable development. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(6), 1881-1892. <https://doi.org/10.12973/eurasia.2017.01206a>
- Hackmann, H. (2018). Science and the sustainable development goals. *Proceedings of the International Astronomical Union*, 14(A30), 558-559. <https://doi.org/10.1017/S1743921319005374>
- Han, Q. (2015). Education for sustainable development and climate change education in China: A status report. *Journal of Education for Sustainable Development*, 9(1), 62-77. <https://doi.org/10.1177/0973408215569114>
- Han, Y., Chong, W. K., & Li, D. (2020). A systematic literature review of the capabilities and

- performance metrics of supply chain resilience. *International Journal of Production Research*, 58(15), 4541-4566. <https://doi.org/10.1080/00207543.2020.1785034>
- Helmers, E., & Ilchmann, F. (2019). Sustainability subjects in university education-development of a comprehensive indicator system and quantitative analysis of degree programs at German universities. *European Journal of Sustainable Development Research*, 3(4), em0092. <https://doi.org/10.29333/ejosdr/5771>
- Hermundsdottir, F., & Aspelund, A. (2021). Sustainability innovations and firm competitiveness: A review. *Journal of Cleaner Production*, 280, 124715. <https://doi.org/10.1016/j.jclepro.2020.124715>
- Hieu, V. M., Trung, L., & Prabhakaran, S. (2021). Perceptions of key stakeholders towards sustainable tourism development: A case study in Mekong Delta, Vietnam. *Journal of Asian Finance*, 8(4), 717-0726. <https://doi.org/10.13106/jafeb.2021.vol8.no4.0717>
- Holfelder, A. K. (2019). Towards a sustainable future with education? *Sustainability Science*, 14(4), 943-952. <https://doi.org/10.1007/s11625-019-00682-z>
- Horta, L. M. (2022). Sharp teacher training and the new constructal pedagogical supervision theory for sustainable development. *European Journal of Sustainable Development Research*, 6(2), em0183. <https://doi.org/10.21601/ejosdr/11895>
- Hsieh, M. Y. (2018). Exploring the most decisive online education determinants as impacted by Taiwan's new southbound policy. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(5), 1945-1962. <https://doi.org/10.29333/ejmste/83608>
- Huang, H., Wang, R., Wang, J., Chai, J., & Xiao, Y. (2021b). Temporal and spatial evolution and obstacle diagnosis of resource and environment carrying capacity in the Loess Plateau. *PLoS ONE*, 16(8), 1-24. <https://doi.org/10.1371/journal.pone.0256334>
- Huang, Y. C., Tu, J. C., & Hung, S. J. (2016). Developing a decision model of sustainable product design and development from product servicizing in Taiwan. *Eurasia Journal of Mathematics, Science and Technology Education*, 12(5), 1285-1302. <https://doi.org/10.12973/eurasia.2016.1513a>
- Huang, Y. S., & Asghar, A. (2021). The political initiative of Taiwan's education for sustainable development: Looking through the lens of Chinese legalism. *Policy Futures in Education*, 19(7), 925-949. <https://doi.org/10.1177/1478210321995650>
- Huang, Y. S., Harvey, B., & Asghar, A. (2021a). Bureaucratic exercise? Education for sustainable development in Taiwan through the stories of policy implementers. *Environmental Education Research*, 27(7), 1099-1114. <https://doi.org/10.1080/13504622.2021.1926431>
- Hubscher-Davidson, S. (2020). The psychology of sustainability and psychological capital: New lenses to examine well-being in the translation profession. *European Journal of Sustainable Development Research*, 4(4), em0127. <https://doi.org/10.29333/ejosdr/7901>
- Husamah, H. (2015). Thinking skills for environmental sustainability perspective of new students of biology education department through blended project based learning model. *Jurnal Pendidikan IPA Indonesia [Indonesian Science Education Journal]*, 4(2), 110-119.
- Johnson, R. B., & Onwuegbuzie, A. J. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, 1(2), 112-133. <https://doi.org/10.1177/1558689806298224>
- Kagawa, F. (2007). Dissonance in students' perceptions of sustainable development and sustainability. *International Journal of Sustainability in Higher Education*, 8(3), 317-338. <https://doi.org/10.1108/14676370710817174>
- Kahn, M. E. (2015). A review of "the age of sustainable development" by Jeffrey Sachs. *Journal of Economic Literature*, 53(3), 654-666. <https://doi.org/10.1257/jel.53.3.654>
- Kantsperger, M., Thees, H., & Eckert, C. (2019). Local participation in tourism development-roles of non-tourism related residents of the Alpine Destination Bad Reichenhall. *Sustainability*, 11(24), 6947. <https://doi.org/10.3390/SU11246947>
- Ken-Giami, I., Simandjuntak, S., Yang, L., Coats, A., & Sanders, D. (2022). Establishing the relative importance of specific sustainability themes that influence women's choice of engineering as a career using the analytical hierarchy process. *Sustainability*, 14(1), 566. <https://doi.org/10.3390/su14010566>
- Khan, N. U., Wei, H., Yue, G., Nazir, N., & Zainol, N. R. (2021). Exploring themes of sustainable practices in manufacturing industry: Using thematic networks approach. *Sustainability*, 13(18), 10288. <https://doi.org/10.3390/su131810288>
- Kidman, G., & Casinader, N. (2019). Developing teachers' environmental literacy through inquiry-based practices. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(6), 1-9. <https://doi.org/10.29333/ejmste/103065>
- Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H., Roder-DeWan, S., Adeyi, O., Barker, P., Daelmans, B., Doubova, S. V., English, M., Elorrio, E. G., Guanais, F., Gureje, O., Hirschhorn, L. R., Jiang, L., Kelley, E., Lemango, E. T., Liljestrand, J.,

- ... Pate, M. (2018). High-quality health systems in the sustainable development goals era: Time for a revolution. *The Lancet Global Health*, 6(11), e1196-e1252. [https://doi.org/10.1016/S2214-109X\(18\)30386-3](https://doi.org/10.1016/S2214-109X(18)30386-3)
- Kumar, S., Kumar, N., & Vivekadhish, S. (2016). Millennium development goals (MDGS) to sustainable development goals (SDGS): Addressing unfinished agenda and strengthening sustainable development and partnership. *Indian Journal of Community Medicine*, 41(1), 1-4. <https://doi.org/10.4103/0970-0218.170955>
- Kuo, F. S., & Perng, Y. H. (2016). The educational strategies of citizens' identification and recognition for sustainable urban development in Taipei. *Eurasia Journal of Mathematics, Science and Technology Education*, 12(6), 1685-1696. <https://doi.org/10.12973/eurasia.2016.1560a>
- Kyle, W. C. (2020). Expanding our views of science education to address sustainable development, empowerment, and social transformation. *Disciplinary and Interdisciplinary Science Education Research*, 2, 2. <https://doi.org/10.1186/s43031-019-0018-5>
- Lan, L. W. (2005). Sustainable development and transportation: A Taiwan perspective. *Invited Speech at Hokkaido University, Japan, January*, 1-25.
- Latchem, C. (2018). Education for sustainable development. *Springer Briefs in Open and Distance Education*, 2(6), 155-165. [https://doi.org/10.1007/978-981-10-6741-9\\_15](https://doi.org/10.1007/978-981-10-6741-9_15)
- Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C. (2016). Contributions of education for sustainable development (ESD) to quality education: A synthesis of research. *Journal of Education for Sustainable Development*, 10(2), 226-242. <https://doi.org/10.1177/0973408216661442>
- Lavonen, J. (2020). Curriculum and teacher education reforms in Finland that support the development of competences for the twenty-first century. In F. M. Reimers (Ed.), *Audacious education purposes: How governments transform the goals of education systems* (pp. 1-250). Springer. <https://doi.org/10.1007/978-3-030-41882-3>
- Lee, J. C.-K. (2010). Education for sustainable development in China. *Chinese Education & Society*, 43(2), 63-81. <https://doi.org/10.2753/CED1061-1932430207>
- Lélé, S. M. (1991). Sustainable development: A critical review. *World Development*, 19(6), 607-621. [https://doi.org/10.1016/0305-750X\(91\)90197-P](https://doi.org/10.1016/0305-750X(91)90197-P)
- Lim, M. M. L., Søggaard Jørgensen, P., & Wyborn, C. A. (2018). Reframing the sustainable development goals to achieve sustainable development in the anthropocene—A systems approach. *Ecology and Society*, 23(3), 22. <https://doi.org/10.5751/ES-10182-230322>
- Liu, H., Long, J., & Shen, Z. (2021). Financial agglomeration, energy efficiency, and sustainable development of China's regional economy: Evidence from provincial panel data. *Mathematical Problems in Engineering*, 2021, 1-15. <https://doi.org/10.1155/2021/3871148>
- Lo, A., Huang, J. J., Chen, C. C., Chou, F. H. C., & Shieh, V. (2020). From biological safety to social safety: How Taiwan's community centered prevention program controlled the COVID-19 outbreak. *Journal of Global Health*, 10(2), 020303. <https://doi.org/10.7189/jogh.10.020303>
- Lohmann, J., Breithecker, J., Ohl, U., Gieß-Stüber, P., & Brandl-Bredenbeck, H. (2021). Teachers' professional action competence in education for sustainable development: A systematic review from the perspective of physical education. *Sustainability*, 13(23), 13343. <https://doi.org/10.3390/su132313343>
- Macura, B., Suškevičs, M., Garside, R., Hannes, K., Rees, R., & Rodela, R. (2019). Systematic reviews of qualitative evidence for environmental policy and management: An overview of different methodological options. *Environmental Evidence*, 8(1), 1-11. <https://doi.org/10.1186/s13750-019-0168-0>
- Mair, S., Jones, A., Ward, J., Christie, I., Druckman, A., & Lyon, F. (2018). A critical review of the role of indicators in implementing the sustainable development goals. In *Handbook of Sustainability Science and Research. World Sustainability Series* (pp. 41-56). Springer. [https://doi.org/10.1007/978-3-319-63007-6\\_3](https://doi.org/10.1007/978-3-319-63007-6_3)
- Malik, R. S. (2018). Educational challenges in 21st century and sustainable development. *Journal of Sustainable Development Education and Research*, 2(1), 10-20. <https://doi.org/10.17509/jsder.v2i1.12266>
- Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent Social Sciences*, 5(1), 1-21. <https://doi.org/10.1080/23311886.2019.1653531>
- Miedijensky, S., & Abramovich, A. (2019). Implementation of "education for sustainability" in three elementary schools-What can we learn about a change process? *Eurasia Journal of Mathematics, Science and Technology Education*, 15(10), em1754. <https://doi.org/10.29333/ejmste/109145>
- Mihalic, T. (2020). Conceptualising overtourism: A sustainability approach. *Annals of Tourism Research*, 84, 103025. <https://doi.org/10.1016/j.annals.2020.103025>

- Min, W., & Dongying, W. (2007). Education for sustainable development in China: A perspective on curricula standards and geography textbooks. *Internationale Schulbuchforschung [International Textbook Research]*, 29(2), 185-197.
- Novidsa, I., Purwianingsih, W., & Riandi, R. (2020). Exploring knowledge of prospective biology teacher about education for sustainable development. *Jurnal Pendidikan Biologi Indonesia [Indonesian Journal of Biology Education]*, 6(2), 317-326. <https://doi.org/10.22219/jpbi.v6i2.12212>
- Olfe-Kräutlein, B. (2020). Advancing CCU technologies pursuant to the SDGs: A challenge for policy making. *Frontiers in Energy Research*, 8, 1-16. <https://doi.org/10.3389/fenrg.2020.00198>
- Omisore, A. G., Babarinde, G. M., Bakare, D. P., & Asekun-Olarinmoye, E. O. (2017). Awareness and knowledge of the sustainable development goals in a university community in Southwestern Nigeria. *Ethiopian Journal of Health Sciences*, 27(6), 669-676. <https://doi.org/10.4314/ejhs.v27i6.12>
- Onoshakpokaiye, O. E. (2021). Functional mathematics education: A tool for developing entrepreneurship for sustainable self-reliance of Nigerian graduates. *Contemporary Mathematics and Science Education*, 2(1), ep21003. <https://doi.org/10.30935/conmaths/9678>
- Ozburak, C., Batirbaygil, M. H., & Uzunoglu, S. S. (2018). Sustainable environment education in pre-school pupils. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(7), 3367-3379. <https://doi.org/10.29333/ejmste/91874>
- Pan, Y. T., Yang, K. K., Hong, Z. R., & Lin, H. S. (2018). The effect of interest and engagement in learning science on adults' scientific competency and environmental action. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(12), em1609. <https://doi.org/10.29333/ejmste/94225>
- Perng, Y. H., Chen, S. M., & Lin, S. C. (2017). Economic analysis for sustainable renovation. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(12), 8139-8147. <https://doi.org/10.12973/ejmste/78633>
- Qiu, S. B., & Yu, D. H. (2018). The influence of higher engineering education investment and technical progress on the sustainable development of manufacturing industry in China. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(3), 823-829. <https://doi.org/10.12973/ejmste/81036>
- Quarless, D. (2014). Transitioning from the millennium development goals to sustainable development goals. *Economic Commission for Latin America and the Caribbean*. <https://www.cepal.org/en/notes/transitioning-millennium-development-goals-sustainable-development-goals>
- Rau, H., & Fahy, F. (2012). Measuring the immeasurable? The challenges and opportunities of sustainability research in the social sciences. In F. Fahy, & H. Rau (Eds.), *Methods of sustainability research in the social sciences* (pp. 1-24). SAGE. <https://doi.org/10.4135/9781526401748.n1>
- Redman, E., Murphy, C., Mancilla Mendez, Y., Mallon, B., Kater-Wettstaedt, L., Barth, M., Ortiz-Martínez, G., Smith, G., & Kelly, O. (2021). International scaling of sustainability continuing professional development for in-service teachers. *Interdisciplinary Journal of Environmental and Science Education*, 17(3), e2243. <https://doi.org/10.21601/ijese/10936>
- Regnault, A., Willgoss, T., & Barbic, S. (2018). Towards the use of mixed methods inquiry as best practice in health outcomes research. *Journal of Patient-Reported Outcomes*, 2, 2-5. <https://doi.org/10.1186/s41687-018-0043-8>
- Regös, E. N. (2015). *Data bases and statistical systems: environment and urban studies*. Elsevier. <https://doi.org/10.1016/B978-0-08-097086-8.41072-X>
- Richardson, R. B. (2021). *The role of tourism in sustainable development*. Oxford Research Encyclopedias, Environmental Science. <https://doi.org/acrefore/9780199389414.013.387>
- Rock, M. T. (1996). Toward more sustainable development: The environment and industrial policy in Taiwan. *Development Policy Review*, 14(3), 255-272. <https://doi.org/10.1111/j.1467-7679.1996.tb00109.x>
- Rosen, M. A. (1995). The role of energy efficiency in sustainable development. In *Proceedings 1995 Interdisciplinary Conference: Knowledge Tools for a Sustainable Civilization. Fourth Canadian Conference on Foundations and Applications of General Science Theory* (pp. 140-148). <https://doi.org/10.1109/KTSC.1995.569167>
- Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitions. *Science of the Total Environment*, 786, 147481. <https://doi.org/10.1016/j.scitotenv.2021.147481>
- Sáiz-Manzanares, M. C., Gutiérrez-González, S., Rodríguez, Á., Alameda Cuenca-Romero, L., Calderón, V., & Queiruga-Dios, M. Á. (2020). Systematic review on inclusive education, sustainability in engineering: An analysis with mixed methods and data mining techniques. *Sustainability*, 12(17), 6861. <https://doi.org/10.3390/su12176861>

- Santamaría-Cárdaba, N., Martins, C., & Sousa, J. (2021). Mathematics teachers facing the challenges of global society: A study in primary and secondary education in Spain. *Eurasia Journal of Mathematics, Science and Technology Education*, 17(4), 1-9. <https://doi.org/10.29333/ejmste/10806>
- Scerri, A., & James, P. (2010). Accounting for sustainability: Combining qualitative and quantitative research in developing “indicators” of sustainability. *International Journal of Social Research Methodology*, 13(1), 41-53. <https://doi.org/10.1080/13645570902864145>
- Seikkula-Leino, J., Jónsdóttir, S. R., Håkansson-Lindqvist, M., Westerberg, M., & Eriksson-Bergström, S. (2021). Responding to global challenges through education: Entrepreneurial, sustainable, and pro-environmental education in nordic teacher education curricula. *Sustainability*, 13(22), 12808. <https://doi.org/10.3390/su132212808>
- Shi, L., Han, L., Yang, F., & Gao, L. (2019). The evolution of sustainable development theory: Types, goals, and research prospects. *Sustainability*, 11(24), 7158. <https://doi.org/10.3390/su11247158>
- Shih, N. J., Hsu, W. T., & Diao, P. H. (2019). Point cloud-oriented inspection of Old Street’s sustainable transformation from the ceramic industry to cultural tourism: A case study of Yingge, a ceramic town in Taiwan. *Sustainability*, 11(17), 4749. <https://doi.org/10.3390/su11174749>
- Shrestha, J. (2020). Authors beware! Publishing in predatory journals is harmful. *Journal of Agriculture and Natural Resources*, 3(2), 1-8. <https://doi.org/10.3126/janr.v3i2.32293>
- Shrestha, J., Subedi, S., & Timsina, K. P. (2020). Predatory publishing: A threat to the credibility of science. *Nepal Journal of Multidisciplinary Research*, 3(1), 7-14. <https://doi.org/10.3126/njmr.v3i1.30214>
- Shrestha, J., Subedi, S., Shokati, B., & Chaudhary, A. (2019). Predatory journals: A threat to scholarly publishing. *Journal of Education and Research*, 8(1), 89-101. <https://doi.org/10.3126/jer.v8i1.25482>
- Shrestha, J., Subedi, S., Timsina, K. P., & Tripathi, M. P. (2018). Risk of publication in worthless journals. *Journal of Agriculture and Natural Resources*, 1(1), 1-5. <https://doi.org/10.3126/janr.v1i1.22217>
- Singh, S. K. (2016). Sustainable development: A literature review. *International Journal of Indian Psychology*, 3(3), 63-69. <https://doi.org/10.25215/0303.104>
- Sneegas, G., Beckner, S., Brannstrom, C., Jepson, W., Lee, K., & Seghezzi, L. (2021). Using q-methodology in environmental sustainability research: A bibliometric analysis and systematic review. *Ecological Economics*, 180, 106864. <https://doi.org/10.1016/j.ecolecon.2020.106864>
- Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333-339. <https://doi.org/10.1016/j.jbusres.2019.07.039>
- Storopoli, J., Ramos, H., Quirino, G., & Ruffn, C. (2019). Themes and methods in sustainability research. *Revista de Gestao Ambiental e Sustentabilidade [Journal of Environmental Management and Sustainability]*, 8(3), 410-430. <https://doi.org/10.5585/GEAS.V8I3.15731>
- Streimikiene, D. (2013). United Nations conference on sustainable development Rio+20. *Intellectual Economics*, 7(1), 126-130.
- Sun, C.-Y. (2014). Sustainable development of three Taiwan’s communities. *World SB 14*, 1-3.
- Tilbury, D. (2004). Rising to the challenge: Education for sustainability in Australia. *Australian Journal of Environmental Education*, 20(2), 103-114. <https://doi.org/10.1017/S081406260000224X>
- Trindade, E. P., Hinnig, M. P. F., da Costa, E. M., Marques, J. S., Bastos, R. C., & Yigitcanlar, T. (2017). Sustainable development of smart cities: A systematic review of the literature. *Journal of Open Innovation: Technology, Market, and Complexity*, 3, 11. <https://doi.org/10.1186/s40852-017-0063-2>
- Trott, C. D., & Weinberg, A. E. (2020). Science education for sustainability: Strengthening children’s science engagement through climate change learning and action. *Sustainability*, 12(16), 6400. <https://doi.org/10.3390/su12166400>
- Tsai, M. C. (2021). Developing a sustainability strategy for Taiwan’s tourism industry after the COVID-19 pandemic. *PLoS ONE*, 16(3), 1-21. <https://doi.org/10.1371/journal.pone.0248319>
- Tu, J. C., Chen, Y. Y., & Chen, S. C. (2017). The study of consumer green education via the internet of things with green marketing. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(9), 6133-6145. <https://doi.org/10.12973/eurasia.2017.01054a>
- Turkoglu, S. P., & Kardogan, P. S. O. (2018). The role and importance of energy efficiency for sustainable development of the countries BT. In S. Firat, J. Kinuthia, & A. Abu-Tair (Eds.), *Proceedings of 3rd International Sustainable Buildings Symposium (ISBS 2017)* (pp. 53-60). Springer. [https://doi.org/10.1007/978-3-319-64349-6\\_5](https://doi.org/10.1007/978-3-319-64349-6_5)
- Uitto, A., & Saloranta, S. (2017). Subject teachers as educators for sustainability: A survey study. *Education Sciences*, 7, 8. <https://doi.org/10.3390/educsci7010008>
- UN DESA. (2016). The 17 goals | Sustainable development. *Sustainable Development*. <https://sdgs.un.org/goals>

- UNESCO. (2012). Education for sustainable development: Sourcebook. *United Nations Educational, Scientific and Cultural Organization*.
- UNESCO. (2020). Education for sustainable development: A roadmap. UNESCO. <https://doi.org/10.4324/9781003022763-5>
- Valencia, M. I. C. (2018). Introducing education for sustainable development (ESD) in the educational institutions in the Philippines. *Journal of Sustainable Development Education and Research*, 2(1), 51-57. <https://doi.org/10.17509/jsder.v2i1.12358>
- van Eijck, M., & Roth, W. M. (2007). Improving science education for sustainable development. *PLoS Biology*, 5(12), 2763-2769. <https://doi.org/10.1371/journal.pbio.0050306>
- Velázquez, F. D. C., & Rivas, F. L. (2020). Education for sustainable development in STEM (technical drawing): Learning approach and method for SDG 11 in classrooms. *Sustainability*, 12(7), 2706. <https://doi.org/10.3390/su12072706>
- Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M., & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the sustainable development goals. *Nature Communications*, 11(1), 1-10. <https://doi.org/10.1038/s41467-019-14108-y>
- Violanda, M. V. G., & Madrigal, D. V. (2021). Education for sustainable development (ESD): A journey towards sustainable future. *Technium Social Sciences Journal*, 20, 172-180. <https://doi.org/10.47577/tssj.v20i1.3521>
- Wang, Y. P. (2016). A study on Kinmen resident's perception of tourism development and culture heritage impact. *Eurasia Journal of Mathematics, Science and Technology Education*, 12(12), 2909-2920. <https://doi.org/10.12973/eurasia.2016.02312a>
- Weicht, R., & Jónsdóttir, S. R. (2021). Education for social change: The case of teacher education in Wales. *Sustainability*, 13(15), 8574. <https://doi.org/10.3390/su13158574>
- Wenhai, L., Cusack, C., Baker, M., Tao, W., Mingbao, C., Paige, K., Xiaofan, Z., Levin, L., Escobar, E., Amon, D., Yue, Y., Reitz, A., Sepp Neves, A. A., O'Rourke, E., Mannarini, G., Pearlman, J., Tinker, J., Horsburgh, K. J., Lehodey, P., ... Yufeng, Y. (2019). Successful blue economy examples with an emphasis on international perspectives. *Frontiers in Marine Science*, 6, 1-14. <https://doi.org/10.3389/fmars.2019.00261>
- Wibowo, Y. G., & Sadikin, A. (2019). Biology in the 21st-century: Transformation in biology science and education in supporting the sustainable development goals. *Jurnal Pendidikan Biologi Indonesia [Indonesian Journal of Biology Education]*, 5(2), 285-296. <https://doi.org/10.22219/jpbi.v5i2.7956>
- Wilujeng, I., Dwandaru, W. S. B., & Rauf, R. A. B. A. (2019). The effectiveness of education for environmental sustainable development to enhance environmental literacy in science education: A case study of hydropower. *Jurnal Pendidikan IPA Indonesia [Indonesian Science Education Journal]*, 8(4), 521-528. <https://doi.org/10.15294/jpii.v8i4.19948>
- Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, 39(1), 93-112. <https://doi.org/10.1177/0739456X17723971>
- Yu, S., Sial, M. S., Tran, D. K., Badulescu, A., Thu, P. A., & Sehleanu, M. (2020). Adoption and implementation of sustainable development goals (SDGs) in China-Agenda 2030. *Sustainability*, 12(15), 6288. <https://doi.org/10.3390/SU12156288>
- Yue, X., & Ji, R. (2012). Teacher professional competencies in education for sustainable development. In *Sustainable Organizations-Models, Applications, and New Perspective* (p. 13). <https://doi.org/10.5772/intechopen.94991>
- Yusof, M. I. B. M., & Ariffin, M. (2020). A journey towards sustainability: A review on sustainable development implementation in Malaysia. *IOP Conference Series: Earth and Environmental Science*, 494(1), 012011. <https://doi.org/10.1088/1755-1315/494/1/012011>
- Yusoff, M. M. (2020). Improving the quality of life for sustainable development. *IOP Conference Series: Earth and Environmental Science*, 561(1), 012020. <https://doi.org/10.1088/1755-1315/561/1/012020>
- Zakari, A., Khan, I., Tan, D., Alvarado, R., & Dagar, V. (2022). Energy efficiency and sustainable development goals (SDGs). *Energy*, 239, 122365. <https://doi.org/10.1016/j.energy.2021.122365>
- Zhao, R. X., Zeng, J. Q., & Zhao, J. L. (2017). Analysis of provincial tourism sustainable development model and countermeasure. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(12), 7671-7677. <https://doi.org/10.12973/ejmste/77930>
- Zidny, R., Laraswati, A. N., & Eilks, I. (2021). A case study on students' application of chemical concepts and use of arguments in teaching on the sustainability-oriented chemistry issue of pesticides use under inclusion of different Scientific worldviews. *Eurasia Journal of Mathematics, Science and Technology Education*, 17(7), 1-17. <https://doi.org/10.29333/EJMSTE/10979>
- Ziolo, M., Jednak, S., Savić, G., & Kragulj, D. (2020). Link between energy efficiency and sustainable economic and financial development in OECD

countries. *Energies*, 13(22), 5898. <https://doi.org/10.3390/en13225898>

Zulkarnaini, Meiwanda, G., Lubis, E. E., Nasution, M. S., & Habibie, D. K. (2020). Peatland management based on education for sustainable development

(ESD). *Journal of Physics: Conference Series*, 1655(1), 1-5. <https://doi.org/10.1088/1742-6596/1655/1/012142>

<https://www.ejmste.com>