

Review

Progressing towards Global Citizenship and a Sustainable Nation: Pillars of Climate Change Education and Actions

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Abstract: This systematic review article focuses on the elements of climate change that have been used to create climate change awareness and hence inculcate sustainable literacy among secondary school students as well as actions that have been undertaken to nourish students' global competencies on climate change. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was adapted for the review of the current research, which utilised two main databases, namely, Scopus and Web of Science. The findings indicate that 35 articles were successfully selected, and were subsequently critically and systematically analysed. The review has successfully formulated three main themes that were commonly used to create climate change awareness among schoolchildren: effects of climate change, factors affecting climate change, and mitigation plans in handling climate change issues. The review has also revealed four major themes and actions that have been used as platforms towards instilling global competencies towards climate actions; indeed, the findings of this systematic review will provide meaningful information, especially to educators as well as decision-makers in developing more effective, efficient, and sustainable strategies that will shape future globally competent citizens in mitigating and adapting climate change issues and problems.

Keywords: climate change; Climate Change Education; global competency; climate actions



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1. Introduction

In recent years, global environmental changes have become more obvious, and the underlying cause for these frequent occurrences is anthropogenic activities [1]. This causal relationship has been proven by various studies in the literature [2–5] besides reports on climate change from global organizations [6–8]. Human activities such as agriculture [8], the burning of fossil fuels [9], and open burning directly or indirectly give negative impacts on climate change in the world. These anthropogenic activities significantly contribute to multiple phenomena such as frequent occurrences of extreme weather and the rising sea level which is a result of the Earth's rising average temperature [8].

The emergence of climate change as a serious issue worldwide, along with other critical issues, has led to the idea and implementation of the 2030 Agenda, which is comprised of 17 Sustainable Development Goals (SDGs). One of the goals, SDG 4, focuses on how quality education amongst students, whether in primary; secondary; or high school, will impact on SDG 13, which is climate action. Education for youth that emphasises more on sustainable actions will aid in improving the environmental condition of this world.

Currently, Climate Change Education (CCE) is one of the initiatives taken to deliver the facts about the current climate status of the world and the proper mitigation actions that need to be done to the youth, as they will be the ones who will have to face and deal with the consequences of climate change [10]; thus, CCE has now become a critical

factor in strengthening the climate change awareness of young people [11,12]. CCE is one of the sub-areas of Education for Sustainable Development (ESD) where the focus is on the complexity and challenges involved in understanding and responding to the impact of climate change [13]; furthermore, the implementation of CCE in ESD should include a holistic and integrated view of all dimensions [14], covering the ecological, economic, and social aspects of the consequences of climate change [15,16]. Students that receive and accept multiple dimensions of sustainable education in the proper and right way will obtain a better understanding of what climate change and sustainable development are all about, and this will eventually help to create awareness amongst them of the need to practise a more environmental-oriented lifestyle. The knowledge and skills acquired by younger people will guide them to conserve the environment [17].

In recent decades, CCE has become an important part of educational policy developments in most countries; however, the ways CCE is adopted in the education system of each country is important as well, as this will determine the success rate of its implementation. For instance, the implementation of CCE and ESD is considered progressive in Sweden [18]. These ideals have been integrated formally into the curricula and educational practices of Sweden [19], and the Swedish education system focuses more on each student's individual responsibility for global environmental issues [20]. On the other hand, more attention is paid to knowledge than environmentally responsible behaviours in the Turkish and Bulgarian curricula [21]; however, an analysis of the national curriculum in England and Wales showed that teachers are legally bound to cover the information contained within the syllabi, and other topics like citizenship or ESD will be taught only if time and space allow [22]. Based on the examples above, different implementations of CCE will produce students with different views of climate change itself.

Effective initiatives of Climate Change Education will employ well-established models, theories, and past literature in guiding the process of creating their curricula for students' learning. Good curriculum content related to the topic of climate change will influence students' global competence which covers three elements, namely knowledge, skills, and attitudes [23]. The first dimension of global competence, which is knowledge regarding the impacts and consequences of climate change, will expose and encourage students to be more climate-friendly [24]. High levels of knowledge about climate change will influence the skills of students in order to scrutinise and appraise information and meanings on this topic [23]. The inculcation of correct attitudes to use their knowledge and skills to produce competent behaviours then constitutes the third dimension of Global Competence [23]; they will feel personally affected by climate change in their daily lives and will engage more in environmental-friendly actions [25,26], and as they practice pro-environmental actions, they will be aware of their responsibilities in encouraging their family and friends to be involved in more positive actions concerning climate change [27]; however, several factors and gaps that will limit students' global competence are found in the process of delivering climate change awareness and knowledge to them.

Climate change issues, such as global warming and others, are perceived as an intersectional area of science and society, where the result will be complex, often controversial [28], and viewed as a productive context for both teaching and learning [29]; thus, teachers and students are the main players in tackling these issues of climate change. More efforts are needed, especially from teachers, to increase students' understanding of controversial issues and to eventually train capable and responsible youngsters to participate in decision-making [30]. This is also supported by the fact that humans need gradual and consistent education for sustainable development (ESD) from an early age. This education should involve their surrounding community so that they will grow to be aware of how their actions affect their environment. ESD covers the balance between the economic, social, and environmental dimensions [31,32] and is not limited to knowledge of one's climate and environment [31].

Each human being tends to become a better person through individual development, which consists of several processes and aspects such as physical, behavioural, cognitive,

and emotional growth [33]. From the social aspect, adolescents will be directly influenced by the people immediately around them in determining what actions they will take in the future, especially in relation to environmental aspects [34,35]; hence, students tend to become aware of the climate issue if the formal education that they receive at school regarding sustainable education is effective, besides the role played by their social context such as the attitudes and actions of their family and friends towards the environment.

A person's attitude towards climate change and sustainable development is seen in their behaviours in relation to any stimuli, external and internal situations [36], and is influenced by knowledge and emotions. All these eventually impact the person's decision-making about natural resources and how those resources are managed [37]. The knowledge and action towards a more environmentally sustainable lifestyle cannot simply be imparted to students through a short training programme. It must be acquired through proper ESD, which will improve the person's capacity and commitment to building more sustainable societies [38–41]; however, there are several constraints that will prevent students from achieving good global competency, which include the lack of knowledge, skills, and correct attitudes toward a sustainable lifestyle [42]. These gaps can be caused by weaknesses in the curriculum of ESD itself, as well as negative factors in the students' surroundings.

In addition, parents of students also play a major role in exerting a significant impact on their values, behaviours, and attitudes towards the natural environment. This will eventually influence the students' positions and stances on environmental issues, such as whether or not they choose to engage in pro-environmental behaviours [43,44]. Children show positive behaviours towards the natural environment when their family is functioning positively [45]. For example, through recent studies, family and friends were observed to have a highly significant role in improving the global competency of students regarding climate change by facilitating communication between them and helping them in their search for information [46–49]. Such information allows parents to show a willingness to inform and discuss with their children the current serious environmental issues that affect us, such as the pollution of the seas and our excessive consumption of energy and water.

Another important group that assists in the process of generating global competency in dealing with climate change among students is the teachers; they are the ones who are directly involved in delivering the input about climate change to the students in school, and any mistakes made by them in the process of delivery will produce a major impact on the objective of Climate Change Education itself.

The pedagogy used by the teachers in teaching this knowledge should be varied and not just adhere to the traditional methods of teaching. Generally, multiple teaching strategies can be applied by teachers to make students interested in obtaining new information about all aspects of climate change; for example, the inquiry-driven approach will allow students to consider the human element of environmental change and at the same time, gain deeper insights into the environmental and social impacts of human activities [50]. The prediction of long-term outcomes of change will take the students' thinking processes into envisioning and imagining outcomes across different scenarios [51]. Thus, a scenario such as the students' observation of accurate sea levels under different levels of carbon emission under their teacher's guidance will provide a better awareness of the risks of global warming causing the sea level to rise [52].

Nevertheless, the most important factor is the curriculum content of the Climate Change Education itself. The implementation of climate change-related curricula is different across the countries. Although most countries have a well-highlighted vision to achieve sustainability based on the Sustainability Development Goals, certain actions taken to realise that vision, especially in the scope of their curricula, are still not well-implemented. Firstly, the textbook topics about climate change are not overarching and sometimes reproduce biased knowledge [53]. In Sweden, certain dimensions of sustainability are underdeveloped in their biology textbooks [54]. Therefore, an integrated and holistic view of all dimensions of sustainability is needed in Climate Change Education [14]; furthermore, the lack of action-oriented content about sustainable development in the textbooks has been mentioned. This lacuna

will become a potential challenge for the ability of educators to promote action competence in their students [55,56]. Most of the textbooks give exercises and tasks that do not encourage readers to find any information beyond the concepts and perspectives that are already provided; indeed, the arrangement and setting of certain values in Climate Change Education will indirectly impact the thinking style of students.

Based on the issues described, the purpose of the researcher is to summarise, identify and analyse the emphasis and gaps of research on climate change knowledge and its impact on the global competencies of secondary school students based on previous studies.

The research questions are:

- What are the elements of climate change that have been used to create climate change awareness among secondary school students?
- What are the actions of secondary school students that have influenced their global competence in climate change?

2. Method

This section explains the method used to analyse the suitable articles related to climate change and the global competence of secondary school students. There are four main sub-sections, namely Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA); the resources used in this study; the systematic review process utilised to select the articles including identification, screening, and eligibility; as well as the processes of data abstraction and analysis which led to the findings of the current research.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

In general, authors need guidance in sourcing standard publications which contain the relevant and necessary information for the purposes of their research. PRISMA can be used as a basis for reporting systematic reviews for all types of research [57]. PRISMA acts as a catalyst to help authors produce further evidence that can be considered when, in the future, they perform further reviews of their checklist for the inclusion of publications in their research [58].

Although PRISMA is often used in medical studies, this method can also be used in the field of environmental management and at the same time, it can help to identify inclusion and exclusion criteria for a particular study [59]. For example, attention was given to studies on physical and biological climate change issues in an effort to address the management of human actions in nature [59]; furthermore, PRISMA examines an extensive database of scientific literature at a given time. That allows the search for appropriate terms to be conducted in relation to the adaptation of education to climate change. Checklist items were included to prove if there was evidence of not reporting certain items, which could increase the risk of bias, or where it was clear that information was needed to assess the reliability of the survey [58].

3. Resources

This study was conducted using two main databases to increase the likelihood of obtaining relevant articles, namely Scopus and Web of Science. Scopus is a robust database and consists of more than 256 fields of study, including environmental studies [60]. Specifically, Scopus indexes a total of 1360 journals related to environmental sciences [60].

4. Systematic Review Process for Selecting the Articles

The review was conducted in June 2021. The systematic review process consisted of three stages, namely identification; screening; and eligibility.

5. Identification

The first stage in the systematic review process was the identification of keywords (Table 1), followed by a process of searching for related and similar keywords based on thesauri, dictionaries, encyclopaedias, and past research. The keywords have been

validated by an expert on the topics of climate change, secondary school students, and global competence (Table 1). The “*” marks enable the keywords to be found in the related articles either the keyword is in the form of singular or plural. The articles found from the Scopus database totalled 206 articles while 200 articles were found from Web of Science (WOS) databases; hence, the accumulated number of articles generated from both resources was 406 articles in the first stage of the systematic review process.

Table 1. Keywords and searching information strategy.

Database	Search String
SCOPUS	TITLE-ABS-KEY (("climate change *" OR "global warming" OR "climate warming" OR "climate variability" OR "environmental change *" OR "climate crisis" OR "global heating" OR "climate fluctuation *" OR "climate action") AND ("global competency" OR "global competencies" OR "global competencies cognitive" OR "knowledge *" OR "cognitive skill *" OR "social-emotional *" OR "global competencies affective *" OR "critical thinking *" OR "problem solving" OR "taking action *" OR "proficiency with new technology" OR "respect *" OR "responsible *" OR "empathy" OR "self-discipline *" OR "aware *" OR "curious") AND ("secondary school *" OR "middle school student *" OR "high school student *" OR "junior high school student *" OR "preparatory school student *" OR "senior high school student *" OR "prep school student *" OR "college preparatory school student *" OR "intermediate school student *" OR "secondary school pupil *" OR "secondary level student *" OR "middle school pupil *"))
WOS	TS(("climate change *" OR "global warming" OR "climate warming" OR "climate variability" OR "environmental change *" OR "climate crisis" OR "global heating" OR "climate fluctuation *" OR "climate action") AND ("global competency" OR "global competencies" OR "global competencies cognitive" OR "knowledge *" OR "cognitive skill *" OR "social-emotional *" OR "global competencies affective *" OR "critical thinking *" OR "problem solving" OR "taking action *" OR "proficiency with new technology" OR "respect *" OR "responsible *" OR "empathy" OR "self-discipline *" OR "aware *" OR "curious") AND ("secondary school *" OR "middle school student *" OR "high school student *" OR "junior high school student *" OR "preparatory school student *" OR "senior high school student *" OR "prep school student *" OR "college preparatory school student *" OR "intermediate school student *" OR "secondary school pupil *" OR "secondary level student *" OR "middle school pupil *"))

6. Screening

Before the screening process began, a total of 26 papers were removed as these papers appeared in both databases. In the first stage of screening, the remaining 380 articles were screened based on several inclusion and exclusion criteria.

The first criterion was accessibility, where the researcher decided to focus on articles with open access. This meant that articles with all available types of open access were accepted, such as Gold open; Hybrid Gold; Bronze; and Green types of open access. The second criterion considered was document type. Research articles were the type of document that the researcher was focused on. This was influenced by the need for primary sources which offered empirical data [60]. Thus, other papers that did not offer empirical data such as systematic reviews; reviews; meta-analyses; meta-syntheses; book series; books; chapters in books; and conference proceedings were excluded. The third criterion was language. Only publications in the English Language were chosen by the researcher. The fourth criterion was that the publication date of the articles needed to be within the period of the last five years. The information related to these criteria of inclusion and exclusion is presented in Table 2.

Table 2. Inclusion and exclusion criteria.

Criteria	Inclusion	Exclusion
Publication timeline	2021–2017	2016 and before
Document type	Article (with empirical data)	Systematic review, review, meta-analysis, meta-synthesis, book series, book, chapter in a book, and conference proceeding
Language	English	Non-English
Nature of study	Related to climate change and global competency of secondary school students	Not related to climate change and global competency of secondary school students

7. Eligibility

After 329 papers were screened out in the previous stage, the third stage in the systematic review process was eligibility. A total of 51 articles underwent this stage. At this stage, the titles, abstracts, and main contents of the remaining articles were thoroughly reviewed to ensure the appropriateness of the stated criteria in achieving the objectives of the current research study. Ultimately, a total of 16 articles were excluded because they were not based on empirical data and were considered articles that did not answer the research question on climate change and the global competencies of secondary school students; therefore, the remaining 35 articles were selected for this study (Figure 1).

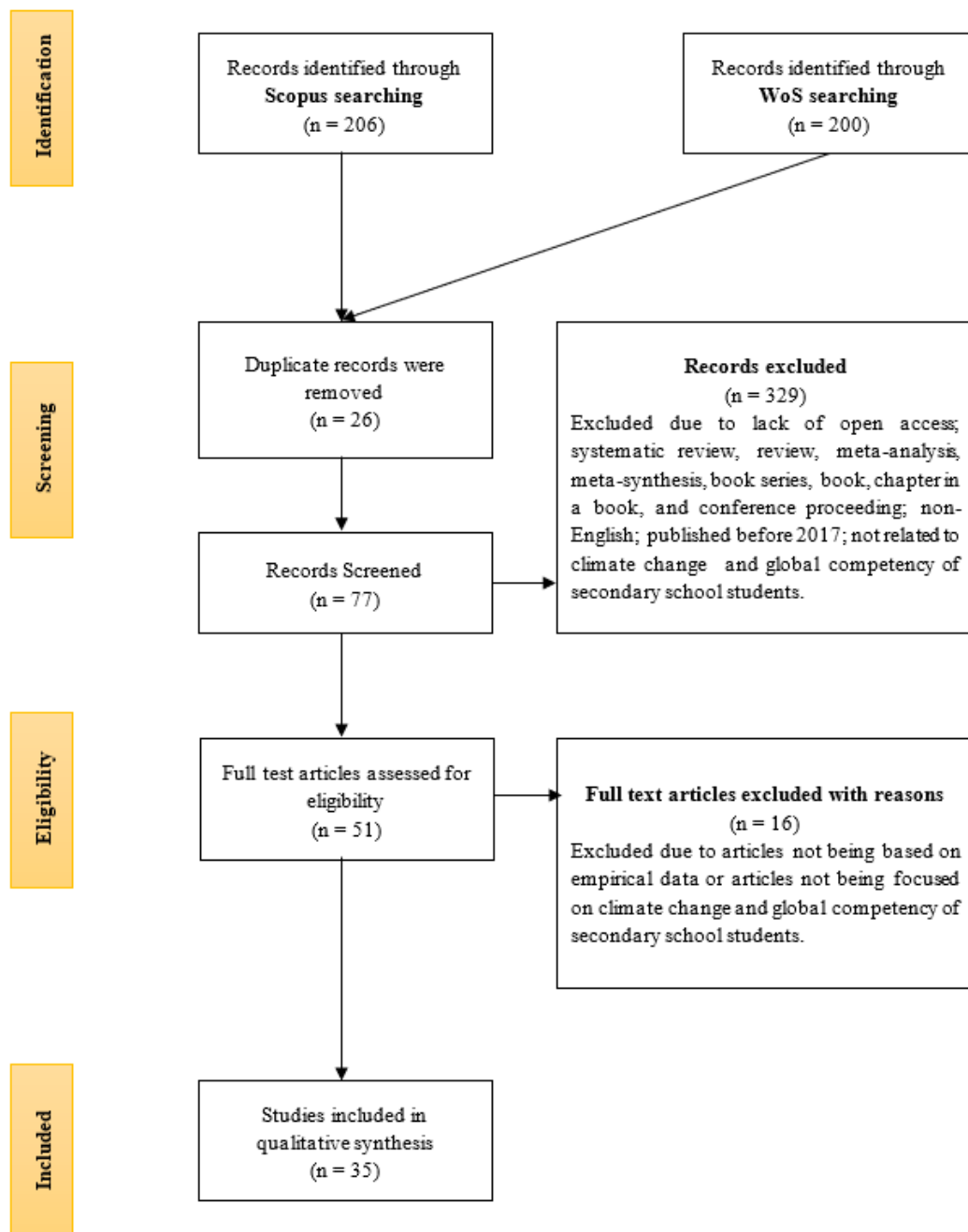


Figure 1. Flow Diagram of the study (adapted from Ref. [57]).

8. Data Abstraction and Analysis

An integrative review was used in this study. This review analysed and synthesized various research designs together, including qualitative; quantitative; and mixed methods [61]. Next, based on the thematic analysis, the processes of developing the appropriate themes and sub-themes were performed. Firstly, the data was compiled. This was done by carefully analysing the 35 selected articles to extract statements or data that answered the research questions. Next, the authors converted the raw data into usable data with the determination of themes, concepts, or ideas for the relevant data through coding methods [62,63]. The authors discussed with each other if there were conflicts of theme that arose. Finally, to ensure their consistency, the developed themes and sub-themes were adjusted according to the aims of this study. Three expert reviews were performed to ensure the validity of the themes and sub-themes. This process was important in determining domain validity and helped ensure the clarity and appropriateness of each subtheme within its respective theme. Based on the experts' feedback and comments, adjustments were made at the authors' discretion.

9. Results

Based on the results from the analysis of the selected articles, there were seven main regions involved in research on climate change, namely Asia; Australia; Europe; the Middle East; North America; South America; and sub-Saharan Africa (Figure 2).

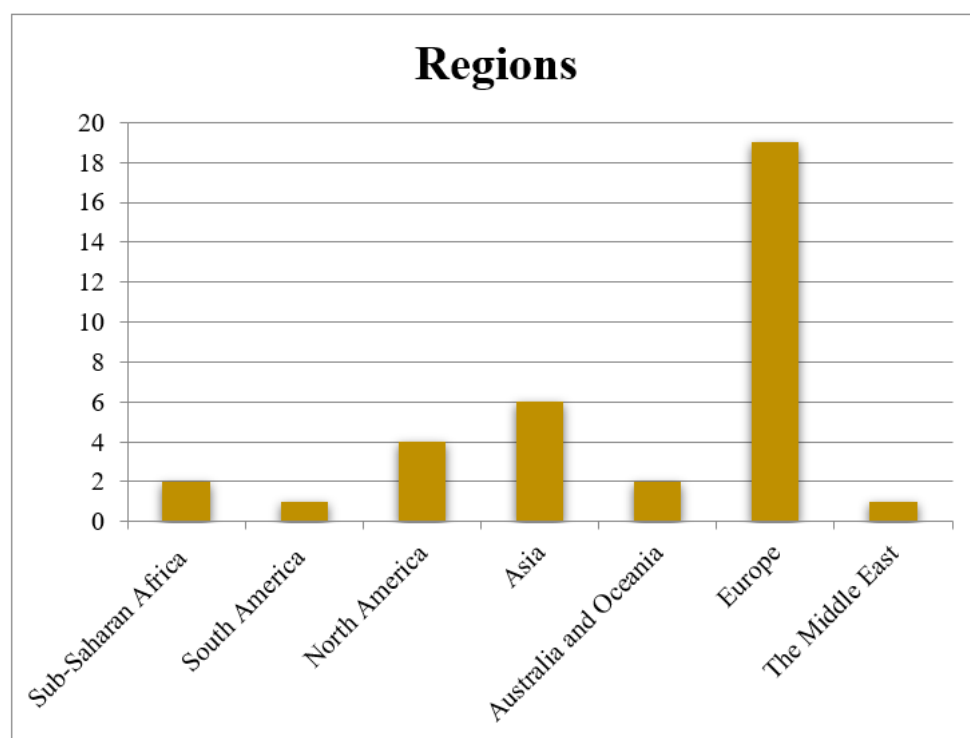


Figure 2. Regions where the studies were conducted.

More specifically, it should be noted that there were six previous studies in Asia while Europe recorded 19 previous studies on climate change among secondary school students. Furthermore, Australia and Oceania also have two previous studies recorded. The next two studies were recorded in sub-Saharan Africa; meanwhile, another study was recorded in the Middle East. Four previous studies were found to be conducted in North America, as well as one study in South America.

In the present systematic review, an analysis of the experimental designs of these studies showed that 15 articles (42.86%) used quantitative designs while nine articles (25.71%) used qualitative designs (Table 3). The remaining eleven articles (31.43%) used mixed methods designs. Four out of the six previous studies in Asia, used quantitative designs while the other two studies used mixed methods designs. In Europe, quantitative designs were most widely used by previous researchers studying climate change among secondary school students. Three previous studies used qualitative designs, meanwhile, seven previous studies in Europe used mixed methods designs. Two studies in Australia used mixed methods designs. Two previous studies in Sub-Saharan Africa used quantitative and qualitative designs, while one in the Middle East used a qualitative design. A study in South America used a qualitative method, while two studies in North America used qualitative methods and one study in North America used a quantitative method (Table 3).

The results showed that most of the studies used quantitative designs and questionnaires (34.3%). Meanwhile, two previous studies used test instruments (5.7%) and questionnaires with quasi-experimental designs (2.9%). In addition, for qualitative designs, three previous studies used document analyses (8.6%) while only two studies used interviews. Other studies used instruments such as semi-structured interviews, observations, and document analyses (2.9%); interviews and document analyses (2.9%); self-reports (2.9%); and interviews and document analyses (2.9%). For the mixed methods designs, three previous studies used questionnaires and interviews, while each study used different instruments as depicted in Table 3. The sample sizes for the questionnaires were diverse, from 195 respondents up to 2624 respondents. Next, amongst the studies using interviews, the smallest recorded sample size was only ten respondents, while the biggest recorded sample size was 162 respondents for focus group interviews. The list of sample sizes for all designs and instruments involved is summarised in Table 3.

Table 3. Summary of Country, Experimental Design, Instrument and Sample Size of 35 Selected Articles.

Author	Region: Country	Experimental Design	Instrument	Sample Size
Mohamed Ali Khan, et al. (2021) [64]	Asia: Malaysia	Quantitative	Questionnaire	221
Prabawani, et al. (2020) [65]	Asia: Indonesia	Quantitative	Questionnaire	336
Kang, et al. (2021) [66]	Asia: Korea	Quantitative	Questionnaire	206
Jackson, et al. (2017) [67]	Asia: Hong Kong	Mixed Methods	Questionnaire and Semi-structured Interviews	1383 students + 34 students and 4 teachers
Paul,, et al. (2020) [68]	Asia: India	Quantitative	Test	341
Yeh, et al. (2017) [69]	Asia: Taiwan	Mixed Methods	Questionnaire and Interview	1231 + 10
Koulougliotis, et al. (2021) [70]	Europe: Athens, Greece	Qualitative	Document analysis	Analysis Content of 107 students.
Biström, et al. (2020) [71]	Europe: Sweden	Qualitative	Document Analysis	Document analysis of Textbook
Jiménez-Liso, et al. (2020) [72]	Europe: Spain	Quantitative	Test	47
Montero-Pau, et al. (2020) [73]	Europe: Spanish	Quantitative	Questionnaire	923
Neset, et al. (2020) [74]	Europe: Sweden	Mixed Methods	Observation and Questionnaire	195
Levrini, et al. (2019) [75]	Europe: Italy	Mixed Methods	Test and Interview	24 students
Majer, et al. (2019) [76]	Europe: Slovenia	Quantitative	Questionnaire	1012
Musitu-Ferrer, et al. (2019) [77]	Europe: Spain	Quantitative	Questionnaire	797
Kurup, et al. (2020) [78]	Europe: United Kingdom	Mixed Methods	Questionnaire and Semi-structured focus group Interviews	65 students (aged 13–14) + a group
Alice, et al. (2017) [79]	Europe: England	Qualitative	Interview focus group	41
Dornhoff, et al. (2019) [80]	Europe: Ecuador and Germany	Quantitative	Questionnaire	2624
Deisenrieder, et al. (2020) [81]	Europe: Austria and Germany	Mixed Methods	Questionnaire, Test, and Interviews	169 + 53 + 10
Böhm, et al. (2020) [82]	Europe: Germany	Quantitative	Questionnaire	760
Parth, et al. (2020) [83]	Europe: Austria	Quantitative	Questionnaire and Quasi-Experiment	2000 respondent + 178 parents
Ganatsa, et al. (2021) [84]	Europe: Greece, Mediterranean	Quantitative	Questionnaire	600

Table 3. Cont.

Author	Region: Country	Experimental Design	Instrument	Sample Size
Schrot, et al. (2021) [85]	Europe: Austria and Italy	Mixed Methods	Quasi-experiment, Questionnaire and Interviews	173 + 231 + 47
Schrot, et al. (2020) [86]	Europe: Freistadt, Upper Austria	Mixed Methods	Test and Document Analysis	41 students + Document analysis
Kleespies, et al. (2020) [87]	Europe: Germany	Quantitative	Questionnaire	889
Kowasch, et al. (2019) [88]	Europe: Germany, Austria	Mixed Methods	Questionnaire, Interview and Document Analysis	1001students + 8 teachers + document analysis of geography textbook
Ng, (2019) [89]	Australia and Oceania: Australia	Mixed Methods	Questionnaire, Interviews, Observations and Open-ended Questions in the Survey	260 students and 19 teachers + 10 teachers
Walshe, et al. (2018) [90]	Australia and Oceania: Samoa, Fiji and Vanuatu	Mixed Methods	Questionnaire and Interactive focus groups	244 + 72 teachers, 35 media and 55 communities
Ige, et al. (2019) [91]	Sub-Saharan Africa: Nigeria	Quantitative	Questionnaire	462
Vincent, (2019) [92]	Sub-Saharan Africa: Nigeria	Qualitative	Interviews and focus groups	Six teachers and 20 students
Ozlem, et al. (2021) [93]	Middle East: Ankara, Turkey	Qualitative	Semi-structured Interviews, Observations and Document Analysis	18 respondents + Document analysis of student task
Kerr, et al. (2018) [94]	North America: The United States of America	Qualitative	Self-Report	25 representatives from 14 indigenous people + 3 interns + 4 directors, staff + 2 expert + 2 officer
Valdez, et al. (2017) [95]	North America: North Carolina	Quantitative	Questionnaire	1371
Wynes, et al. (2019) [96]	North America: Canada	Qualitative	Interview and Document Analysis	Document Analysis of Science Curriculum + 6 teachers
Lombardi, et al. (2018) [97]	North America: The United States of America	Qualitative	Content analysis	299
Rodriguez, et al. (2018) [98]	South America: Colombian Andes	Qualitative	Semi-structured Interviews	80

Based on the findings of this study regarding the year of publication of these articles, ten articles were published in 2019 and 2020, respectively. Eight articles were published in 2021, followed by four articles published in 2018 and three articles published in 2017 (Figure 3).

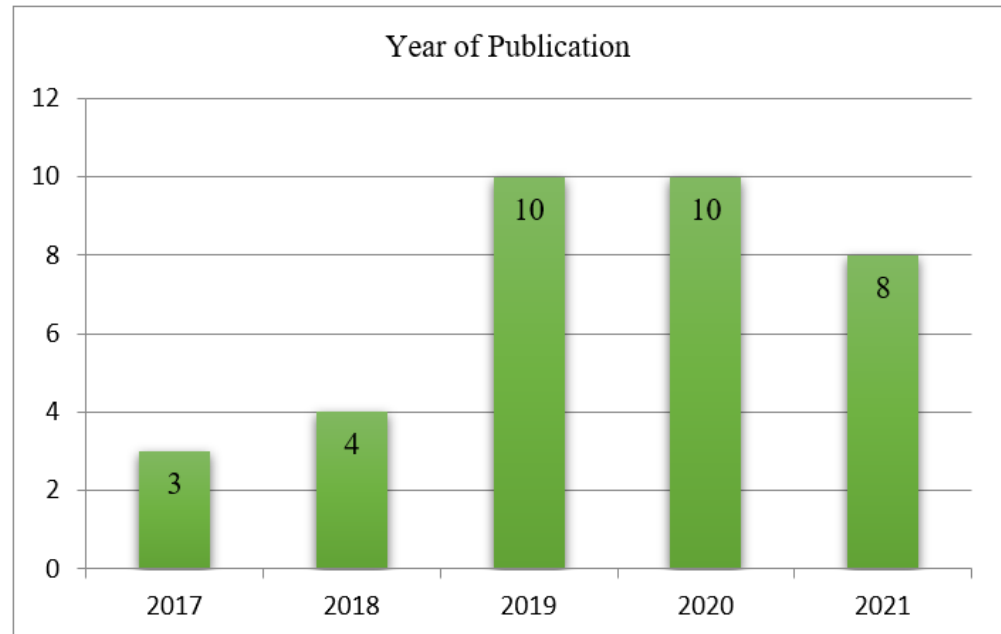


Figure 3. Year of Publication.

To answer the research questions, three themes that revolved around the elements of climate change used to foster awareness among secondary school students were elaborated. The themes which emerged from the analysis were effects on climate change, factors affecting climate change, and mitigation plans in handling the climate change issue (Figures 4–6) (Table 4). Each of these three themes had specific sub-themes (Figures 4–6). In answer to the second research question, it was found that there were four main themes, namely plant trees; reduce energy consumption; reduce the rate of carbon emission; and recycle, reduce, and reuse (Table 5). Each of these main themes also had their respective sub-themes (Figure 7). Students' lack of exposure to the causes and effects of their ongoing actions toward the environment gave them a lack of awareness concerning climate change. High school students were often unclear about the role of humans in the problem of global warming, and they had an extended lack of perceived personal responsibility [99]; furthermore, students did not understand which of their specific daily actions could potentially impact climate change. This ignorance of direct cause–effect links would reduce students' motivation to make the necessary changes to face this problem, which usually are personally and socially costly [100].

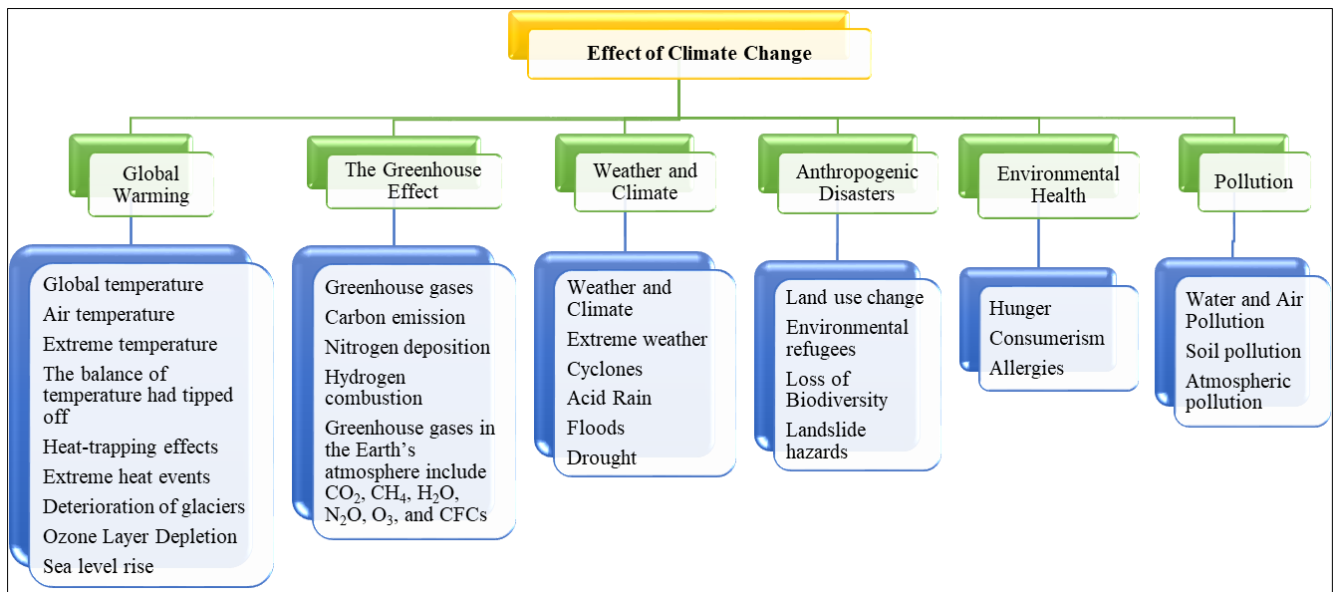


Figure 4. Effects of Climate Change.

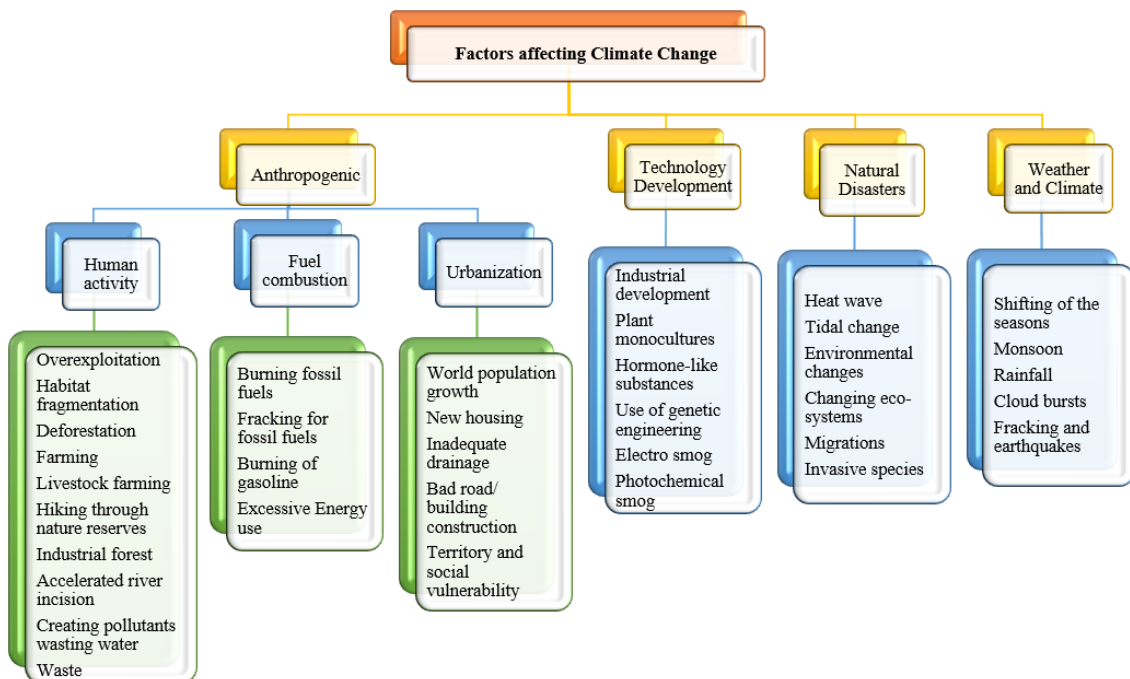


Figure 5. Factors affecting Climate Change.

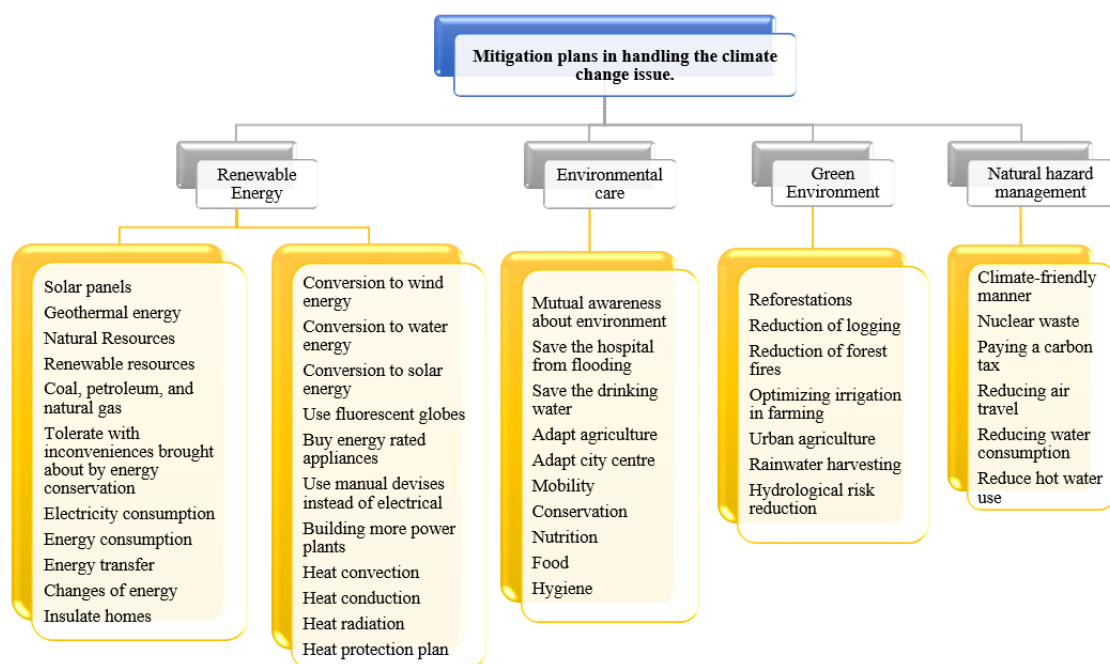


Figure 6. Mitigation plans in handling the climate change issue.

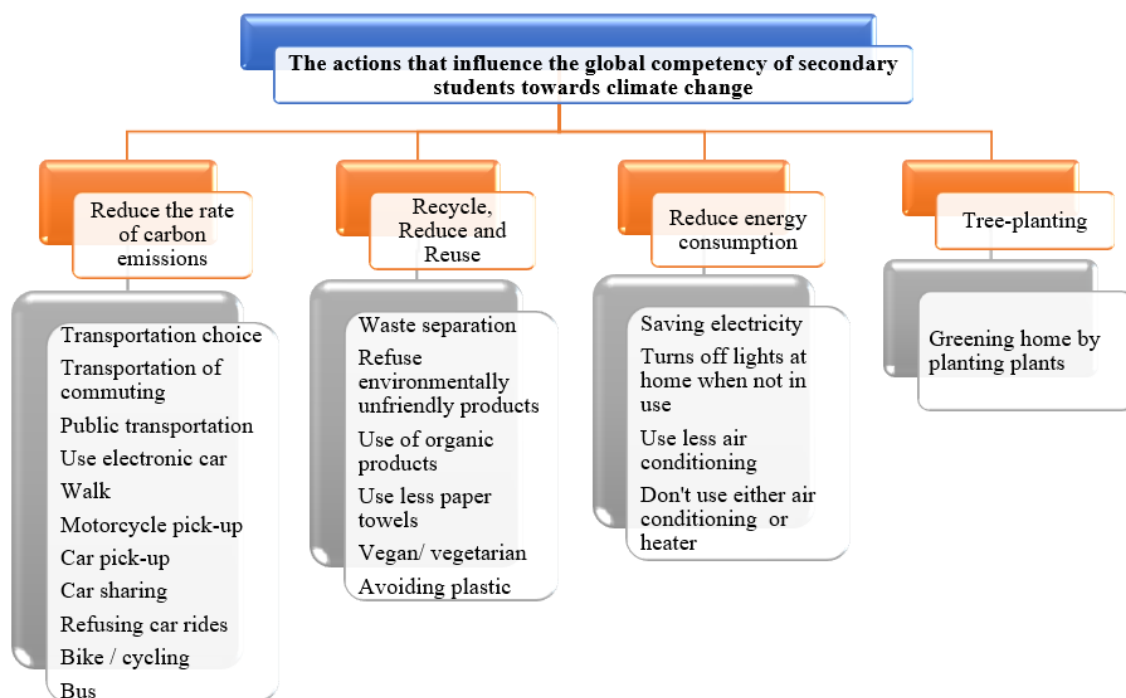


Figure 7. The actions that influence the global competency of secondary school students towards climate change.

Table 4. Summary of elements of climate change that have been used to create climate change awareness among secondary school students.

Author	Effects on Climate Change						Factors Affecting Climate Change						Mitigation Plan in Handling the Climate Change Issue			
	GW	GH	WC	D	EH	PL	HA	FC	UB	TD	ND	WC	RE	EC	GE	NM
Mohamed Ali Khan, et al. (2021) [64]	X	X	X	X												
Prabawani, et al. (2020) [65]	X					X	X				X		X	X		
Kang, et al. (2021) [66]																
Jackson, et al. (2017) [67]	X					X	X			X			X			
Paul, et al. (2020) [68]			X	X					X		X	X			X	
Yeh, et al. (2017) [69]	X	X	X					X					X			
Koulougliotis, et al. (2021) [70]	X	X														
Biström, et al. (2020) [71]																
Jiménez-Liso, et al. (2020) [72]				X												
Montero-Pau, et al. (2020) [73]				X	X	X										
Neset, et al. (2020) [74]			X						X	X	X			X		
Levrini, et al. (2019) [75]	X	X	X				X		X		X					
Majer, et al. (2019) [76]	X	X	X			X				X					X	
Musitu-Ferrer, et al. (2019) [77]															X	
Kurup, et al. (2020) [78]	X	X		X			X	X					X	X		X
Alice, et al. (2017) [79]	X	X	X	X		X	X	X								
Dornhoff, et al. (2019) [80]				X											X	
Deisenrieder, et al. (2020) [81]													X	X		X
Böhm, et al. (2020) [82]		X		X												
Parth, et al. (2020) [83]	X		X	X	X		X	X	X		X	X		X		
Ganatsa, et al. (2021) [84]	X	X				X	X						X	X	X	
Schrot, et al. (2021) [85]	X	X	X											X		
Schrot, et al. (2020) [86]		X											X	X	X	X
Kleespies, et al. (2020) [87]		X		X		X	X		X	X	X					
Kowasch, et al. (2019) [88]					X								X			
Ng, (2019) [89]		X					X						X			
Walshe, et al. (2018) [90]			X													
Ige, et al. (2019) [91]															X	
Vincent, (2019) [92]			X									X		X		
Ozlem, et al. (2021) [93]							X	X								
Kerr, et al. (2018) [94]															X	
Valdez, et al. (2017) [95]		X														
Wynes, et al. (2019) [96]	X	X					X						X			
Lombardi, et al. (2018) [97]	X	X	X	X		X	X	X				X	X	X		
Rodriguez, et al. (2018) [98]	X		X	X			X				X			X		X

Notes: GW: Global Warming; GH: Greenhouse Effect; WC: Weather and Climate; D: Disaster; EH: Environmental Health; PL: Pollution; HA: Human activity; FC: Fuel combustion; UB: Urbanization; TD: Technology Development; ND: Natural Disasters; WC: Weather and Climate; RE: Renewable Energy; EC: Environmental care; GE: Green Environment; NM: Natural hazard management.

Table 5. Summary of the actions that influence the global competency of secondary school students towards climate change.

Author	Tree-Planting	Reduce Energy Consumption	Reduce the Rate of Carbon Emissions	Recycle, Reduce and Reuse
Mohamed Ali Khan, et al. (2021) [64]				
Prabawani, et al. (2020) [65]				X
Kang, et al. (2021) [66]				
Jackson, et al. (2017) [67]	X	X		X
Paul, et al. (2020) [68]	X			
Yeh, et al. (2017) [69]		X	X	
Koulougliotis, et al. (2021) [70]				
Biström, et al. (2020) [71]				
Jiménez-Liso, et al. (2020) [72]				
Montero-Pau, et al. (2020) [73]				
Neset, et al. (2020) [74]				
Levrini, et al. (2019) [75]				
Majer, et al. (2019) [76]				
Musitu-Ferrer, et al. (2019) [77]				
Kurup, et al. (2020) [78]	X	X	X	
Alice, et al. (2017) [79]				
Dornhoff, et al. (2019) [80]				
Deisenrieder, et al. (2020) [81]			X	X
Böhm, et al. (2020) [82]				
Parth, et al. (2020) [83]				
Ganatsa, et al. (2021) [84]			X	
Schrot, et al. (2021) [85]				
Schrot, et al. (2020) [86]		X	X	X
Kleespies, et al. (2020) [87]				
Kowasch, et al. (2019) [88]				
Ng, (2019) [89]				
Walshe, et al. (2018) [90]				
Ige, et al. (2019) [91]				
Vincent, (2019) [92]				
Ozlem, et al. (2021) [93]				
Kerr, et al. (2018) [94]				
Valdez, et al. (2017) [95]		X	X	X
Wynes, et al. (2019) [96]				
Lombardi, et al. (2018) [97]				
Rodriguez, et al. (2018) [98]				

10. What Are the Elements of Climate Change That Have Been Used to Create Climate Change Awareness among Secondary School Students?

10.1. Effects of Climate Change

The effects of climate change were divided into six sub-themes: global warming, the greenhouse effect, weather and climate, anthropogenic disasters, environmental health, as well as pollution (Figure 4) (Table 4). Global warming, the greenhouse effect, and similar keywords are the most frequently found sub-themes in the past papers, with a total of 18 papers. These two main effects of climate change have caused various impacts, such as extreme weather; deterioration of glaciers; acid rain; and the depletion of the ozone layer, which will affect the health of humans. Recently, it has been shown that students of all ages have various misconceptions about global warming [101]. For instance, they have the misperception that a hole in the ozone layer causes global warming, as it allows more of the sun's rays to penetrate the atmosphere. While this causes increased ultraviolet radiation levels which are harmful to human health, it actually does not cause the Earth's temperature to increase. The misconceptions related to many climate change issues are not limited to students, but also include teachers [102]. Moreover, what is more, serious is that there are still people who are not aware of global warming issues and the greenhouse effect

as well as what causes them. In Canada, only 61% of the population believes that global warming is happening and is caused mostly by human activities [103].

Climate change is closely linked to the increasing amount of greenhouse gases in the atmosphere [104]. Emissions of greenhouse gases are mainly caused by deforestation; open burning; and the excessive use of water, energy, and transportation [105]. In a survey involving 14-year-old Malaysian students, a total of 221 questionnaires was distributed and it was concluded from the survey that the students agreed that greenhouse gases have been excessively released, but the problem is that they did not translate their agreement into behavioural change [106,107].

10.2. Factors Affecting Climate Change

The factors that contribute to climate change are divided into four main sub-themes: anthropogenic activities, which refer to all activities that originate from humans; natural disasters; technology development; as well as weather and climate (Figure 5) (Table 4).

The most common sub-theme, anthropogenic activity, was found and mentioned in 18 articles. There are several keywords found in these studies which were related to this sub-theme: overexploitation, livestock farming, use of genetic engineering, hiking through nature reserves, waste management, human activity, industrial development, deforestation, burning fossil fuels, bad road or building construction, accelerated river incision, inadequate drainage, territory and social vulnerability, burning of gasoline, as well as excessive energy use. There is strong evidence that human activities have induced most of the environmental changes, especially in the aspect of climate change [1]; however, the negative contributions of these human activities toward climate change and other elements of the environment are poorly understood. Overexploitation by humans is one of the main causes of climate change [108]. Human activities such as intensive livestock farming also exacerbate climate change issues [109]. The use of genetic engineering and hiking through nature reserves could also be considered minor influencing factors of climate change. The element of waste management is one of the indicators in assessing students' knowledge and perceptions towards sustainable development and surprisingly, one study found that they obtained low scores for their knowledge, but average scores for their attitudes [65].

Furthermore, a survey done amongst 1383 secondary school students in Hong Kong about climate change found that students realised the negative impacts of industrial development and deforestation such as global warming, and they tend to disagree with the statement that the balance of nature is strong enough to cope with these impacts of modern industrial development. In addition, in the IPCC report, territory and social vulnerability are also listed in the dimensions related to issues of climate change. As for energy use, most students have a low level of interest in doing personal behaviours out of their comfort zone, such as using public transportation. Singaporean students tend to perform climate-friendly behaviours only if fit in their daily lives [110].

10.3. Mitigation Plans in Handling the Climate Change Issue

Next is the theme of mitigation plans in handling the climate change issue. This theme is divided into four sub-themes: use of renewable resources, environmental care, green environment, and natural hazard management (Figure 6) (Table 4). The main sub-theme highlighted in most past papers is the use of renewable resources as a mitigation plan in handling the climate change issue. This sub-theme is highlighted in 12 papers. The use of natural energies such as geothermal energy, solar energy, water energy, and wind energy as alternative sources of energy has been practised in several countries. For example, windmills are used to generate electricity in the Netherlands. In Germany, the German Educational Standards for the Intermediate School Certificate in Geography calls for students to be familiarised with socially and environmentally acceptable lifestyles such as the use of public transport and renewable energy sources [111]. This was formulated by the government because many Germans were found to underestimate the importance

of using renewable energy resources, besides the existence of misconceptions amongst students and teachers in primary and secondary education about energy [112–114].

Furthermore, a transition from high-carbon to low-carbon energy systems is one of the mitigation goals aimed at by most countries [115], as currently, various reports reveal that energy-related GHG emissions account for more than 60% of the global inventory [116,117]. Thus, carbon reduction should be practised in the electricity sector as one of the climate change mitigation plans, especially as most electricity is generated from fossil fuels; however, the rapid increase in electricity generation from solar photovoltaic technology and wind energy is insufficient to support the transition to meet the goal of limiting global warming to below 2 °C [116]. Thus, energy literacy, which includes the three traditional aspects of cognition, affect, and behaviour is important in informing and educating people about the basis for the design and implementation of intelligent and forward-looking policies.

11. What Are the Actions That Influence the Global Competency of Secondary School Students towards Climate Change?

The second research question is raised to find out actions that can improve the global competence of secondary school students, especially in the aspect of climate change. Through the measurement of their global competencies, an indirect assessment can be made regarding their level of awareness and responsibility towards caring for the environment. In this question, there is one theme that is emphasized, which is the actions and attitudes of secondary school students towards addressing the issue of climate change in their daily lives. There are several sub-themes that can be listed here, namely: reduce the rate of carbon emission by making use of different transportation choices; reduce energy consumption; apply the concept of recycling, reducing, and reusing; manage waste; as well as plant plants to green the home (Figure 7) (Table 5).

The sub-theme of reducing carbon emissions through the use of alternative transportation choices in this second research question had some related keywords such as taking public transportation, using an electronic car, walking, motorcycle pick up, car sharing, refusing car rides, biking or cycling, and taking a bus. As for the sub-theme of reducing energy consumption, the keywords found were to save electricity; turn off lights at home when not in use, and use less air conditioning. In addition, the related keywords for the sub-theme of applying the concept of recycling, reducing, and reusing were waste separation; refuse environmentally unfriendly products; use organic products; use fewer paper towels; consume vegan-based products; and avoid plastic. The last sub-theme is tree-planting, which involves the process of greening the home.

The reduction of carbon emissions through the use of different transportation choices was the most frequently found sub-theme in the selected past papers which were reviewed by the authors. This sub-theme and its related keywords have been mentioned in seven papers. This aspect of the action is quite common in students' lives as they tend to experience using different modes of transport either to go to school or to other places; moreover, most papers gave greater focus to this sub-theme because of the authors' intention to appraise the students' knowledge about climate change and how their preferences on transportation would affect it. Besides this, if the students had enough awareness and knowledge about climate change and its impact on them, the authors wished to examine how they would react and whether they would tend to change their lifestyle to more environmentally friendly approaches, especially in the aspect of transportation. Unfortunately, it was found that the students' climate change knowledge and the educational approach they experienced were somehow ineffective for the adoption of critical behaviours that required greater lifestyle changes, such as using public transport [118].

In another study, the students' climate change knowledge and its impact on their behaviour and actions were measured through mixed methods of online pre- and post-tests besides personal interviews [81]. The sample involved were students at secondary schools in Austria and Southern Germany. Alternative choices of transportation were chosen as one of the indicators in measuring the students' levels of knowledge and their

behaviours towards climate change. In summary, the students were exposed to climate change knowledge for one year and this resulted in greater awareness amongst them about the impact of their actions on climate change. For example, more than half of the students decided to change their mobility behaviour by refusing car rides and switching to public transport or bicycles; this was in contrast with the pre-test, where the students' willingness to change their modes of transport was quite low [25].

12. Implication

Apparently, there has been a movement in schools towards bringing up the awareness of students concerning climate change; this could be related to the current changes we are experiencing in climate conditions, which have become worse from day to day mostly as a consequence of human activities. Thus, this study is done in order to measure the students' and teachers' levels of understanding concerning topics related to climate change in the current syllabus; moreover, aspects of the current syllabus that should be changed and improved have been discovered to ease the process of delivery and increase the probability of students' acceptance of the inserted information and input regarding climate change. In addition, the direct responses obtained from teachers, parents, and especially students through this case study have made the situation clear, as to how the input regarding climate change should be effectively delivered in schools. All of these are important to create the best way of delivering Climate Change Education that matches the students' preferences and interests. For example, teachers majoring in Geography and living in urban areas may deliver input concerning the impacts of climate change-related to the haze, as the students who live there have directly experienced it. In addition, the relevant parties especially the Ministry of Education can use this case study as an aiding tool or additional guidance in reconstructing school syllabi in their own contexts to be more student-friendly and effective.

13. Limitations and Recommendations

The systematic literature review that has been conducted was limited to two databases only, namely WOS and Scopus. Only publications that used the English language, articles published with open access and studies with empirical data were chosen for review. The study was conducted in June 2021 and articles published in the period from 2017 to 2021 were selected. Therefore, only 35 articles were selected to answer this study's research questions. For future research, the number of databases and main keywords should be increased, while the sources of papers should not be limited to open access only. This would allow for the discovery of more relevant papers that can be used as resources and references.

14. Conclusions

The recent literature on climate change and sustainable development plus the effectiveness of Climate Change Education for students reflect a basic understanding of the students' levels of knowledge and understanding about this issue and how they respond to the worsening impacts of climate change; furthermore, four main themes that correspond to the two main objectives of this study were identified based on the systematic review performed by the current research. The first three themes cover the first objective, which concerns the elements of climate change that have been used to create climate change awareness among secondary school students. These three main themes are the overall aspects of climate change and sustainable development, which are: the factors influencing climate change; its impacts on humans; and the mitigation actions that can be taken in handling climate change. Moreover, the second objective, which concerns the actions that influence the global competency of secondary school students towards climate change, has been met through the list of the sub-themes, namely: reducing the rate of carbon emission by making use of different transportation choices; reducing energy consumption; applying the concept of recycling, reducing, and reusing; managing waste; as well as greening the home by planting plants. Therefore, the further broadening of this basic understanding

through the integration of diverse research findings in future studies may be able to assist the concerned parties in developing more efficient strategies that will enable and empower more young people, especially secondary school students, in effectively adapting their knowledge about climate change into their behaviours so that climate change impacts can be minimized.

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