Disaster Risk Reduction Education

The integration of disaster risk reduction efforts with natural science learning tools can effectively increase students' preparedness in facing disasters. Learning tools developed for students might include syllabus, lesson plans, student worksheets, and handouts. In addition, the design of inclusive tools for disaster education programs focused on children and young people with disabilities needs to be worked with a differentiated instruction strategy so that their perceptions and knowledge regarding disasters and their role to build resilience is proper for their reality.

1. Introduction

Our changing world has brought periods of conflict due to the enormous challenge of meeting our current human needs without compromising the capacities to meet the needs of future societies. This challenge has increased in the present era of the Anthropocene [1], in which there is evidence of local and global ecological systems with higher levels of vulnerability, economic and social instability/inequity, and fragile political systems. It can be said that we are living in times of ecological precarity [2], where negative encounters between people and the threats of natural disasters are more likely, leading to social, environmental, and economic impacts. However, human efforts are central to transforming this state of vulnerability into a state of security before and after a particular natural phenomenon turns into a disaster [2][3][4].

The capacity for preparedness, response, and recovery implies that the measure of societal resilience to hazardous conditions varies over space and time and can be measured by different index calculations. For example, the social vulnerability index (SoVI) measures the overall social vulnerability based upon socio-economic indicators for different geographic areas. A higher SoVI in a region means that communities need more resources to respond and recover from environmental hazards [5][6]. In addition, the Global Delta Risk Index (GDRI) ranks the spatial single- or multi-hazard vulnerabilities and risks of deltaic social-ecological systems. A higher GDRI in a location means a higher social and environmental vulnerability and risk within that particular delta. Therefore, risk reduction and adaptation strategies are more necessary in such cases [6][7]. Finally, the SC index indicates which factors are dominant in measuring the relative level of social vulnerability based upon socioeconomic and biophysical indicators, which can help allocate disaster risk reduction policies to prevent, mitigate, take actions, and recover from disaster events [8].

In this regard, it is necessary to consider how the interaction of extreme climatic events with inequality and contextual vulnerability affects the well-being of particularly vulnerable groups, such as children and adolescents [9]. Education plays a predominant role in transforming the social space so that the decisions of people, communities, and, on a broad scale, governments minimize social and environmental damage. The Education 2030 agenda, which promotes global agreement regarding the goals that we as humanity must assume for global well-being, suggests critical socio-scientific problems to address educationally, such as sustainable development, disaster risk reduction, and care of the environment [10].

Local environmental risks and threats have increased during the last decades, and extreme climatic events have amplified [11][12], negatively affecting people's lives, especially those in vulnerable groups [13]. For example, the lack of understanding about climate change causes great anxiety in children about their future [14], which could lead to so-called "ecophobia" or permanent fear regarding the uncertainty of their own life on the planet [15]. Some research suggests that anxiety increases as a function of exposure to events. Although it depends on children's ability to understand such impacts and take action, anxiety decreases with community-level social support [16][17].

Due to the above, education has been considered an engine that influences the commitment and direction of student and community action within the world they inhabit. The role of education in this regard aims toward preparing students to respond to uncertainty in ways that are effective, adaptive, and collaborative [18]. The educational curriculum should be understood as a tool under constant reevaluation that allows society to face the future in the best way [19]. The curriculum

is understood as a cultural selection of educational purposes, which organizes the trajectory of students over time and which, in the selection of contents, skills, values, or attitudes, is a significant regulator of their future experience [20].

2. Methodology

A systematic review of previous works was used to characterize the state of the field, following the steps recommended by Cook and West (2012) [21]. These steps are (1). To define the question that will guide the review (stated in the previous paragraph). (2). To identify the information sources, we decided to use the Web of Science database (core collection) and Scopus, as they contain a vast collection of educational studies. (3). To search for studies that are eligible based on search keywords, we used ("Education"), ("Disaster"), ("Childhood" or "Early Childhood"), and ("Disaster Risk Reduction") with minimal variations depending on the search options of each database. (4). To define inclusion criteria, empirical articles in the English language were included. (5). To define exclusion criteria, articles about pre-service or in-service teachers without connection to childhood or children's community, articles that do not focus on children's education in DRR, literature review studies, or meta-analysis were excluded. (6). To define data abstraction elements, we removed duplicate articles according to their title. (7). To analyze and synthesize the information, two independent researchers who synthesized the information read each article in detail. All the team members agreed on the categorization of the connection between the purpose of DRR education and certain SDGs.

We retrieved 104 articles, 47 from Scopus and 57 from the Web of Science database, following these steps. We removed the repeated articles, which were 25. The detailed reading process led us to exclude the articles without empirical approaches to education about DRR with the target group, children. Finally, 27 articles were selected for this review, as shown in **Figure 1**. The list of the articles included are presented in the Results section as a table, also linked to **Figure 1**.
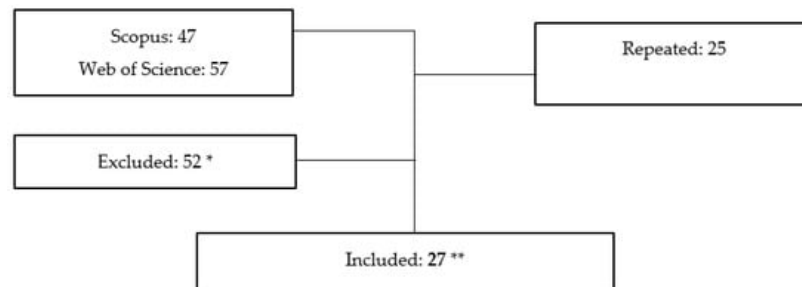
Figure 1. Flow diagram of steps in the articles' review process (* Exclusion criteria: articles about pre-service or in-service teachers without connection to childhood or children's community, articles that do not focus on children's education in DRR, literature review studies, or meta-analysis. ** These are detailed in **Table 1**).

Table 1. List of articles included in the present entry.

Title	Authors	Year	Area	SDGs				
				1	3	4	11	13
A1. Fostering student participation in disaster risk reduction through disaster video games	Gampell et al.	2020	New Zealand			X		
A2. Kura e Tai Āniwhaniwha (schools and tsunami): bi-cultural and student-centered tsunami education in Aotearoa New Zealand	Kaiser, L.; Boersen, K.	2020	New Zealand			X	X	
A3. From tale to reality: Geographical differences in children's flood-risk perception	Carone, M.T.; Marincioni, F.	2020	Italy		X	X		
A4. Participatory approach to natural hazard education for hydrological risk reduction	Piangiamore, G.L.; Musacchio, G	2017	Italy			X	X	
A5. Disaster risk reduction education in Indonesia: Challenges and recommendations for scaling up	Amri et al.	2017	Indonesia			X		
A6. Informal education for disaster risk reduction	Bernhardsdottir et al.	2016	Europe			X	X	
A7. Education: Can a bottom-up strategy help for earthquake disaster prevention?	Musacchio et al.	2016	Europe			X	X	
A8. Natural hazards revealed to children: The other side of prevention	Piangiamore et al.	2015	Europe			X	X	

| Title	Authors	Year	Area	SDGs			
A9. CDMG: Crises and disasters management game (video game to teach Arab children how to handle emergencies and crises)	Shohieb, S.	2018	Egypt		X		
A10. Transversal integration of geohydrological risks in an elementary school in Brazil: A disaster education experiment	De Mendonca et al.	2019	Brazil		X	X	X
A11. Understanding operations of floating schools: A case of Shidhulai Swanirvar Sangstha in Bangladesh	Ahmed et al.	2016	Bangladesh	X	X	X	X
A12. The role of children in disaster risk reduction policies: A case study with hearing and hard of hearing children	Nikolaraisi et al.	2016	Greece		X		
A13. Integrating disaster risk reduction with science education to students of junior high school in Merapi Mountain areas, Indonesia	Tyas, R.A.; Pujianto, S	2020	Indonesia		X		
A14. Children in disaster risk reduction in Portugal	Delicado et al.	2017	Portugal		X		
A15. "That's where I first saw the water." Mobilizing children's voices in UK flood risk management.	Williams et al.	2017	United Kindom		X		
A16. Disaster risk reduction knowledge among children in Muzarabani district, Zimbabwe	Muzenda-Mudavanhu et al.	2016	Zimbabwe		X		
A17. Drawing on fire: Children's knowledge and needs after a wildfire disaster in Portugal	Ribeiro, A.S.; Silva, I	2019	Portugal	X		X	X
A18. Landslide exposure awareness: a community-based approach towards the engagement of children	Ruiz-Cortés, N.S.; Alcántara-Ayala, I.	2020	Mexico	X		X	
A19. School-based health education for dengue control in Kelantan, Malaysia: Impact on knowledge, attitude, and practice	AhbiRami, R.; Zuharah, W.F.	2020	Malaysia	X			
A20. Assessment of educational methods for improving children's awareness of tsunamis and other natural disasters: Focusing on changes in awareness and regional characteristics in Japan	Yasuda, M. et al.	2018	Japan			X	
A21. Use of comic strips in teaching earthquakes to kindergarten children	Sharpe, J.; Izadkhah, Y.O.	2014	Iran	X		X	
A22. Should I stay or should I go? Determinants of evacuation upon flood warning among households in a flood prone area in Bukidnon, Philippines	Medina, M.A.; Moraca, J.M.	2016	Philippines			X	
A23. We need to do something about this: Children and youth's post-disaster views on climate change and environmental crisis	McDonald-Harker et al.	2020	India				X
A24. Resilience of an earthquake-stricken rural community in Southwest China: Correlation with disaster risk reduction efforts	Cui, K. et al.	2018	China			X	
A25. Children's views on evacuation drills and school preparedness: Mapping experiences and unfolding perspectives	Vásquez et al.	2018	Chile	X			
A26. Promoting climate change transformation with young people in Brazil: Participatory action research through a looping approach	Trajber et al.	2019	Brazil	X		X	X
A27. Along the cays and bays: Climate change learning in a small island developing state	Selby, D. et al.	2020	Bahamas			X	X

The comparison of the primary purposes of each study and the links with SDGs allow us to find emergent connections with this agenda and identify some conceptual tensions and research gaps for future studies. Most of the studies were carried out in Europe and Asia and only occasionally in the Americas, covering diverse types of hazards.

The specific analysis of the selected articles followed an interpretative paradigm, looking for comprehension and relevance to understand the topic. The objective of our study was not to inform practice but to scope the current trends in

the studies about DRRE, their connections with SDGs, and the areas in which more research is needed. Therefore, the steps we followed were consistent with an interpretive approach to qualitative evidence synthesis. We analyzed the selected articles in the forward and backward directions and used a thematic synthesis, as we explain below.

Forward direction. First, the 27 articles were analyzed and organized in a summary sheet to identify the central theme and the extent to which each one was connected to SDGs. The direction of the analysis went from the articles to the SDGs. Although there are different emphases in the definitions of these goals among organizations, we used UNESCO's definition—presented below—of SDGs, which explicitly links several of the SDGs with educational strategies [22].

We created a double-entry grid to systematize the information of the articles' authors, year, summary, aim, country, type of disaster, and what the SDGs were orientated towards. In a blind process, two independent researchers categorized the SDGs involved in each of the articles. If there were inter-coder disagreements, they were reviewed in an argumentative discussion until 100% consensus was reached. This analysis found that some articles could be linked to more than one SDG, as shown in **Figure 2**a. Once the first matrix was completed, the team's five members participated in iterative discussion sessions to determine the final connections between the studies' purposes and the SDGs. The SDGs that matched to at least one article were five:
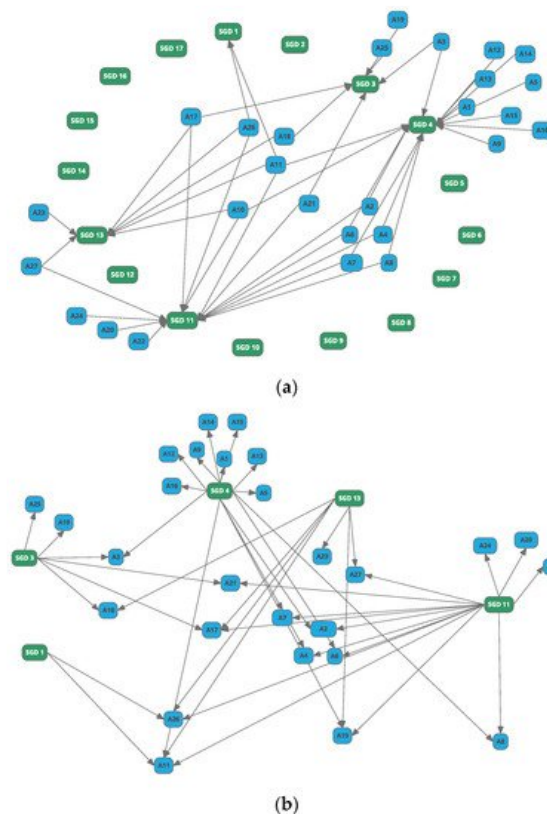
Figure 2. Influence graphs. (**a**) Forward direction: from articles to SDGs. (**b**) Backward direction: from SDGs to articles.

SDG 1: Eradicate poverty by developing human capacity and productivity through quality education and skills development; science, technology, and innovation; access to ICTs and the media; sustainable management of terrestrial and marine resources; protection and promotion of cultural heritage and of the diversity of cultural expressions.

SDG 3: Access to safe, inclusive, and health-promoting learning environments and comprehensive sexuality education.

SDG 4: Development of education systems which foster quality inclusive education and promote lifelong learning opportunities for all.

SDG 11: Promote inclusive sustainable cities through quality education for all, safeguarding cultural heritage, innovation, and creativity, promoting environmental sustainability, and building resilience to the effects of climate change, disasters, and conflicts.

SDG 13: Provide climate services in support of climate change mitigation and adaptation efforts with a focus on knowledge (co)production and dissemination, policy advice, education, public awareness, and capacity development.

Backward direction. Second, to identify the coverage of the SDGs by the articles found, we connected the selected papers to the SDGs by generating a critical interpretive synthesis of each SDG regarding the articles' purposes. In an

independent critical appraisal, we scrutinized the main targets presented in each SGD and examined whether they were addressed entirely or partially by the group of articles we had found a match with. This analysis process was done from the SDGs to the scope of the articles, looking at the degree of qualitative saturation of the SDG goal definition by the articles found in DRRE, as shown in **Figure 2**b.

An illustrative example of these forward direction and backward direction analysis steps is the following:

Forward direction: we found that six articles were connected to SDG 3.

Backward direction: considering the definition of SDG 3 (access to safe, inclusive, and health-promoting learning environments and comprehensive sexuality education), we appraised the main themes of the definition, in this case: (1) access to safe learning environments, (2) access to inclusive learning environments, (3) access to health-promoting learning environments, and (4) comprehensive sexuality education. Later, we matched the selected articles' scope with those themes, finding that theme four was not referred to by any article. Thus, we recognized this lack of coverage as an emerging tension regarding DRRE in connection with SDGs.

Thematic Synthesis. Third, after the process illustrated in the previous diagrams, we used thematic synthesis, focusing on re-interpretation for drawing conclusions based on common elements across the heterogeneous studies we had found to understand how the main aspects connect and interact. We represented the findings in geography and network maps and their aggregation into the SDGs' definition framework categories. We signaled the connections and tensions we found in the articles regarding DRRE and the SDGs in these categories, described in the next section.

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