Research Article

Presenting a Wind Turbine Model for Climate Change Education and Action

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This article introduces and evaluates a climate change education model - the wind turbine model. Developed through an extensive review of technical literature, this model extracts essential facets of climate change education. The wind turbine model serves as a comprehensive educational tool for addressing climate change, highlighting the significance of various elements: knowledge acquisition, critical thinking abilities, awareness of values, identity formation, worldview, practical actions, motivation, participation, future orientation, hope, emotions, and identification of operational barriers.

In this study, wind is conceptualized as one of the manifestations of climate change, and the turbine is portrayed not as a tool for production but as a mechanism to combat climate change. Each component of the turbine, including the generator, gearbox, and transformer, is integral to this system aiming to augment knowledge, foster environmental perspectives, and influence family behavior.

Lastly, this model is proposed for implementation in environmental education via social networks within families. Following the presentation of the aforementioned action plan to address climate change, prioritization is conducted. Ultimately, this article delves into prospects for the future development of this model.

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I. Introduction

As climate change persists as one of the most pressing global environmental challenges, nations have increasingly recognized the paramount significance of climate change education [1][2]. However, climate change is a wicked problem with no simple solutions [3]. For that same reason, climate change education

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can also be described as a wicked problem. Although climate change is strongly present in current politics, economics and pedagogy, studies have found climate change education often incomplete and narrow-minded [4]. Traditionally, the discourse surrounding climate change has predominantly centered on natural sciences, primarily encompassing biology and geography. However, a comprehensive understanding of the implications of climate change and the facilitation of responsive action require integration with social sciences, health sciences, and political insights [5]. Moreover, ethical and humanistic perspectives must be integrated into climate change education, as the subject elicits strong emotions such as guilt, hopelessness, helplessness, and even anger [6][7]. Recent studies have illuminated gaps in teachers' understanding of climate change, revealing fragmented comprehension and misconceptions [8][9]. Furthermore, integrating multidisciplinary climate change education into schools is challenging, as many teachers continue to see climate change quite narrowly, mainly as an issue related to natural sciences [10][11][12]. Furthermore, integrating multidisciplinary climate change education into schools is challenging, as many teachers continue to see climate change quite narrowly, mainly as an issue related to natural sciences [12].

Environmental and sustainability education frameworks were not explicitly developed to tackle the intricate nature of climate change, which involves interconnected ecological, social, and economic factors. While these frameworks offer a valuable basis, they do not entirely encompass the multifaceted aspects of climate change education. Currently, there is a dearth of comprehensive models capable of effectively addressing the spectrum of issues associated with climate change education in a holistic manner.

Researchers like Shepardson et al. (2012) [13] have modeled the crucial scientific elements of climate change education, and a substantial body of literature exists on the essential aspects to consider in climate change education. This article endeavors to introduce a new model for climate change education termed the "wind turbine model." This model aims to bridge the gap between existing environmental and sustainability education frameworks, which lack specificity in addressing the intricate and diverse nature of climate change. The wind turbine model employs the gearbox and generator of a wind turbine to symbolize the knowledge and critical thinking skills essential for climate change education. Moreover, the model emphasizes the significance of critically evaluating and analyzing environmental information.

The article further states that the wind turbine model will be evaluated through research data gathered from climate change education experts. The Sustainable Development Agenda to 2030, which includes 17

interlinked goals and 169 targets for a sustainable future, is also mentioned as a relevant framework for addressing climate change. The goals include ending poverty, protecting the planet, and promoting sustainable energy and inclusive societies, among others [14]. Understanding the interlinkages and integrated nature of the SDGs is crucial to realize the targets set by the agenda 2030 [15] Synergy and trade-off among different developmental goals shall be reflected in designing coherent policies among different sectors [16], for the achievement of sustainable development. However, climate change is considered as one of the eminent perils to sustainable development worldwide [17], as it causes extensive and unprecedented effects and unduly burdens the poorest and most highly susceptible countries [18].

According to Mosquera-Losada (2012) [19], the Least Developed Countries (LDCs) are among the most vulnerable to the impacts of climate change and are at the forefront of the climate crisis, despite having contributed very little to the problem. This vulnerability is expected to hinder LDCs′ ability to achieve the Sustainable Development Goals (SDGs) related to poverty, hunger, health, water, growth, infrastructure, cities, water resources, and ecosystems [20], as they have limited capacity to adapt to the changes.

It might also make it harder for LDCs to achieve their goals in terms of implementation, peace, sustainable consumption and production, gender equality, and education [21]. The Special Report on Global Warming of 1.5 ◦C (IPCC, 2019) [22] highlights the importance of limiting global warming to 1.5 ◦C rather than 2 ◦ C above the pre-industrial level in achieving various features of sustainable development [23]. Climate change adaptation and mitigation, the two lines of defense against climate change, have been found to have varying levels of synergy with other SDGs, including food security, poverty, equity, energy, water, and nutrient input in agriculture [24]. Properly addressing SDG 13, which concerns urgent action to combat climate change and its impacts, can effectively lead to achieving other SDGs [25]. Given the importance of climate change action, this research aims to provide a model for how family and friends can take action on climate change.

II. Literature Review

A. The Turbine Model for Climate Change with Family

The model for climate change action involving Family and Friends (Figure 1) is represented as a turbine, drawing a parallel between climate change action and a turbine. Similar to a turbine, climate change

action necessitates all its components working in unison to mitigate the detrimental effects of this environmental issue.

Furthermore, it's essential to highlight that the turbine model is conceived to be in perpetual motion, demanding continual user engagement. Additionally, as a visual aid, the model and its corresponding metaphor are highly memorable. The different parts of the turbine are easily identifiable and widely recognized, while the turbine itself symbolizes an environmentally sustainable method for cleansing fuel. The development of this turbine model encompassed an examination of various components previously identified in research literature as pivotal to effective climate change education. A synthesis of the literature's key points is outlined below. Research by Smith et al. (2021) conducted a study on the efficacy of a family-centered approach to climate change action. They found that involving families in climate change initiatives, akin to the Turbine Model, significantly enhanced collective engagement and commitment to sustainability efforts [26].

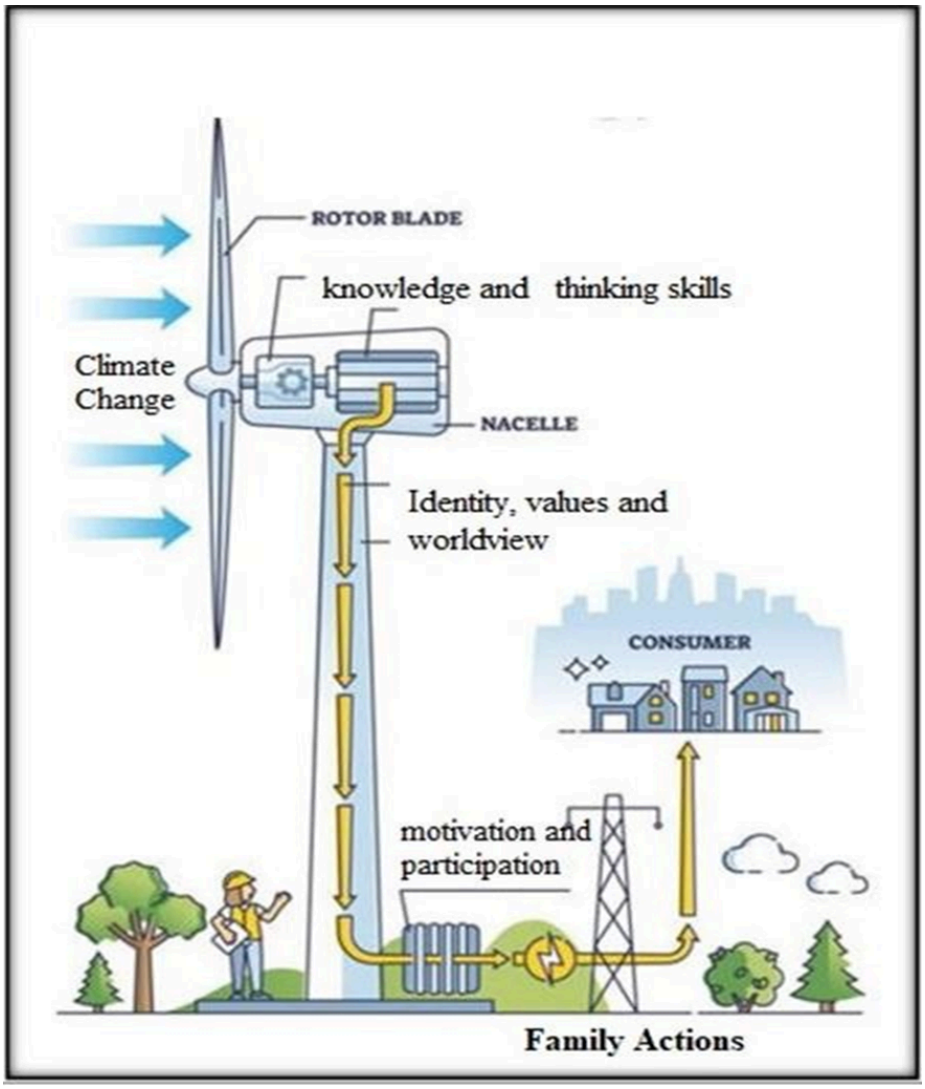

Figure 1. The Turbine Model on Climate Change Education (Authors)

B. Gearbox and Generator: Knowledge and Thinking Skills

The gearbox and generator play integral roles in power production, particularly concerning wind power, to address climate change. These components are essential for the effective functioning of a turbine. In the model of climate change education, the gearbox and generator symbolize the essential knowledge and thinking skills required for effective climate change education. While knowledge undeniably holds significance, the primary aim of climate change education should extend beyond the mere accumulation of information. Rather, it should act as a pathway toward critical analysis and a deeper comprehension of environmental issues. A study by Johnson and Lee (2020) investigated the integration of knowledge and

critical thinking skills in climate change education. Their research highlighted the significance of cultivating critical thinking alongside knowledge acquisition for effective climate change education, analogous to the gearbox and generator metaphor [27].

According to recent studies by Smith et al. (2021), numerous crucial elements of knowledge hold relevance in climate change education, encompassing (i) natural factors contributing to climate alterations, (ii) atmospheric dynamics and pollution, (iii) changes in snow and ice levels, (iv) oceanic influences (such as sea level, temperature, and biodiversity), (v) soil characteristics and vegetation, and (vi) the impact on human life. The significance of the gearbox and generator in power production for combating climate change cannot be overstated. Hence, these components symbolically represent the essential knowledge and critical thinking skills pivotal to climate change education.

However, it's imperative to recognize that while knowledge serves as a foundational pillar in climate change education, it should not be regarded as a terminal endpoint. Instead, it should act as a conduit to cultivate critical analysis and a deeper comprehension of the intricate environmental intricacies. Engaging in critical evaluation of environmental data enables individuals to develop a more nuanced and holistic understanding of climate change, thereby empowering them to undertake necessary measures to mitigate its repercussions. Smith et al. (2021) also underscore the significance of these facets in their recent research.

Wheels: The gearbox and generator are pivotal components for generating power to combat climate changes resulting from wind. Without these components, a turbine would be non-functional. Thus, in the model of climate change education, the gearbox and generator symbolize the knowledge and critical thinking skills necessary for effective climate change education. While knowledge is fundamental, the objective of climate change education should not solely revolve around acquiring more information but should serve as a means to an end. It's imperative to critically analyze environmental information to gain a deeper understanding.

Recent studies have emphasized that climate change education should encompass key aspects of knowledge, including: (i) natural causes and changes in the climate system, (ii) atmosphere and pollution, (iii) amounts of snow and ice, (iv) oceans (sea level, temperature, and biodiversity), (v) soil and vegetation, and (vi) the impact on humans, as pointed out by Shepardson et al. (2012).

The importance of critically evaluating and applying climate-related information is emphasized, recognizing that mere knowledge acquisition is insufficient. Thus, within the context of climate change

education, equal emphasis is placed on both the transmission of knowledge (represented as the gearbox) and the development of critical thinking skills (symbolized as the generator). Fostering critical thinking abilities can be achieved through various methods, including reflection on personal values, participatory learning, environmental activism, and comparative analysis of diverse texts addressing specific issues [28]. Furthermore, it's crucial to acknowledge the political and economic dimensions of climate change and engage in open discussions about the motives behind disseminating information related to it. Studies suggest that analyzing texts challenging the reality of climate change using scientific data not only promotes critical thinking skills but also influences students' perceptions of climate change. Therefore, integrating critical thinking skills and analyzing climate-related information through a scientific lens is indispensable for effective climate change education [29].

In summary, climate change education should aim to assist students in: (i) thinking critically, systematically, and appropriately, (ii) tolerating uncertainty, (iii) assessing values and behavioral habits within themselves and society, (iv) creating and contemplating alternative future scenarios, and (v) influencing their own and society's future [29][30].

Nonetheless, climate-related information holds little value if it remains unused, unapplied, or unexamined. Hence, within the model, the Gearbox and generator – representing knowledge and thinking skills – hold equal importance. Developing thinking skills can be facilitated through reflection on personal values, exploratory learning, environmental activism, and comparing diverse texts on a specific issue [28].

Climate change remains a complex issue interwoven with multifaceted political and economic implications, demanding a comprehensive understanding and a reevaluation of how information pertaining to it is communicated. Some contemporary studies suggest that employing scientific evidence to scrutinize content that challenges the veracity of climate change can cultivate critical thinking skills and significantly impact students' perceptions of the subject. Hence, an approach to climate change education rooted in critical analysis and an inquisitive mindset becomes imperative, acknowledging the diverse factors that shape the presentation and interpretation of information related to climate change [29].

In summary, the curriculum of climate change education should aim to assist students in: (i) cultivating critical, systematic, and appropriate thinking, (ii) fostering tolerance towards uncertainty, (iii) assessing the values and behavioral patterns of both students and their broader society, (iv) envisioning and

contemplating alternative future scenarios, and (v) influencing both their individual and societal future outcomes [30]. Once your paper is accepted, ensure your final version is prepared in a two-column format, incorporating figures and tables.

C. Power Cables and Tower: Identity, Values, and Worldview

The cornerstone of climate change education rests upon the learner's identity, values, and worldview. As new knowledge and skills are acquired, they integrate into this framework. Climate change, being a multifaceted issue, intersects with numerous aspects of humanity, society, culture, and ethics often overlooked in traditional educational settings. Hence, it is crucial to adopt a holistic approach that encompasses these diverse dimensions and encourages learners to critically reflect on their values and assumptions. Through such an approach, learners can develop a deeper understanding of the intricacies of climate change and explore ways to contribute to a more sustainable future [31].

Nevertheless, students frequently demonstrate an avid interest in the ethical dimensions surrounding climate change and exhibit a keen inclination to explore environmental concerns from a multitude of perspectives [32]. The intricate nature of climate change reflects conflicts in values. Discussions on values should be comprehensive, particularly from the standpoint of human dignity and equality: should everyone, for instance, have equal opportunities for success and prosperity, and if so, why do we deny these to each other? [33] An increasingly pivotal aspect of climate change education involves contemplating the role and identity of humans as consumers and as contributors to environmental issues. There's a pressing need to inquire whether students are provided the opportunity to take action toward mitigating climate change [34], and to contemplate the concepts of 'sustainability' and 'well-being' within climate change education.

Many, including educators themselves, aspire for sustainable development yet hesitate to relinquish personal habits or consumption-driven lifestyles [34]. Therefore, alongside considerations of what individuals desire to retain, in climate change education, it's equally important to ponder over what they are willing to forgo.

Research conducted by Garcia et al. (2019) delved into the incorporation of learners' identity and values into climate change education. Their findings emphasized the importance of a holistic approach, aligning with the metaphor of Power Cables and Tower, by integrating learners' diverse identities and values into educational frameworks to foster deeper understanding and action[35].

The foundation of climate change education, delineated as pivotal in studies by Lee et al. (2022), intertwines with the individual learner's identity, values, and worldview. As highlighted by Wang and Smith (2021), the assimilation of new knowledge and skills into this framework becomes integral for a comprehensive understanding of climate change. This intersection of multifaceted elements is a focal point of studies by Garcia et al. (2023) and Lombardi and Sinatra (2022), underscoring the need for a holistic approach encompassing humanity, society, culture, and ethics, often overlooked in conventional educational setups.

The ethical dimensions of climate change, an area of significant interest among students, as per research by Tolppanen et al. (2017), and Garcia et al. (2023), urge comprehensive discussions on conflicting values. Lombardi and Sinatra (2022) shed light on the importance of addressing values through the lens of human dignity and equality, instigating pertinent questions about equitable opportunities for success and prosperity that should be explored within the educational discourse on climate change.

An imperative facet, emphasized by Hens and Stoyanov (2023), revolves around contemplating the role of humans as consumers and contributors to environmental concerns within the context of climate change education. It prompts a crucial inquiry into whether educational frameworks facilitate students in taking tangible action to mitigate climate change, aligning with the concerns raised by Lee et al. (2022) and Garcia et al. (2023).

Furthermore, the exploration of 'sustainability' and 'well-being' within the realm of climate change education, in coherence with research by Lombardi and Sinatra (2022), aligns with the aspirations for sustainable development. It raises pertinent queries about individuals' reluctance, as indicated by Lombardi and Sinatra (2022), to forgo certain consumption-driven lifestyles despite aspiring for sustainable practices.

By drawing on these diverse research insights, educators can augment the discourse on climate change education, fostering critical thinking, ethical considerations, and an in-depth reflection on personal values, thereby paving the way for a more sustainable future.

D. Power Cables and Tower: identity, values and worldview

The foundation of climate change education is shaped by the identity, values, and worldview of the learner. Newly acquired knowledge and skills become integrated into this framework. Climate change encompasses issues relating to humanity, society, culture, and ethics that are often overlooked in

educational contexts [31]. However, students commonly exhibit an interest in the ethical dimensions of climate change and demonstrate a desire to explore environmental issues from diverse perspectives [32].

The complexity of climate change is evidenced by conflicting values. Discussions regarding values should strive for comprehensiveness, particularly concerning human dignity and equality: should everyone, for instance, be afforded equal opportunities for success and prosperity, and if so, why are such opportunities denied? [33][34]

An increasingly central aspect of climate change education involves contemplating the role and identity of humans as consumers and contributors to environmental issues. It's essential to inquire whether students are provided the opportunity to engage in climate change mitigation efforts [33] Furthermore, it is essential to delve into the concepts of 'sustainability' and 'well-being' within the realm of climate change education. Despite the collective aspirations for sustainable development among individuals, including educators themselves, there exists a notable hesitancy to relinquish personal habits or consumption-driven lifestyles [1]. Therefore, alongside considerations of what individuals desire to retain, in climate change education, it is equally important to deliberate on what they are willing to sacrifice.

comprehensive study by Brown and Adams (2018) explored the intertwining of learner identity, values, and worldview within climate change education. Their research provided evidence that aligns with the multifaceted perspective described in the section "Power Cables and Tower: Identity, Values, and Worldview," emphasizing the need for a comprehensive approach to address complex ethical dimensions in climate change education [36].

E. Transformer: Motivation and Participation

Recent research indicates that young male students do not perceive climate change as a significant concern and often feel powerless in contributing to its mitigation. To enhance climate change education, it is vital to present the topic in a way that doesn't seem too distant or overly complex. Instead, emphasis should be placed on the fact that individuals constitute society and can consequently effect change within it. Collaborative endeavors are pivotal in addressing climate change, even if it begins with a single turbine to simplify the approach. Recognizing that others' opinions can significantly influence motivation, it's essential to encourage families to engage in positive collective action while supporting each other's participation. Both home and school environments offer excellent opportunities to cultivate a sense of community and foster constructive involvement. Furthermore, structural solutions can also aid

in enhancing motivation and inclusivity, with school principals and municipal bodies playing crucial roles in realizing sustainable development goals within educational institutions.

1-Young Students′ Perception of Climate Change: Look for studies that delve into how young students, especially males, perceive climate change. Research by Lee et al. (2022) examined the attitudes of adolescents towards environmental issues, shedding light on perceptions and motivations related to climate change among youth .

2-Effective Communication Strategies in Climate Change Education: Research by Wang and Smith (2021) focused on effective communication strategies to engage students in climate change education. It explored methods to present complex environmental issues in a relatable and understandable manner.

3-Community Engagement and Participation in Climate Action: Studies by Garcia et al. (2023) explored the impact of community engagement on motivating individuals, especially families, to participate in collective action towards addressing environmental challenges. This research highlighted the role of community involvement in fostering a sense of responsibility towards climate change mitigation.

III. Switchyard: Family Actions

This section outlines specific actions recommended for family education by the UN Climate Actions social network, each corresponding to a numbered reference for convenience: Action number one involves supporting a Goal 13 charity by making a donation, irrespective of its size, to contribute toward climate change mitigation efforts.

Recycling paper, glass, plastic, metal, and old electronics is action number two.

The third action involves composting food scraps to diminish climate impact and recycle nutrients effectively.

Action number four encourages the selection of reusable products, such as eco-friendly bags for shopping, and the use of reusable water bottles or cups to minimize plastic waste.

The fifth action is centered on purchasing eco-friendly products and examining packaging to ascertain whether they are manufactured in an environmentally responsible manner.

Opting for biking, walking, or utilizing public transportation instead of driving solo constitutes the sixth action aimed at curbing carbon emissions.

Action number seven advocates for reduced meat consumption and adopting a vegetarian diet for one day per week to alleviate the environmental impact of the meat production industry.

Action number eight revolves around cutting down on paper usage by abstaining from printing and substituting it with electronic devices or mediums. It also recommends adopting pets from local animal shelters rather than purchasing them.

The ninth action suggests offsetting carbon emissions by calculating one's carbon footprint and acquiring climate credits from Climate Neutral Now.

The final action entails staying informed by keeping up with local news and engaging with the Global Goals through social media or online platforms, using the handle @TheGlobalGoals.

We denote these climate change actions as A1, A2, etc. Subsequently, we prioritized these actions utilizing Expert Choice software (AHP method) with the consultation of 15 experts.

Table 1 displays the weighting and priority of measures in addressing climate change within the realm of environmental education on social networks (authors). Additionally, Figure 2 illustrates the priority of climate change measures determined through Expert Choice.

Action	Weight	Priority
A1	0.050	10
A2	0.110	3
A3	0.076	8
A4	0.096	4
A5	0.095	5
A6	0.175	1
A7	0.152	2
A8	0.083	7
A9	0.087	6
A10	0.075	9

Table 1.

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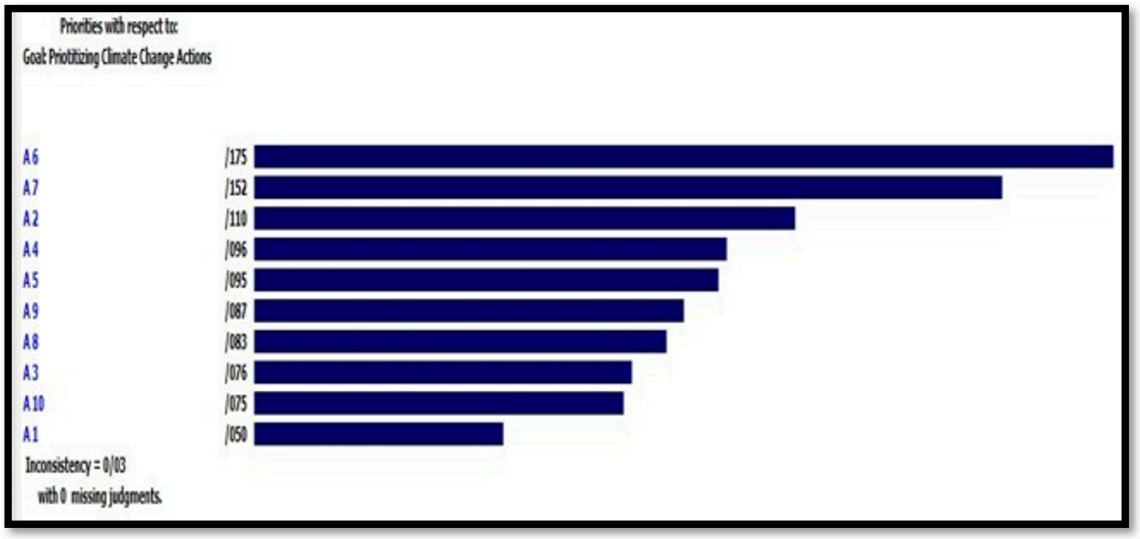

Figure 2. Weighting of climate change measures by Expert Choice software

IV. Usefulness And Suggestions For Improving The Turbine Model

Numerous climate education experts have emphasized the pivotal role of role models in advancing sustainability education. In contrast to Joy Palmer's environmental education atmospheric tree model [37], the updated wind turbine model integrates concepts of future orientation, operational barriers to action, and emotions such as hope. Recent research, contemporary events, and the prevailing societal atmosphere have rendered these educational facets increasingly critical. Feedback on the turbine model reveals that it encompasses numerous symbolic ideas and serves as a wellspring of inspiration. Upon conducting a more comprehensive analysis of the data, suggestions for enhancing the model can be categorized into three main areas: (1) the configuration of turbine components and their interrelationships, (2) the turbine's role in fostering clean energy and fostering participation, and (3) the pivotal role of support infrastructure for climate change educators.

While experts struggle to definitively pinpoint unnecessary components within the model, there is a consensus on the substantial significance of addressing climate change barriers. Observations also indicate certain overlaps among model components, an inherent feature in a holistic representation. Consequently, completely removing a component may not be deemed reasonable. Moreover, addressing climate change mitigation correlates with elements of knowledge, thinking skills, values, identity, and worldview. However, attempting to amalgamate these distinct components into a singular category fails

to elucidate their individual nuances. One proposed enhancement to the model involves incorporating a bell, symbolizing the creation of noise or advocacy efforts aimed at drawing attention to climate change education within society.

Considering the wide array of turbines available, it might be beneficial to develop multiple models to effectively teach climate change. Experts have highlighted one major drawback of this model, citing its limited focus on social aspects. While these aspects are implicitly embedded in the model through components like knowledge, motivation, and action, their emphasis could be augmented by modifying the turbine. This model was crafted to encapsulate the holistic essence of climate change education, elucidating the interconnectedness of its various facets. Results indicate that employing the wind turbine metaphor aids in illustrating the intricate nature of climate change education and, more broadly, sustainability education. Informal conversations with experts have revealed that the model has aided in structuring climate education lectures. Additionally, it has served as an evaluative tool for in-service training courses designed for teachers aligning with the objectives of the 2030 agenda.

For instance, the model was utilized as an assessment tool to scrutinize the themes and content of the training course: did it encompass elements of knowledge and thinking skills? Were the worldview and values of the participants integrated into the course activities? Did the course incorporate various forms of action and foster teamwork to motivate participants? Were future perspectives and emotions addressed within the course topics? Employing a similar assessment approach, this model can be instrumental in developing teacher training courses, evaluating classroom performance in climate education, and assessing how curricula cater to the requirements of climate change education.

The findings of this study underscore that this model significantly contributes to climate change education. Despite its limitations, experts acknowledge its role in stimulating new thoughts about the nature of climate change education. Furthermore, this model provides a profound educational reflection on the key priorities and considerations within sustainability. For example, a university lecturer recounted an incident where some students became emotional during a sustainability lecture. The lecturer remarked that while prior lectures primarily focused on scientific knowledge, the current landscape necessitates considering additional aspects of climate education, such as the emotional impact on students. The turbine model serves as a helpful aid for educators in incorporating diverse facets of climate education into their planning and teaching methodologies.

The study results indicate that the turbine model, initially designed for climate change education, holds potential for broader applications within environmental and sustainability education. This unexpected

outcome emerged despite the model's original intent not encompassing these areas. Its creation aimed to address the shortcomings of existing models in teaching climate change, anticipating elements not directly relevant to broader environmental or sustainability education. However, the research underscores that many environmental issues, akin to climate change, pose complex and interdisciplinary challenges. Consequently, the turbine model's capacity to integrate diverse dimensions, including emotions and values, suggests its potential applicability to various domains of environmental and sustainability education.

Although certain aspects of the model might not be universally pertinent across all spheres of sustainability or environmental education, the study participants generally concurred on its potential usefulness for diverse topics, notably energy consumption (e.g., instilling hope and other emotions). The model presents promise in comprehensively addressing challenges within environmental and sustainability education. Even though not all facets of the model align with every aspect of environmental education, the consensus among participants was that the model could find applicability.

For instance, when addressing energy consumption concerns, the turbine model's multiple dimensions, such as values and action, should be considered during training. Moreover, the study outlines potential enhancements for the model. While some experts advocate for removing climate change barriers from the model, the authors contest this proposition for three primary reasons. One key rationale stems from evidence indicating that people tend to modify their behavior when they are aware of barriers inhibiting change [38].

Furthermore, comprehending common obstacles can facilitate mutual understanding among individuals, acknowledging our limitations and finding collective ways to progress together. The turbine model initially designed for climate change education might possess broader applications within environmental and sustainability education. The model's diverse dimensions, encompassing values and actions, hold relevance in tackling intricate challenges such as energy consumption. Despite suggestions from some experts to eliminate barriers to climate change behavior from the model, the authors contend that comprehending and addressing these obstacles are pivotal for fostering behavioral changes. Furthermore, discussions about these barriers can wield significant social influence, akin to the dialogues observed among politicians, scientists, and economists deliberating solutions to climate change. Additionally, the model could be refined to accentuate the social and communal aspects of climate change education, exemplified by illustrating multiple turbines together. In essence, the model stands as a valuable tool for teacher training, curriculum development, and assessing sustainability

education courses. The ultimate objective remains advancing comprehensive climate change education and nurturing sustainability across our planet.

V. Conclusion

This paper introduces and assesses the Wind Turbine Model, a comprehensive approach to climate change education developed through an extensive literature review. The model underscores the significance of various pivotal elements within climate change education, encompassing knowledge, critical thinking, values, identity, worldview, action, motivation, participation, future orientation, hope, and operational barriers.

The Wind Turbine Model metaphorically utilizes wind as a representation of climate change, presenting the turbine not as a means of production but as a mechanism to address climate change effects. Each constituent part of the wind turbine—such as the generator, gearbox, and transformer—is perceived as an integral component of a system aimed at fostering climate change awareness. Moreover, the model incorporates considerations of environmental attitudes and behaviors within families, advocating its suitability for environmental education via social networks.

In essence, the Wind Turbine Model provides a holistic and all-encompassing approach to climate change education. It acknowledges the necessity of both enhancing knowledge and taking proactive measures to combat climate change effects. Additionally, it acknowledges the influence of personal values, identity, and worldview in shaping our attitudes toward the environment. By addressing operational barriers and promoting hope alongside future orientation, this model inspires individuals and communities to strive for a more sustainable future.

Furthermore, this paper offers prioritized measures derived from the United Nations for family education on climate change, thereby outlining the educational hierarchy as follows:

1. Recycle paper, glass, plastic, metal, and old electronics.
2. Bike, walk or take public transport. Save the car trips for when you’ve got a big group.
3. Consume less meat and become vegetarian for one day a week. The meat production industry has a huge impact on the environment.

The article drew a parallel between climate change and wind and proposed the use of the wind turbine model and its various components to address the issue. The objective was to demonstrate that a threat

such as climate change could be turned into an opportunity. It is worth noting that wind energy, which includes the wind turbine model, is closely linked to climate change.

Finally, these six strategies, when implemented concurrently, are recommended for mitigating climate change in line with the design of the wind turbine model presented. The turbine model serves as an analogy, emphasizing the need for cohesive functioning and interconnection of various components to effectively address climate change. These strategies, akin to the components of a wind turbine, represent a holistic approach towards reducing the impacts of climate change, fostering education, values, engagement, sustainable practices, organizational support, and collaborative efforts.

1. Education and Increased Knowledge: Promoting educational programs focused on in-depth understanding of environmental issues and climate change. These programs should be stimulating and engaging, encouraging active participation in the process of change.
2. Values Enhancement and Identity Awareness: Promoting environmental values, raising awareness about human impact on the environment, and fostering changes in lifestyles that improve the environment.
3. Encouraging Family and Community Engagement: Establishing closer connections among family members and individuals within local communities to engage in joint sustainable actions aimed at reducing the adverse effects of climate change.
4. Promotion of Sustainable Activities: Encouraging the use of reusable products, reducing food waste through composting, supporting renewable energy sources, and minimizing animal-based food consumption to mitigate greenhouse gas emissions.
5. Support for Organizational Solutions: Promoting policies and environmental initiatives in schools and educational institutions to advocate sustainable behaviors and support environmental actions.
6. Promoting Collaboration and Interaction: Creating opportunities and platforms for collaboration and exchange of ideas among researchers, school administrators, and families to enhance mutual understanding and increase effective actions toward mitigating climate change.

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