

FROM AWARENESS TO CONCERN: A THEMATIC ANALYSIS OF MIDDLE SCHOOL STUDENTS' VIEWS ON CLIMATE CHANGE IN TURKIYE

DA CONSCIÊNCIA À PREOCUPAÇÃO: UMA ANÁLISE TEMÁTICA DAS OPINIÕES DE ALUNOS DO ENSINO FUNDAMENTAL II SOBRE AS MUDANÇAS CLIMÁTICAS NA TURQUIA

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Abstract

Climate change is a significant global challenge that necessitates heightened environmental awareness among younger generations. This study investigated middle school students' perspectives on climate change by examining their conceptualisations, perceived causes and effects, and primary concerns. Employing a qualitative research design, the study engaged 86 students in Türkiye, with data collected through semi-structured interviews and analysed thematically. The findings revealed that students associated climate change with disrupted seasonal cycles, global warming, and pollution. Many students identified anthropogenic causes, such as fossil fuel consumption and industrial emissions, although some confused climate with weather. Students perceived the effects of climate change to include temperature rise, drought, natural disasters, disease, biodiversity loss, and disruptions to daily life. Concerns encompassed desertification, species extinction, water scarcity, and disasters, which were influenced by local experiences and sociocultural contexts. Despite the high level of awareness, a few students exhibited indifference or uncertainty. The results suggest that students possess an emerging, yet incomplete, understanding of climate change, characterised by scientific awareness and ambiguities. This study underscores the role of education in

Resumo

As mudanças climáticas representam um desafio global significativo que exige maior conscientização ambiental entre as gerações mais jovens. Este estudo investigou as perspectivas de alunos do ensino fundamental sobre as mudanças climáticas, examinando suas conceitualizações, causas e efeitos percebidos e principais preocupações. Utilizando uma abordagem qualitativa, o estudo envolveu 86 alunos na Turquia, com dados coletados por meio de entrevistas semiestruturadas e analisados tematicamente. Os resultados revelaram que os alunos associaram as mudanças climáticas à ruptura dos ciclos sazonais, ao aquecimento global e à poluição. Muitos alunos identificaram causas antropogênicas, como o consumo de combustíveis fósseis e as emissões industriais, embora alguns tenham confundido clima com tempo. Os alunos perceberam os efeitos das mudanças climáticas como incluindo aumento da temperatura, seca, desastres naturais, doenças, perda de biodiversidade e perturbações na vida cotidiana. As preocupações abrangeram desertificação, extinção de espécies, escassez de água e desastres, influenciadas por experiências locais e contextos socioculturais. Apesar do alto nível de conscientização, alguns alunos demonstraram indiferença ou incerteza. Os



enhancing climate literacy and fostering responsibility and citizenship. The findings have implications for curriculum developers, educators, and policymakers to strengthen climate education.

Keywords: Climate Change. Environmental Education. Middle School Students. Climate Literacy. Qualitative Research. Thematic Analysis. Türkiye.

resultados sugerem que os alunos possuem uma compreensão emergente, porém incompleta, das mudanças climáticas, caracterizada por consciência científica e ambiguidades. Este estudo destaca o papel da educação no aprimoramento da alfabetização climática e na promoção da responsabilidade e da cidadania. As descobertas têm implicações para desenvolvedores de currículo, educadores e formuladores de políticas, visando fortalecer a educação climática.

Palavras-chave: Mudanças Climáticas. Educação Ambiental. Ensino Fundamental II Alunos. Alfabetização Climática. Pesquisa Qualitativa. Análise Temática. Turquia.

1 INTRODUCTION

Climate change represents a significant global challenge, impacting ecosystems, human health, and socioeconomic systems (Matta *et al.*, 2025; Rahman *et al.*, 2025; Rouf and Tanveer, 2026). The phenomena of rising temperatures, extreme weather events, melting glaciers, biodiversity loss, and water scarcity underscore the urgency of this crisis (Debsarma & Sahu, 2025). The Intergovernmental Panel on Climate Change (IPCC) underscores that addressing climate change necessitates technological innovation, policy reform, and an informed citizenry (Wagner and Hornidge, 2025). Education plays a pivotal role in fostering climate literacy and promoting sustainable behaviour among younger generations (Akinsemolu and Onyeaka, 2025).

Climate change education is crucial for fostering awareness, attitudes, and responsible behaviour (Karpudewan and Mohd Ali Khan, 2017). Educational institutions play a pivotal role in cultivating environmentally literate citizens who comprehend complex issues and contribute to sustainable solutions (Shutaleva 2023). Middle school represents a critical stage in the development of abstract reasoning and environmental values (Temel, 2026). Understanding students' perceptions of climate change is essential for designing effective curricula and interventions that enhance awareness and responsibility.

Research indicates that students acknowledge climate change as a global concern; however, they frequently conflate it with weather phenomena, attribute it to natural

causes, and misconstrue its long-term implications (Gray, 2023). They often associate climate change with global warming, pollution, and extreme weather events, reflecting partial understanding (Hansen *et al.*, 2025). Children's perceptions are shaped by educational exposure, media influence, and local experiences (Ma and Harris, 2026). These findings highlight the need to investigate how young learners comprehend climate change and the factors that shape their perspectives.

International studies provide valuable insights into students' perceptions of climate change; however, cultural differences significantly influence environmental awareness (da Silva-Vieira *et al.*, 2026). Factors such as educational systems, socioeconomic conditions, and local challenges play crucial roles in shaping responses to climate issues (Naydenov and Atanasova, 2026). In Türkiye, the risks associated with climate change include drought, desertification, fires, and water scarcity, particularly in the Mediterranean regions (Bayram *et al.*, 2023). Although national policies and curricula prioritise environmental education, there is a paucity of research on Turkish students' climate change perceptions (Kurttekin, 2026). Existing studies have predominantly focused on teachers' attitudes and sustainability education, with limited exploration of middle school students' perspectives (Altıntaş *et al.*, 2026). Previous research often isolates specific aspects of climate change perceptions, such as knowledge or attitudes, without comprehensively examining how students define, identify causes and effects, and articulate their concerns (Cunha *et al.*, 2026). This gap underscores the necessity of a holistic investigation of students' cognitive, emotional, and experiential perspectives, which is essential for curriculum development and the promotion of climate literacy in alignment with global sustainability objectives.

This study is grounded in constructivist learning theory, which posits that learners construct knowledge through interactions with their environment and their prior experiences (Li and Zhang, 2025). Students' comprehension of climate change is derived from formal education, cultural values, and observation. This study also incorporates concepts from environmental literacy and Education for Sustainable Development (ESD), emphasising knowledge, attitudes, and responsible environmental behaviours (Kazazoğlu, 2025). In Turkey, environmental awareness is influenced by communal values, respect for nature, and traditional practices that align with environmental harmony

(Mukil *et al.*, 2026). These sociocultural factors shape students' perspectives on environmental issues, underscoring the importance of context-sensitive research.

This study investigates the perspectives of middle school students in Türkiye regarding climate change discourse, thereby contributing to the existing body of knowledge by elucidating their conceptualisations, misconceptions and environmental concerns. It contextualises climate change education within a specific cultural framework, thereby enriching the international literature, and proposes recommendations for enhancing climate literacy and fostering sustainable behaviour within middle school curricula.

This study aimed to address the following research questions:

RQ1: How do middle school students conceptualise climate change

RQ2: What are middle school students' perceptions of the causes of climate change?

RQ3: What are middle school students' perspectives on the impact of climate change?

RQ4: Which aspects of climate change are of the greatest concern to middle school students?

2 METHOD

2.1 Research design

This study employed a qualitative research design to investigate middle school students' perspectives on climate change discourse (Rivera *et al.*, 2025). A basic interpretive qualitative approach was used to comprehend how students construct meaning through their personal experiences, knowledge, and perceptions. Qualitative research facilitates an in-depth exploration of perspectives and is particularly suitable for examining complex phenomena, such as environmental awareness and climate change discourse.

2.2 Participants

The study comprised 86 middle school students, characterised by diversity in gender, grade level, and parental background, thereby enhancing the credibility of the research. The gender distribution included 46 females (53.5%) and 40 males (46.5%), ensuring balanced representation of perspectives. Although females were slightly more prevalent, previous studies suggest that they may have greater environmental awareness, potentially influencing the results. Participants were drawn from the 5th grade (45 students, 52.3%) and the 7th grade (41 students, 47.7%), facilitating comparisons of climate perception across different age groups. The educational background of mothers was predominantly at the elementary level, with some having completed middle school, a limited number having completed high school, and a few having attained an undergraduate education. This suggests that students' environmental knowledge is likely to be derived from formal education. Fathers generally had slightly higher educational attainment, with elementary and middle school being predominant, followed by high school and a limited number with undergraduate education, introducing sociocultural variability that may affect climate awareness.

The mothers' occupations were primarily housewives, followed by service workers (e.g. hotel staff and cleaners) and professionals (e.g. midwives, accountants, and journalists). Fathers' occupations varied, including manual labour (e.g. construction and farming), service (e.g. hotel and tourism), skilled professions (e.g. electricians and security), professionals (e.g. teachers and accountants), and self-employed roles (e.g. retailers and barbers). This occupational diversity enriches the study with varied socioeconomic perspectives, indicative of a region with significant tourism activity. Participants predominantly originated from lower- and middle-income families, with service and tourism professions being prevalent, thus reflecting a working-class demographic. This diversity contributes to the authenticity of students' perceptions of climate change, particularly concerning pollution, droughts, and natural disasters.

2.3 Researcher positionality and reflexivity

In qualitative research, the researcher plays a pivotal role in data collection and interpretation. The researchers involved in this study were education scholars with specialised knowledge of environmental education and qualitative methodologies, which facilitated the development of the research questions and interpretation of student responses. To mitigate potential biases, reflexive practices such as analytic memos, adherence to participants' expressions and systematic coding were employed. The use of direct quotations further enhanced the study's authenticity and its credibility.

2.4 Data collection instruments

The data collection process employed a semi-structured interview form developed by the researchers following a comprehensive review of the literature on climate change education and environmental awareness. The instrument comprised four open-ended questions: How do middle school students define climate change? What are middle school students' perceptions of climate change causes? What are middle school students' views on climate change? What is the issue that concerns middle school students the most regarding climate change? To ensure content validity, the interview questions were reviewed by two experts in science education and one expert in qualitative research. Minor revisions were implemented based on their feedback to enhance clarity and age-appropriateness. A pilot study involving five students was conducted to ensure comprehensibility; these participants were not included in the final sample of the study.

2.5 Data collection procedure

Data were gathered through face-to-face interviews conducted in a quiet school setting, each lasting approximately 10–15 minutes. Students were encouraged to express their views freely, and probing questions were employed for clarification. Consideration was given to Power dynamics arising from age and authority differences were considered. To address these imbalances: (1) students were informed that there were no right or wrong answers, (2) participation was voluntary, (3) the interviewer maintained a neutral tone,

and (4) teachers were absent to prevent any undue influence. Participants were coded (S1–S86) to ensure their anonymity and confidentiality.

2.6 Ethical considerations

The study adhered to ethical principles as follows (Patel *et al.*, 2016): (1) Minimisation of Risk: The study posed minimal risk as it involved only opinions on environmental issues without incorporating sensitive questions. (2) Risk–Benefit Assessment: The benefits, such as contributing to climate change education, outweighed the minimal risks. (3) Informed Consent: Written consent was obtained from parents or guardians, and verbal assent was obtained from students. Participants were informed about the study’s purpose, confidentiality, voluntary participation, and their right to withdraw from the study. (4) Confidentiality: Personal identifiers were removed, and the data were securely stored. This study complied with international ethical standards, including the Declaration of Helsinki.

2.7 Data analysis

The data were subjected to thematic analysis using Braun and Clarke’s six-phase framework to discern patterns (Eslit, 2025). In Phase 1, the interview responses were transcribed and thoroughly examined to facilitate comprehension, with initial notes capturing emergent ideas. During Phase 2, data segments were systematically coded; for instance, “Global Warming” was coded as Global Warming, pollution as Environmental Pollution, and irregular seasons as Disruption of Seasonal Cycles. In Phase 3, these codes were organised into broader categories, such as Fossil Fuels and Natural Disasters. Phase 4 involved reviewing the themes for alignment with the research questions, merging redundant codes, and refining the categories. In Phase 5, themes and subthemes were clearly defined, culminating in four principal themes: (1) Conception of Climate Change, (2) Causes of Climate Change, (3) Effects of Climate Change, and (4) Issues of Greatest Concern. Finally, in Phase 6, quotations were meticulously selected to substantiate the themes, ensuring an accurate representation of the participants’ perspectives.

2.8 Trustworthiness

To ensure the rigor of the study, the following strategies were employed (McGinley *et al.*, 2021): (1) credibility was achieved through expert review, pilot testing, and the inclusion of direct quotations; (2) transferability was facilitated by providing detailed descriptions of the research context and participants; (3) dependability was ensured through transparent and systematic coding processes; (4) confirmability was maintained by having two researchers independently code the data, followed by consensus discussions, resulting in an intercoder agreement of approximately 90%, indicating high reliability; and (5) an audit trail was established by documenting all stages of the research and the analytical decisions made.

2.9 Limitations

This study is subject to several limitations: (1) Geographical Constraint: The research was conducted exclusively in Türkiye, which may limit the generalisability of the findings; (2) Gender Imbalance: The unequal distribution of genders among participants could potentially influence the results; (3) Self-Reported Data: The data are based on students' self-perceptions, which may be affected by their level of knowledge or social desirability bias; (4) Age Restriction: The study is confined to students in the 5th and 7th grades; (5) Interview Context: The face-to-face nature of the interviews may have influenced responses due to perceived authority or pressure; and (6) Conceptual Misconceptions: Confusion between the concepts of weather and climate may have impacted the thematic structure of the study.

3 RESULTS

This study demonstrates that middle school students have a multifaceted yet fragmented understanding of climate change. While many students are cognizant of concepts such as global warming and pollution, their perceptions are predominantly influenced by observable changes and their personal experiences. They associate climate change with seasonal disruptions, extreme weather events, and environmental

degradation, identifying human activities as the primary cause and highlighting issues such as droughts, natural disasters, diseases, and biodiversity loss. Concerns regarding desertification, species extinction, and water scarcity are particularly prominent in this region. These findings indicate increasing environmental awareness among students, alongside persistent misconceptions, underscoring the necessity for climate education to cultivate an accurate understanding and a sense of responsibility among young learners.

3.1 Theme 1. Conception

To evaluate middle school students' perceptions of climate change, the research question was articulated as follows: "How would you define the concept of climate change?" The table below delineates the themes, subthemes, and representative quotations.

Table 1

Middle School Students' Perceptions of the Concept of Climate Change and Direct Quotes

Theme 1	Sub Theme	Sample Comments
Conception	Global Warming (S1,S6,S7,S14,S17,S24,S63,S70,S71)	In the past, summer temperatures were, on average, 5–6 °C lower than they are now. However, now that the glaciers have melted and the forests have burned, summers are getting hotter. (S6)
		Global warming. (S24)
	Environmental pollution (S3,S67,S77)	The first thing that comes to mind is how our world is changing, along with global warming and climate shifts. The world and agriculture are changing. (S63)
		The scientific term for the warming of the Earth and changing lengths of the seasons. The warming of the Earth and changing lengths of the seasons, as well as climate change, are caused by car exhaust, factory emissions, excessive coal use, and other factors. (S71)
Disruption of the seasonal cycle	Results of the scientific studies. (S3)	
		Air pollution is similar to trash in water. There is trash all around us, and all of it contributes to global warming. I will work on a project where I explain climate change, or I will prepare a speech and deliver it. (S67)
		Smoke, factories, forests, animals, humans, environment, landfills, and cleanliness. Polluting the environment, keeping it clean, cutting down trees, and polluting the seas. (S77)
		Natural changes in climate over time and disruption of the climate cycle. (S4)

Theme 1	Sub Theme	Sample Comments
(S4,S10,S12,S15,S18,S19,S20,S21,S23,S25,S26,S33,S36,S37,S38,S40,S41,S42,S43,S45,S47,S51,S52,S53,S58,S59,S61,S62,S64,S65,S66,S68,S69,S72,S81,S82,S83,S86)	Winters feel like summer. Wearing T-shirts during winter months. Just like Antalya's warm climate is getting even warmer. (S12)	
	The weather suddenly turns bad when it is nice. Weather phenomena can be compared to seasons. Rain in summer or sunny weather in winter. (S15)	
	Experiencing winter conditions in summer and summer conditions in winter. (S18)	
	When summer feels like winter and winter feels like summer, or when seasons begin later or earlier than usual, this phenomenon, characterised by seasons lasting longer or shorter, is known as climate change. (S25)	
	Climate change refers to the disruption of the natural balance, resulting in hot summers and long, cold winters. Climate change refers to the disruption of the natural balance, causing seasons to shift, such that summers become cool and winters become long and cold. (S26)	
	The changing of the seasons—for example, spending September as if it were summer. (S38)	
	This makes me think of the atmosphere's sudden reaction. It is a sudden change in the atmosphere, which animals sense. (S41)	
	People's harmful actions, which they carry out without realising it, negatively impact the world. For example, fruits and vegetables that normally grow in the summer grow in the winter. (S47)	
	One consequence of global warming is that seasons are no longer what they used to be. There are more sunny days in winter, and it rains heavily during summer. Climate change is disrupting the world's equilibrium. (S58)	
	Winters are warm, summers are even warmer, and too much rain falls in the winter. Summers feeling like fall, winters feeling like spring, summer temperatures rising above normal levels, and the weather being very cold winters. (S62)	
	The disruption of this balance affects natural elements such as forests and the sea. Climate change refers to irregular or unpredictable shifts in the four seasons. (S68)	
	Weather conditions are constantly changing owing to air and ground pollution. (S69)	
	Seasonal transitions (S5,S8,S9,S11,S13,S16,S22,S27,S28,S29,S30,S31,S32,S34,S25,S39,S44,S46,S48,S49,S50,S54,S55,S56,S57,S60,S74,S75,S76,S78,S79,S80,S84,S85)	I define climate change as the fact that summer is very long and winter is short. (S72)
Climate change, cold weather in summer, and leaves falling from trees in spring. Warm weather in winter, with no snowfall. (S73)		
The seasons we are supposed to experience arrive earlier. Climate change causes seasons to arrive earlier or later. Summers are not hot, or winters are not cold. (S86)		
The changing of the seasons—that is, spring, summer, fall, and winter. (S5)		
This makes me think of the transition from one season to the next. (S8)		
The changing of the seasons and the arrival of a different season. For example, it is cold in winter and warm in summer. (S11)		

Theme 1	Sub Theme	Sample Comments
		The transition from one season to the next is a gradual process. (S22)
		Dress appropriately according to the weather. (S27)
		Changes in weather conditions. The transition from cold to warm weather is due to seasonal changes. For example, a transition from rainy to sunny weather. (S29)
		Climate change refers to the transition from summer to fall, that is, from warm to cold. (S32)
		Let us say that a season is unfolding, and then that season comes to an end. The changing of the seasons, the changing of natural phenomena. (S35)
		The season is coming. This is the succession of the four seasons. (S49)
		Weather phenomena or conditions include noise and noise pollution across the four seasons: winter, summer, autumn, and spring. Climate change affects the seasons. Each season is different, and climate change occurs during the year. (S57)
		The four seasons—summer, winter, spring, and fall— occur over 12 months. Climate change involves constant shifts between hot, cold, and mild weathers. (S74)
	Inability to identify (S2)	I can't describe it. (S2)

The findings indicate that middle school students predominantly perceive climate change as irregular seasonal variations and global warming, with fewer students associating it with environmental pollution or confusing it with weather phenomena (Table 1). Participants characterised climate change as global warming, environmental pollution, disruption of seasonal cycles, or seasonal transitions, or were unable to define it. These findings reflect a range of scientific understanding, from accurate comprehension to misconceptions and limited awareness of the disease.

3.1.1 Understanding climate change as global warming

In a recent study, a cohort of students demonstrated their scientific comprehension by correlating climate change with global warming, highlighting increased temperatures and anthropogenic environmental damage. One participant remarked, “In the past, summer temperatures were 5–6 °C lower. But now that glaciers have melted and forests have burned, summers are hotter” (S6). Another student characterized climate change as “the warming of the Earth and changing seasons caused by car exhaust, factory emissions, coal use, and other factors” (S71). These responses suggest that some students possess a

foundational level of scientific literacy, recognising human contributions to climate change. Nevertheless, the limited frequency of such responses indicates that a comprehensive understanding is not yet achieved.

3.1.2 Associating climate change with environmental pollution

Table 1 illustrates that some students perceive climate change as a consequence of pollution, associating it with waste and emissions, as exemplified by the statement: “Air pollution is like trash in the water.” (S67) Another participant highlighted broader environmental issues: “Polluting the environment, cutting down trees, polluting the seas.” (S77) These perspectives demonstrate an awareness of environmental issues but also reveal a tendency to conflate them with climate change, suggesting a partial understanding of human responsibility that lacks precision.

3.1.3 Perceiving climate change as the disruption of the seasonal cycle

The predominant subtheme identified in Table 1 is the disruption of the seasonal cycles. Students characterised climate change as irregular weather patterns and shifts in seasons, exemplified by statements such as, “Winters feeling like summer” (S12). Another student remarked, “When summer feels like winter, or seasons shift, it’s climate change” (S25). Additionally, a student highlighted ecological impacts, noting, “Fruits growing in winter” (S47). These observations indicate that students perceive climate change through personal observations and experiences, yet they frequently conflate short-term weather variability with long-term climate change.

3.1.4 Confusing climate change with seasonal transitions

Many participants equated climate change with seasonal transitions. As illustrated in Table 1, students characterized it as the progression of seasons: “The changing of the seasons—that is, spring, summer, fall, and winter.” (S5) Another student commented: “It makes me think of the transition from one season to the next.” (S8) These responses suggest a misconception of climate change as a long-term phenomenon, perceiving it

instead as a normal cycle. This underscores the necessity of enhancing climate literacy within middle school curricula.

3.1.5 Inability to define climate change

As indicated in Table 1, a minority of students reported challenges in defining the concept of sustainability. One participant expressed this difficulty by stating, “I can’t describe it” (S2). Although these responses were limited in number, they underscore gaps in awareness and suggest that some students have not received adequate exposure to climate change education.

3.2 Theme 2. The causes of climate change

To evaluate middle school students’ perspectives regarding the causes of climate change, the research question was articulated as follows: “What are the causes of climate change?” The table below presents the themes, subthemes, and illustrative quotes.

Table 2

Middle School Students’ Perceptions of the Causes of Climate Change and Direct Quotes

Theme	Sub Theme	Sample Comments
2		
The causes of climate change	People (S1,S2,S16,S34,S47,S65,S69,S70,S73)	They could be people. (S2)
		Water waste, lack of conservation, and irresponsibility are also major issues. (S16)
		People’s irresponsible and careless behaviour—in other words, the real problem lies in people’s behaviour. (S47)
		This is a result of the damage humans cause to nature. (S65)
		Littering, environmental pollution, and a lack of awareness among people. (S69)
	Environmental pollution (S3,S14,S30,S40,S41,S45,S51,S66,S67,S77,S81,S83)	Melting glaciers, global warming, and human indifference. (S70)
		People cut down trees and disrupt the cycle of nature. (S73)
		Pollution. (S14)
		People littering. (S30)
		Human damage to nature. (S40)
		For example, climate change occurs when the air is very bad or very polluted. (S45)
		It is also caused by people littering and high levels of exhaust fumes. (S66)
		Climate change has emerged due to environmental, air, and water pollution. (S67)

Theme 2	Sub Theme	Sample Comments
	Melting of glaciers (S4,S6,S7,S8,S15,S18)	I think it is because people pollute the environment. (S81) The cause of climate change is the melting of glaciers and breaching of ice sheets. (S4) Melting of glaciers. (S8) This was because the ice sheet had been breached. (S15)
	Seasonal change (S5,S11,S13,S17,S27,S28,S29,S31,S35,S36,S38,S39,S43,S44,S48,S50,S52,S55,S57,S72,S75,S80,S85)	The cooling and warming of air. (S5) It is not just in summer that the heat gets to us; the same goes for winter. (S17) A change in weather conditions. (S27) For example, the cold winter affects climate change. (S29) Seasonal changes. (S44) Four Seasons. (S48) As the new season begins, the weather changes, becoming hot, cold, or mild. (S52) The weather and the days are getting shorter and longer. (S72) This was because it was raining and the weather had changed. (S85)
	Fossil fuels (S10,S26,S37,S53,S54,S56,S58,S61,S62,S71,S86)	The air is polluted by exhaust fumes from cars. (S10) People constantly drive their own cars, which causes a lot of air pollution from the exhaust fumes. (S26) Factory smoke, environmental pollution, and misuse of resources. (S37) The gases emitted from factory chimneys are unfiltered. (S56) Car emissions, industrial emissions, greenhouse gases, and wildfires contribute to the climate change. (S58) Unfiltered exhaust systems, factory chimneys, and fossil fuels (S62) The lengthening of seasons is due to the depletion of the ozone layer caused by excessive coal use, exhaust fumes, and industrial emissions. (S71) Exhaust fumes and factory smoke. (S86)
	Use of greenhouse gases (S12,S46,S74)	Humans use deodorants, which deplete the ozone layer. (S12) The use of greenhouse gases and air conditioners. For example, an increase in greenhouse gas emissions leads to global warming. (S46) Excessive car use. (S54) If the ozone layer were to disappear, the weather would become extremely hot or extremely cold. (S74)
	Global Warming (S19,S20,S22,S24,S25,S32,S42,S49,S59,S63,S68,S76,S82,S84)	Due to global warming. (S19) Global warming. (S63) Global warming, factory smoke, car exhaust, and factory waste. (S68) Triggering factors that contribute to global warming (such as the excessive use of perfume and deodorant) lead to climate change. (S82)
	The absence of seasons (S21,S23,S60)	The absence of seasons. (S21) For example, it might rain and then the sun might come out, or it might be snowing and then the sun might suddenly come out—that's what climate change is. (S60)
	Extreme weather events (S33,S64,S79)	Heavy rainfall. (S33) For example, extreme weather events such as rain, avalanches, snow, and floods occur very frequently, yet no precautions are taken against them. (S64)

Theme 2	Sub Theme	Sample Comments
		This is because of the extreme heat in summer and smoke in winter. (S79)
		I don't know. (S9)
	Not knowing (S9,S78)	I am not sure, but it might be due to a lack of concern for the environment. (S78)

Research indicates that middle school students predominantly associate climate change with anthropogenic activities and pollution, whereas a smaller proportion recognises the roles of fossil fuels and greenhouse gases. Persistent misconceptions include conflating causes with consequences and confusion about natural weather variability. Participants were queried regarding the causes of climate change, and their responses were categorised into the following subthemes: human activities, pollution, fossil fuels, greenhouse gases, global warming, seasonal changes, melting glaciers, extreme weather events, absence of seasons, and lack of knowledge. These findings underscore the diverse levels of environmental literacy, ranging from accurate explanations to misunderstandings to misconceptions.

3.2.1 Human responsibility as the primary cause

Table 2 presents students' attribution of climate change to anthropogenic activities, highlighting the themes of irresponsibility, neglect, and unsustainable practices. One participant articulated, "People's irresponsible and careless behavior" (S47). Another remarked, "It results from the damage people cause to nature" (S65). Specific behaviours such as wastefulness and a lack of conservation were identified, exemplified by the statement, "Water waste, lack of conservation, and irresponsibility" (S16). These responses underscore students' perception of climate change as a consequence of human-induced environmental degradation, emphasising moral accountability.

3.2.2 Environmental pollution as a central explanation

Environmental pollution emerged as a sub-theme (Table 2). Numerous participants associated climate change with air, water, and land pollution. One student succinctly stated, “Pollution” (S14), while another elaborated, “The emergence of climate change due to environmental pollution, air pollution, and water pollution” (S67); and Another participant observed that climate change occurs “when the air is very bad or very polluted” (S45). These responses indicate that students linked climate change to broader environmental issues. This reflects a degree of environmental awareness but also suggests a conflation of distinct ecological problems, highlighting the need for clearer instructional guidance in this regard.

3.2.3 Scientific awareness of fossil fuels and greenhouse gases

Several students demonstrated advanced comprehension of climate change by identifying fossil fuels and greenhouse gases as its primary drivers. Table 2 presents the references for automobile exhaust, factory emissions, and industrial activities. One student remarked, “People constantly drive their own cars, which causes air pollution from exhaust fumes” (S26), while another observed, “Car emissions, industrial emissions, greenhouse gases, and wildfires contribute to climate change” (S58). A participant highlighted industrial accountability: “The gases emitted from factory chimneys are not filtered” (S56). Some students explicitly mentioned greenhouse gases and technological sources, as exemplified by the statement, “The use of greenhouse gases, air conditioners... leads to global warming” (S46). These findings indicate that some students possess foundational scientific knowledge, which is likely acquired through education and media exposure.

3.2.4 Misconceptions: confusing causes with consequences

Despite the increased scientific awareness, misconceptions regarding climate change persist. A prevalent misunderstanding involves perceiving global warming and glacier melting as causes rather than effects of climate change. For example, students

associated climate change with the “melting of glaciers” (S8) and “ice sheet breaches” (S15), and identified “global warming” as a direct cause (S19, S63). These responses demonstrate a reversal of the cause-and-effect relationships, indicating conceptual confusion. Such misconceptions highlight the necessity for improved climate change education that clearly distinguishes between the drivers, processes, and outcomes.

3.2.5 Confusion between climate and weather

Table 2 illustrates the prevalent misconception that attributes climate change to natural seasonal variability and short-term weather phenomena. Students frequently referenced seasonal transitions, citing the “cooling and warming of the air” (S5) and “a change in the weather” (S27). Others emphasised the cyclical nature of seasons, such as “Four Seasons” (S48) and “days getting shorter and longer” (S72). Some students identified extreme weather events as causal factors, with one noting, “Extreme weather events such as rain, avalanches, snow, and floods occur frequently” (S64), while another mentioned “heavy rainfall” (S33). These perspectives reflect an experiential understanding but also reveal confusion between climate and weather, a common misconception in climate literacy education.

3.2.6 Limited knowledge and uncertainty

As illustrated in Table 2, a minority of students admitted to having a limited understanding of the causes of climate change. One participant remarked, “I don’t know” (S9), while another conveyed uncertainty, stating, “I’m not really sure, but it might be a lack of concern for the environment” (S78). These responses highlight the necessity of more comprehensive environmental education at the middle school level.

3.3 Theme 3. The effects of climate change

In order to evaluate middle school students’ perspectives regarding the impacts of climate change, the research question was articulated as follows: “What are the effects of

climate change?" The table below presents the themes, subthemes, and illustrative quotations.

Table 3

Middle School Students' Perceptions of the Effects of Climate Change and Direct Quotes

Theme 3	Sub Theme	Sample Comments
The effects of climate change	The effects of seasonal change (S1,S3,S17,S18,S23,S27,S28,S29,S46,S52,S57,S64,S67,S76,S79,S81)	When winter arrives, the plants wither. (S1)
		While the homeless feel the cold in winter, they do not in summer; that is the effect it has on people. (S28)
		Weather conditions, pollution, noise, and sound pollution vary by season: winter, spring, summer, and fall. (S57)
	Social activities (S2,S20,S26,S50,S53,S80,S86)	The heat can be stifling and make it hard to work, and in the winter, the cold can make us feel cold. On rainy days, getting around is difficult. (S76)
		Because it snows in winter, the children cannot have fun. (S2)
		People are on vacation during the summer months; if the weather changes, it could turn into winter. Money would be wasted on vacations. (S20)
	Temperature and drought (S4,S7,S16,S22,S30,S34,S41,S62,S74)	It can be difficult for me and the people around me. Because we cannot go anywhere, and when we have work to do, we cannot get it done. (S50)
		Some events are postponed because of the weather. (S53)
		Someone who wants to go on a picnic in the summer might get sick because of cold weather. (S86)
	Melting of glaciers (S5,S10,S40)	For example, when it gets very hot, people feel uncomfortable, and plants wither because of the heat. Since it is so hot in Antalya, people feel suffocated; we cannot go outside, especially the elderly. The grass is drying up. (S4)
Extreme temperatures. (S7)		
We might run out of water because of the drought. (S16)		
Fire (S6,S10,S45,S62)	Hot weather can lead to water shortages for all living organisms. (S74)	
	Glaciers are melting. (S5)	
	If the glaciers melt, penguins and polar bears will not survive. (S10)	
Diseases (S8,S9,S12,S14,S15,S19,S21,S32,S33,S36,S37,S43,S48,S49,S52,S55,S59,S63,S68,S71,S73,S75,S83,S84)	It poses a fire hazard by radiating heat into the environment. It has a negative impact on animals and can cause sunstroke in humans. (S6)	
	Because nature is burning, people suffer as a result of it. (S45)	
	People can become ill during seasonal changes. (S8)	
	It can have a negative effect because the heat gets even hotter, and we sweat; we might even get sick. (S12)	
	Sudden changes in weather can lead to the onset of illnesses. (S15)	
	For example, getting sick when the weather gets colder as we transition from summer to autumn. (S32)	
	If the weather changes suddenly, people can catch the flu, cold, or other illnesses. (S52)	
	Asthma, poisoning, and epidemics have negatively impacted me and those around me. (S71)	

Theme 3	Sub Theme	Sample Comments
		People's health deteriorates, and diseases become increasingly prevalent. (S75)
		Breathing polluted air causes health problems. (S83)
	Dressing (S11,S13,S38)	Since it is cold in winter, everyone wears hats, long-sleeved clothing, and gloves. However, in summer, they prefer lightweight, short-sleeved clothing. (S11)
		Heavy rainfall can cause flooding and damage homes. (S24)
		The increase in the number of natural disasters. (S47)
	Natural disasters (S24,S35,S39,S47,S58,S60,S70,S85)	When crops fail to grow properly, the soil where trees grow becomes dry, and rain makes it difficult for people to get around. (S58)
		For example, it might rain and flood homes, or an avalanche might occur, damaging homes and causing death. (S60)
		Heavy rain may cause flooding. (S85)
	Economic impact (S25,S65)	People buy clothes to prepare for winter, but since winter conditions have not yet set in, they cannot wear the clothes they have bought. (S25)
		Agricultural production has declined. Environmental damage affects people. It has a negative impact on many professions and livelihoods. (S65)
	Mental health disorders (S31,S44,S72)	One day, it is really hot, and then it starts raining immediately. I mean, this really gets on my nerves. (S31)
		Climate change can cause emotional distress in some individuals. (S72)
		This could have harmful effects, including the death of stray animals. (S54)
	Its adverse effects on animals (S54,S56,S69,S82)	It has no effect on people but has a negative impact on the environment and stray animals. This is because, during winter, animals can become cold and die from freezing. (S56)
		The damage it causes to the environment includes the destruction of animal habitats and the cutting down of trees. (S77)
		This negatively affects animal migration and reproduction. (S82)

The findings suggest that middle school students perceive the effects of climate change as encompassing environmental, social, economic, and health-related dimensions. They predominantly associate climate change with extreme temperatures, natural disasters, and health-related issues, while acknowledging its influence on ecosystems, daily life, and mental well-being. Responses to the query, "What are the effects of climate change?" were categorised into subthemes such as seasonal changes, social activities, temperature and drought, melting glaciers, fires, diseases, clothing, natural disasters, economic impacts, mental health disorders, and effects on animals. These findings demonstrate both experiential awareness and emerging environmental literacy among students.

3.3.1 *Environmental and climatic impacts*

Table 3 presents evidence that students identified environmental changes as manifestations of climate change, citing irregular seasonal patterns, extreme temperature fluctuations, and water scarcity. One student remarked, “When winter comes, plants wither” (S1), which underscores ecological vulnerability. Another student observed, “In Antalya, it is too hot to go outside, especially for the elderly. The grass is drying up” (S4). These statements reflect students’ local experiences and observations of environmental changes. Concerns regarding drought and water scarcity were also expressed, with one student noting, “We might run out of water” (S16), and another stating, “Hot weather can lead to water shortages” (S74), indicating their awareness of resource depletion. Furthermore, students associated climate change with global phenomena, such as glacial melting. One student commented, “If glaciers melt, penguins and polar bears cannot survive” (S10), demonstrating the influence of media and education.

3.3.2 *Natural disasters and wildfires*

Table 3 shows the occurrence of natural disasters and wildfires. Students frequently associated climate change with phenomena such as floods, avalanches, and other events. One student observed, “Heavy rainfall can cause flooding and damage homes” (S24), while another remarked on “The increase in natural disasters” (S47). A further student elaborated, “It might rain and flood homes, or an avalanche might occur, damaging homes and causing deaths” (S60). Wildfires were identified as a significant consequence. One participant noted, “It poses a fire hazard by radiating heat” (S6), and another stated, “Because nature is burning, people suffer” (S45). These responses indicate students awareness of the risks associated with rising global temperatures.

3.3.3 *Health-related consequences*

Health impacts are frequently cited as significant. Students identified both physical and environmental health risks related to climate change (Table 3). One participant remarked, “Sudden weather changes can lead to illnesses” (S15), while

another noted, “People can catch the flu or a cold” (S52). A student articulated broader health concerns, stating, “Asthma, poisoning, and epidemics negatively impact me and others” (S71). Air pollution was specifically linked to health issues, as one student observed, “Breathing polluted air causes health problems” (S83). These responses indicate that students perceive climate change as a threat to both environmental and human health.

3.3.4 Impacts on daily life and social activities

Students highlighted climate change’s influence on their daily lives and social engagement. Table 3 illustrates how weather conditions serve as obstacles to recreation, mobility, and social interactions. One student remarked, “Because it snows in the winter, the children can’t have fun” (S2), while another observed, “Some events are being postponed due to the weather” (S53). These responses reflect students’ perceptions of the impact of climate change on their routines and their quality of life.

3.3.5 Economic and psychological consequences

Students have identified both the economic and psychological ramifications of climate change. One student remarked, “Agricultural production declines... It impacts professions and livelihoods” (S65), thereby underscoring their economic vulnerability. Another student noted disruptions in consumption patterns: “People buy clothes for winter, but can’t wear them” (S25). Psychological effects were also evident, including frustration with unpredictable weather: “One day, it is hot, and then it rains. It gets on my nerves” (S31), and emotional distress: “Climate change may cause emotional distress” (S72). These responses reflect awareness of climate-related anxiety.

3.3.6 Impacts on animals and ecosystems

Students acknowledged the ecological consequences of climate change on fauna and biodiversity. One participant remarked, “Stray animals could die” (S54), while another observed the suffering caused by severe weather conditions (S56). One student

emphasised “the destruction of animal habitats” (S77). Another explained, “It negatively affects animal migration and reproduction” (S82). These findings demonstrate students’ empathy towards non-human life and their comprehension of ecological interdependence.

3.4 Theme 4. The issue of greatest concern

To assess middle school students’ perspectives on their primary concerns related to climate change, the research question formulated was: “What is the issue regarding climate change that concerns you the most?” The table below presents the themes, subthemes, and illustrative quotes.

Table 4

Middle School Students’ Perceptions of the Issue Regarding Climate Change That Concerns Them the Most, Along With Direct Quotes

Theme 4	Sub Theme	Sample Comments
The issue of greatest concern	Desertification (S1,S4,S5,S7,S16,S17,S22,S34,S41,S58,S63,S71,S74,S75,S76,S83)	In social studies class, we learned that Turkey is at risk of turning into a desert due to climate change, and things like this worry me. (S1)
		If temperatures continue to rise, I am afraid we will run out of water. (S4)
		Getting dehydrated because Antalya is a very hot city. (S16)
		When the weather gets hot, the trees wither, and the crops fail to yield a harvest. (S34)
		I am very worried about the trees drying out. (S41)
		The world has become too hot, and the world’s balance has shifted, making it impossible to go outside. (S58)
		The extreme heating and cooling of the Earth and the cold and hot conditions on planets such as Mars. (S71)
		If it is very hot and does not rain, we might run out of water. (S76).
		They do not keep the environment clean. (S3)
		Environmental and air pollution. (S67)
	The extinction of animal species (S6,S13,S53,S54,S56,S69,S70,S82,S86)	I love penguins and seals. I am afraid they will go extinct when the glaciers melt. (S6)
	Extinction of animals. (S13)	
		It refers to animals living outdoors under poor conditions. (S53)
		Everyone could lose their balance, and many animals could lose their lives; there could also be famine. (S69)
		I care just as much about the animals’ well-being as I do about our own. The timing of their migration and births is changing. (S82)

Theme 4	Sub Theme	Sample Comments
		One day, we might lose our balance, and many animals could lose their lives. (S86)
	Illness (S8,S9,S15,S36,S48,S57,S60,S84)	To suddenly fall ill. (S8) I am worried that many people will become ill. (S9) Not being able to go to the beach in summer and getting sick. (S15) Climate change can harm some people and cause illnesses in others. This is my primary concern. (S84)
	Forest fires (S10,S77,S79)	Forest fires. (S10) There are only forest fires; nothing else exists. (S77) Fires. (S79)
	Mass casualties (S12,S47,S59,S61,S72,S80)	For example, the population is declining. (S12) If things continue this way, humanity will come to an end—things like poverty and drought. (S47) Drastic changes in the weather, global warming, and the resulting melting of the poles mark the end of life. (S59) The fact that winters are getting shorter and summers are getting longer makes it feel like the end of the world is just around the corner. That's why I'm afraid of climate change. (S72)
	Ozone layer depletion (S14,S30)	Ozone layer depletion. (S14)
	The irregularity of the seasons (S18,S19,S20,S23,S25,S26,S31,S32,S37,S43,S52,S66,S68,S81)	I am afraid of fires in winter or floods in summer. (S18) Experiencing winter conditions during summer. (S19) Winter conditions persisted throughout the entire year. (S25) I worry that if we were to experience an endless winter or endless summer, people would not be able to go outside, would have to stay home, and would not be able to communicate with anyone. (S26) The transition from summer to winter is marked by the onset of winter rains, and even though it is early winter, flooding has already occurred. (S32) Summer days are very cold, and winter days are very hot. (S43) Animals and humans suddenly experience summer in winter or winter in summer. (S81).
	Natural disasters (S21,S24,S27,S28,S29,S33,S35,S38,S39,S40,S42,S44,S45,S46,S49,S50,S51,S55,S64,S78,S85)	I am afraid that the entire city will be destroyed. (S21) Disasters occur, and people die as a result. (S24) Hurricanes and tornadoes can occur in winter. (S27) I am worried that hail will shatter the car windows. (S29) I am afraid of flooding. (S33) One day, a natural disaster could strike where we live, and that frightens me. (S40) I am worried about disasters such as floods, heat waves, and landslides. (S49)

Theme 4	Sub Theme	Sample Comments
		Floods, storms, and droughts are causes for concern. (S78)
		Flood. (S85)
	There is no cause for concern (S2,S11,S62,S65,S73)	There is nothing to worry about. (S2)
		It doesn't worry me. After all, there is nothing I can do about it. (S62)
		I'm not worried. (S65)

Research indicates that middle school students predominantly express concerns regarding the environmental and existential ramifications of climate change, such as desertification, natural disasters, and biodiversity loss. These apprehensions reflect emotional engagement with the associated risks, which are influenced by educational exposure, local environmental conditions, and global awareness (see Table 4). Students were queried: “What climate change issue concerns you most?” Their responses were categorised into subthemes, including desertification, pollution, species extinction, illness, fires, casualties, ozone depletion, seasonal irregularity, disasters, and apathy. Overall, students perceive climate change as a significant threat to the ecological balance and human survival.

3.4.1 Concern about desertification and water scarcity

Desertification, which is associated with drought, water scarcity, and extreme heat, is a significant environmental concern. Students demonstrated awareness of regional environmental risks and recognised the role of education in shaping their perspectives. For instance, one student remarked, “In social studies class, we learned that Turkey is at risk of turning into a desert due to climate change, and things like that worry me.” (S1) Another student expressed apprehension regarding water shortages: “If temperatures keep rising, I'm afraid we'll run out of water.” (S4) The local climate also influenced their concerns, as one student noted: “Getting dehydrated, because Antalya is a very hot city.” (S16) These responses indicate that students comprehend climate change through both education and personal experience, highlighting the importance of addressing desertification and promoting sustainability in semi-arid regions.

3.4.2 Fear of natural disasters and seasonal irregularities

Table 4 raises additional concerns regarding the impact of natural disasters and seasonal patterns. Students frequently associate climate change with flooding and extreme weather events. One participant articulated this apprehension, stating: “One day, a natural disaster could strike where we live, and that scares me.” (S40) Another participant expressed anxiety about floods, heat waves, and landslides. (S49) Concerns regarding seasonal irregularities underscore the perception of environmental instability. For example, a participant noted: “I worry that endless winter or summer would prevent people from going outside.” (S26) These perspectives indicate that students perceive climate change as a disruptive force that threatens their daily lives and safety.

3.4.3 Concerns regarding biodiversity and animal extinction

Students exhibited ecological empathy, particularly regarding endangered species. Table 4 presents the apprehensions regarding biodiversity loss. One student expressed, “I love penguins and seals. I’m afraid they’ll go extinct when glaciers melt.” (S6) Another student highlighted ecological balance: “I care about animals’ well-being as much as ours because their migration and birth timing is changing.” (S82) These responses indicate that students recognise the interconnectedness of ecosystems and human life. Their concern for animals reflects a developing sense of environmental ethics and global responsibility among the youth.

3.4.4 Health risks and forest fires

Health concerns and forest fires have emerged as significant issues in recent years. Some students expressed apprehension regarding the potential spread of diseases and the deterioration of public health, as evidenced by one student’s remark: “I’m worried that many people will get sick.” (S9) Others highlighted the destructive nature of wildfires, simply stating: “Forest fires.” (S10) These responses indicate that students are cognizant of the connections between climate change, environmental degradation, and human well-being.

3.4.5 Existential anxiety and global catastrophe

Table 4 elucidates the phenomenon of existential anxiety, as the participants expressed concerns regarding the survival of humanity. One student articulated, “If things keep going this way, humanity will come to an end—things like poverty and drought.” (S47) Another participant observed, “The drastic changes in the weather and global warming make it feel like the end of life.” (S59) These perspectives underscore climate change as a crisis, highlighting the emotional and psychological dimensions of students’ environmental consciousness.

3.4.6 Limited concern or climate indifference

As shown in Table 4, a minority of students expressed a lack of concern about climate change. One student remarked, “There’s nothing to worry about” (S2), while another conveyed a sense of helplessness, stating, “It does not worry me. After all, there is nothing I can do about it” (S62). These responses may reflect either limited awareness or a perceived lack of agency, underscoring the necessity for educational initiatives aimed at fostering environmental empowerment.

4 DISCUSSION

This study investigated middle school students’ perspectives on climate change, focusing on their conceptualisations, perceived causes, effects, and concerns. The findings revealed that students possessed a developing understanding of climate change, influenced by scientific knowledge and personal experiences. The results indicate that while students demonstrate environmental awareness, misconceptions remain. These findings underscore the importance of enhancing climate change education using appropriate pedagogical approaches.

4.1 Students' conceptualizations of climate change

Students frequently conceptualise climate change as a disruption of seasonal cycles, associating it with irregular weather patterns, extended summer seasons, and milder winter seasons. This perspective indicates reliance on observable changes and personal experiences. While some individuals associate climate change with global warming and pollution, many erroneously perceive it as a routine seasonal variation rather than a long-term shift. Previous research indicates that young learners often confuse weather with climate because of limited scientific exposure (Lämmer and Ohl, 2026; Nyarko *et al.*, 2026). Scientifically informed responses, such as those involving greenhouse gases and fossil fuels, suggest that education and media play roles in enhancing environmental literacy. These findings illustrate a cognitive transition in which intuitive knowledge coexists with scientific understanding. Integrating enquiry-based climate education into curricula may help students develop accurate conceptual frameworks (Brumann *et al.*, 2022).

4.2 Perceived causes of climate change

Students predominantly associate climate change with anthropogenic activities such as pollution and fossil fuel utilisation, thereby demonstrating an awareness of human-induced environmental issues and aligning with the prevailing scientific consensus. They identified sources such as vehicular emissions, industrial discharges, deforestation, and resource consumption, thereby acknowledging human responsibility. However, some students erroneously perceived natural phenomena, including seasonal variations or extreme weather events, as direct causes rather than effects, underscoring the necessity for enhanced education regarding causality (Sánchez-Almodóvar, 2023; Köç, *et al.*, 2025). The findings indicate that middle school environmental education promotes a sense of responsibility but requires greater emphasis on scientific accuracy and systems thinking (Erol *et al.*, 2026).

4.3 Perceived effects of climate change

Students perceive climate change as having extensive consequences, associating it with droughts, extreme temperatures, melting glaciers, natural disasters, biodiversity loss, and forest fires. They observed effects on human health, such as diseases and respiratory issues, as well as disruptions to daily life. This reflects students' awareness of the impacts of climate change and sensitivity to real-world challenges (Lavin and Kafle, 2026; Wright *et al.*, 2026). They also acknowledge the psychological and economic consequences, such as emotional distress and agricultural losses. This suggests that learners comprehend the broader societal implications of environmental issues, aligning with research on climate change's interconnected influence on human well-being and sustainable development (David, 2024; Fortunato *et al.*, 2026; Sohn, 2026; Demirkaya, *et al.*, 2024).

4.4 Students' climate change concerns

The findings indicate that desertification, water scarcity, and species extinction are primary concerns among students, reflecting Türkiye's ecological challenges, particularly in the Mediterranean region, which is experiencing rising temperatures, drought, and wildfires. Apprehensions regarding natural disasters and environmental degradation suggest heightened awareness among students of local risks (Jum'a and Hamdan, 2026). Fears of mass casualties, global catastrophes, and the potential extinction of life underscore climate anxiety, emphasising the necessity for educational initiatives that foster hope, resilience, and agency (Martuscelli *et al.*, 2026). Some participants expressed no concerns about climate change, indicating variability in awareness and underscoring the need for inclusive educational strategies.

4.5 Theoretical and cultural implications

These findings can be interpreted through the lens of constructivist learning theory and environmental literacy frameworks (Le and Nguyen, 2024; Hidayah *et al.*, 2026). Students develop an understanding of climate change based on their prior knowledge,

experiences, and sociocultural contexts. Local environmental phenomena, such as heat, drought, and forest fires, illustrate the impact of experiential learning. This study aligns with environmental literacy models that emphasise the knowledge, attitudes, and responsible behaviours essential for sustainable citizenship. In Turkey, climate change education has been integrated into curricula that focus on environmental awareness and sustainability (Olgun, 2026). Students' references to classroom learning, particularly in social studies, underscore the role of formal education in shaping their environmental perceptions. These findings underscore the importance of culturally responsive educational initiatives that address regional challenges while promoting global responsibility.

5 IMPLICATIONS FOR EDUCATION AND PRACTICE

These findings suggest several critical actions for educators and policymakers. First, climate literacy must be enhanced by incorporating accurate climate-related content across various disciplines. Second, misconceptions should be addressed by clearly differentiating between weather and climate and between causes and effects. Third, experiential learning should be promoted through projects and fieldwork. Fourth, sustainable behaviour and active citizenship should be encouraged. Fifth, emotional resilience should be supported by integrating solution-oriented approaches to mitigate climate-related anxiety. Finally, emphasis should be placed on local issues, such as droughts and fires in Türkiye, to ensure relevance and engagement.

6 LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Although this study offers valuable insights, it is not without limitations. First, the research was conducted with students from a single country, which may constrain the generalisability of the findings. Second, as a qualitative study relying on self-reported data, the responses may be influenced by subjective interpretations. Third, the sample was limited to fifth- and seventh-grade students, thereby restricting the ability to make broader age-related comparisons. Some participants exhibited conceptual misunderstandings that could be attributed to linguistic or cognitive factors. Future

research could benefit from employing mixed methods to integrate qualitative and quantitative data analyses. Additionally, comparative cross-cultural studies could elucidate the influence of sociocultural contexts on climate change perceptions. Longitudinal research could further investigate how understanding evolves in response to educational interventions.

7 CONCLUSION

In conclusion, this study demonstrates the increasing awareness of climate change among middle school students, as informed by scientific, experiential and cultural perspectives. Although students recognise human responsibility and express concerns, misconceptions remain prevalent. These findings underscore the critical role of education in promoting accurate understanding, environmental responsibility and sustainable citizenship. Enhancing climate change education in middle schools is essential for equipping future generations to address one of the most pressing global challenges of the twenty-first century.

AUTHORS' CONTRIBUTION

All authors contributed equally to the development of this article.

DATA AVAILABILITY

All datasets relevant to this study's findings are fully available within the article.

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