

Increasing the Climate Change Awareness on SDGs among Higher Education Students: Age and Environmental-Related Education as Dual Moderators

Yükseköğretim Öğrencileri Arasında Sürdürülebilir Kalkınma Hedefleri Konusunda İklim Değişikliği Farkındalığının Artırılması: Yaş ve Çevreyle İlgili Eğitimin Çifte Moderatör Olarak Rolü

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Abstract: The consequences of climate change are one of the greatest threats to sustainability. Awareness of climate change is vital for both combating climate change and achieving the sustainable development goals (SDGs). This study specifically examined the moderating effects of age and environmentally-related education (E-Re) on climate change awareness and SDGs. First, the scales were administered to 1067 participants. Second, 31.4% (n = 335) of higher education students who volunteered took E-Re courses through online portals. Regulating factors and variables that define the impact of climate change on the SDGs and interaction effects were examined and hypotheses were tested. The most critical finding of the study shows that even if climate change awareness increases among young students who have not received environmental education, behaviors towards SDGs do not change. This indicates that the SDG practices of young generations who have not received E-Re may be ignored. The results of this study also reveal the necessity of revising SDG practices according to climate change awareness and socio-demographic characteristics such as age, education level, long-term residence, and the need for customized trainings.

Keywords: Climate Change, Sustainable Development Goals, Awareness, Environmental-Related Education, Higher Education Students.

Özet: İklim değişikliğinin sonuçları sürdürülebilirlik için en büyük tehditlerden birisidir. İklim değişikliği konusunda farkındalık hem iklim değişikliği ile mücadele ve hem de sürdürülebilir kalkınma hedeflerine (SKH) ulaşmak için hayati öneme sahiptir. Bu çalışma, özellikle yaş ve çevreyle ilişkili eğitimin (E-Re) iklim değişikliği farkındalığı ve SKH üzerindeki düzenleyici etkilerini incelemiştir. İlk olarak, ölçekler 1067 katılımcıya uygulanmıştır. İkinci olarak, gönüllü olan yükseköğretim öğrencilerinin %31,4'ü (n = 335), çevrim içi portallar aracılığıyla E-Re dersleri almıştır. İklim değişikliğinin SKH üzerindeki etkisi ile etkileşim etkilerini tanımlayan düzenleyici faktörler ve değişkenler incelenmiş, hipotezler test edilmiştir. Araştırmanın en kritik bulgusu, çevre eğitimi almamış genç öğrenciler arasında iklim değişikliği farkındalığı artsa bile SKH'ye yönelik davranışların değişmediğini göstermektedir. Bu, E-Re almamış genç nesillerin SKH uygulamalarının göz ardı edilebileceğine işaret etmektedir. Bu çalışmanın sonuçları özellikle, iklim değişikliği farkındalığına ve yaş, eğitim düzeyi, uzun süreli yerleşim gibi sosyo-demografik özelliklere göre SKH uygulamalarında yeniden gözden geçirilmesi ve özelleştirilen eğitimler yapılması gerekliliğini de ortaya koymaktadır.

Anahtar Kelimeler: İklim Değişikliği, Sürdürülebilir Kalkınma Hedefleri, Farkındalık, Çevreyle İlişkili Eğitim, Yükseköğretim Öğrencileri.

1. Introduction

Climate change is one of the most critical challenges of our time, impacting local communities and nations alike. It poses serious risks to natural ecosystems and human societies, making it the most pressing environmental issue we face today. The economic, social, and ecological

consequences are devastating, particularly for those in underdeveloped and developing regions, where vulnerable populations endure the worst effects (Athy et al., 2022). Unsustainable human activities contributing to climate change demand immediate action and accountability from individuals and organizations alike. This

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necessity has sparked significant policy developments focusing on mitigating climate change and fostering sustainable growth (Abela, 2022; Rickard et al., 2014). The stakes are incredibly high; the future of our planet hinges on our willingness to act. This is not just a responsibility—we must view it as an urgent call to action for the health of our world and future generations.

Growing concern about sustainable development megatrends, especially climate change, cannot be ignored. The accounting profession is responsible for recognizing and mitigating the risks associated with sustainable development while identifying opportunities to address them (Adams & Mueller, 2022). Awareness is crucial for both individuals and organizations in addressing climate change. Our actions today significantly influence the future risks we face from climate change (Weber, 2010). Research shows that individual awareness positively impacts combating climate change and fostering sustainable development (Calculli et al., 2021; Luís et al., 2018; Marshall et al., 2013). Sustainable development seeks to fulfill present needs without jeopardizing future generations' ability to meet their own. This imperative for global awareness has spurred the international cooperation necessary to mitigate the harmful consequences of climate change effectively (Munasinghe, 2003). The need for this collaboration cannot be overstated, as climate change knows no borders; it is a global issue that calls for a united response. This is not merely a local challenge but a call to action for all of us to join in seeking comprehensive, global solutions.

Various methods can significantly enhance individual awareness. Numerous studies highlight that education is one of the most potent predictors of awareness across different countries (Abbasi & Nawaz, 2020; Gönen et al., 2022; J. J. Lee et al., 2013; Venghaus et al., 2022; Yu et al., 2013). Education is not merely about acquiring facts; it is a vital tool that empowers individuals to make informed choices and take impactful actions. Individual differences influence the effectiveness of education in addressing climate change, an aspect often overlooked in current research (Kuthe et al., 2019; Rahman et al., 2014). Notably, there is a pressing need for studies focusing on higher education students and how environmental-related education (E-Re) can enhance awareness of climate change on sustainable development. This study explores the moderating effects of age and E-Re on the connection between climate change awareness and SDGs among higher education students education. By addressing this gap, we can better understand how to equip future leaders with the knowledge needed to create sustainable change.

2. Conceptual Framework for Hypothesis Development

Climate change and awareness of climate change are critical elements of sustainable development. To address the literature gap and construct a model, this study aimed to determine the level of SDGs and climate change awareness. The various repercussions of climate change are the greatest threat to sustainability, while awareness plays a crucial role in reaching SDGs. It's crucial to further research on the role of socio-demographic characteristics and education in achieving SDGs. The study investigated age and E-Re's moderate influence on climate change awareness and SDGs. The model is presented in ►Figure 1.

2.1. Sustainable Development Goals (SDGs) and Awareness of Climate Change

According to research, human activity is most responsible for almost all of the increase in greenhouse gases in the atmosphere over the last hundred and fifty years (Spratt & Dunlop, 2019). In the past, climate change led to the extinction of many species, population migrations, and pronounced differences in the land surface and ocean circulation. The atmosphere and oceans are warming, and habitats are undergoing rapid shifts in response to changing temperatures and precipitation patterns (Drolet & Sampson, 2017; Ganase & Sookram, 2021). Unprecedented flooding, heat waves, and wildfires have cost billions in damages. More frequent and intense extreme weather and climate changes will continue to harm infrastructure, ecosystems, and social systems (Reidmiller et al., 2018). As expected, the environmental consequences of climate change have triggered societal effects that challenge human health, quality of life, security, and sustainable development (Lal et al., 2011).

Sustainable development, defined as meeting current needs without compromising future generations' ability to meet theirs (WCED, 1987), emerged from extensive and complex deliberations. These discussions culminated in September 2015 when The United Nations General Assembly, after three years of multi-stakeholder talks (Nonet et al., 2022; Saxena et al., 2021), approved 17 SDGs (United Nations, 2023). The SDGs superseded the Millennium Development Goals (MDGs) by integrating development and environmental objectives. These combined objectives, also highlighted in the Brundtland Commission's 1987 report "Our Common Future," helped the concept of sustainable development gain universal significance (Bexell & Jönsson, 2017). Most studies have shown the emerging evidence of the severe impacts and damages of climate change and

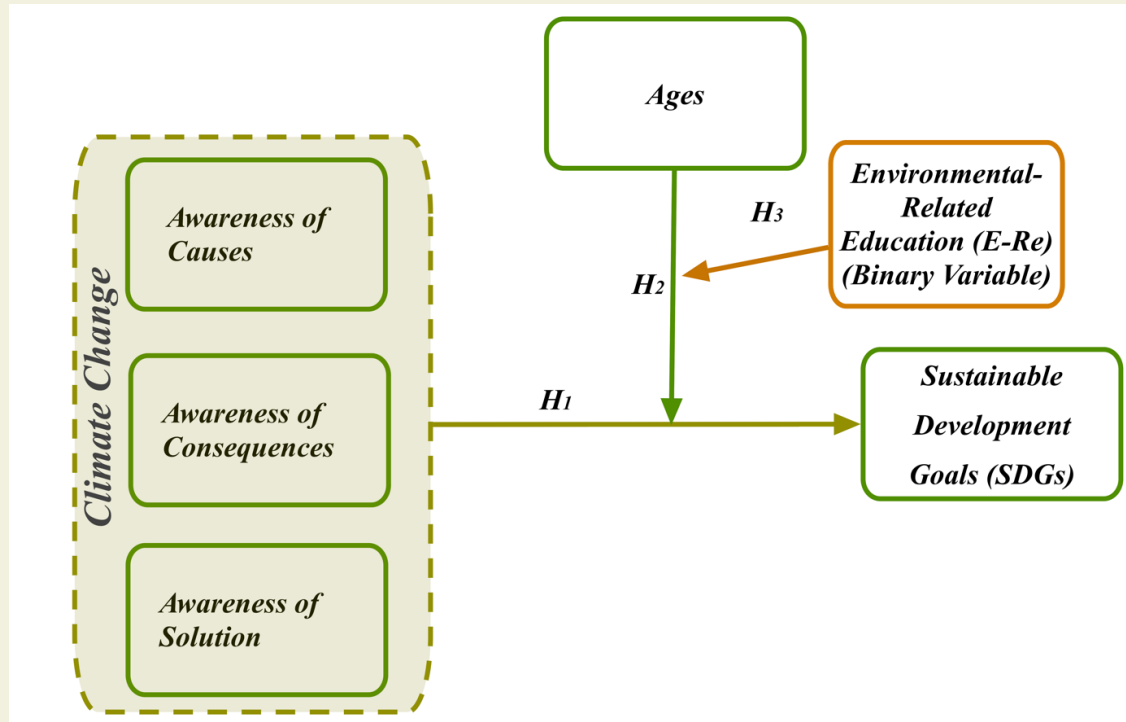


Figure.1 Hypothesized model

tried convincing practical solutions for raising public awareness, understanding reasons, and warning policymakers about climate change (Moser, 2010; Moser & Dilling, 2008; Pedelty, 2015). Local policies and changes in behavior related to climate change have become more global. However, the issues and scientific evidence vary from county to county, and as a result, the general idea of climate change awareness changes widely (T. M. Lee et al., 2015; Zaval & Cornwell, 2017). In light of this, there are various studies in the literature about the relationships between awareness, climate change, and sustainable development from many different countries (Barreda, 2018; Sola & Michael, 2016; Venghaus et al., 2022). However, many researchers demonstrated that collective approaches mainly result in public opinion (Athy et al., 2022). This study shows that the climate and sustainable development domains continuously interact in a dynamic cycle marked by a considerable temporal (Munasinghe, 2003). Especially after setting the SDGs, which have 17 objectives and 169 inclusive and indivisible targets across the economic, social, and environmental realms, sustainable development and climate change have been made more concrete linkages at the policy-making level (Jakob & Steckel, 2016; Pérez-Peña et al., 2021). The SDGs have addressed various social and economic progress challenges, including poverty, education, climate change, the environment, and the environment (Griggs et al., 2013). If examined more specifically, the goals are linked and require a distinct focus

to accomplish each: material and physical well-being, prosperity, welfare, poverty eradication, employment, food, energy, water availability, and health. Elements of each of the achievable goals have been impacted by climate change (Lotze-Campen et al., 2014). Thus, it can be said that a holistic approach has been realized that can pave the way for achieving not only SDG 13-climate change but all goals for sustainable development (Fuso Nerini et al., 2019; Morton et al., 2019). This study postulates that climate change awareness is a social precaution that leads to achieving the SDGs. Accordingly, the following null hypothesis was formulated inductively:

H₁: Climate change awareness influences SDGs.

2.2. Role of Education and Age in Climate Change Awareness

The urgency and complexity of mitigating and adapting to climate change have escalated, involving various factors such as stakeholders and non-governmental organizations (NGOs) (Glover & Granberg, 2020). NGOs, which have taken action quickly to achieve the goals locally and globally for environmental issues, play a crucial role in raising awareness of the causes and consequences of climate change. This is frequently regarded as critical to public support for mitigation and adaptation programs (Luís et al., 2018; Pandve et al., 2011; Tiller & Schott, 2013).

Education has emerged as a practical and cost-effective solution for addressing climate change, taking action on environmental issues, and fostering sustainable development through increasing awareness (Reid, 2019; Wamsler, 2020). Some studies indicated that environmental-related and climate change education has strengthened climate change awareness. However, some conditions must be appropriately met, such as methods, contents, frame, and socio-demographic characteristics (Kuthe et al., 2019; Moser, 2010; Zaval & Cornwell, 2017). Hence, in the last decade, educational institutions have tried to adopt environmental education curricula as national policies. These policies cover many areas from preschool to universities that play a vital role in identifying the impacts of climate change and formulating adaptation policies (Feinstein & Mach, 2020; Ramadani et al., 2023). Alongside educational institutions' efforts, NGO initiatives and education programs play an undeniable role in reaching broad local communities. These combined efforts contribute to establishing more sustainable societies and mitigating environmental and climate-related challenges. These initiatives, often with

a global reach, demonstrate the interconnectedness of our efforts in addressing climate change (Læssøe & Mochizuki, 2015; McGregor et al., 2018).

As a socio-demographic characteristic, age is deemed to be one of the indicators of how it affects climate change awareness and action. Depending on the research, because NGOs can reach a broad community of different ages, campaigns, and global figures have been shown to help raise youth climate awareness (Clayton et al., 2023; Diffey et al., 2022; Pearse, 2017). Additionally, various studies across different countries show the consistent success of environmental education and training programs provided by NGOs to diverse age groups. These programs effectively merge local and global discussions, thereby increasing awareness of climate change and sustainable development (Chacowry, 2023; Lu et al., 2021; Mbah et al., 2022; Rousell & Cutter-Mackenzie-Knowles, 2020; Trott, 2020). This process of reasoning and the consistent findings of previous research have shown that E-Re or climate change education, considering social demographic background such as age, has as

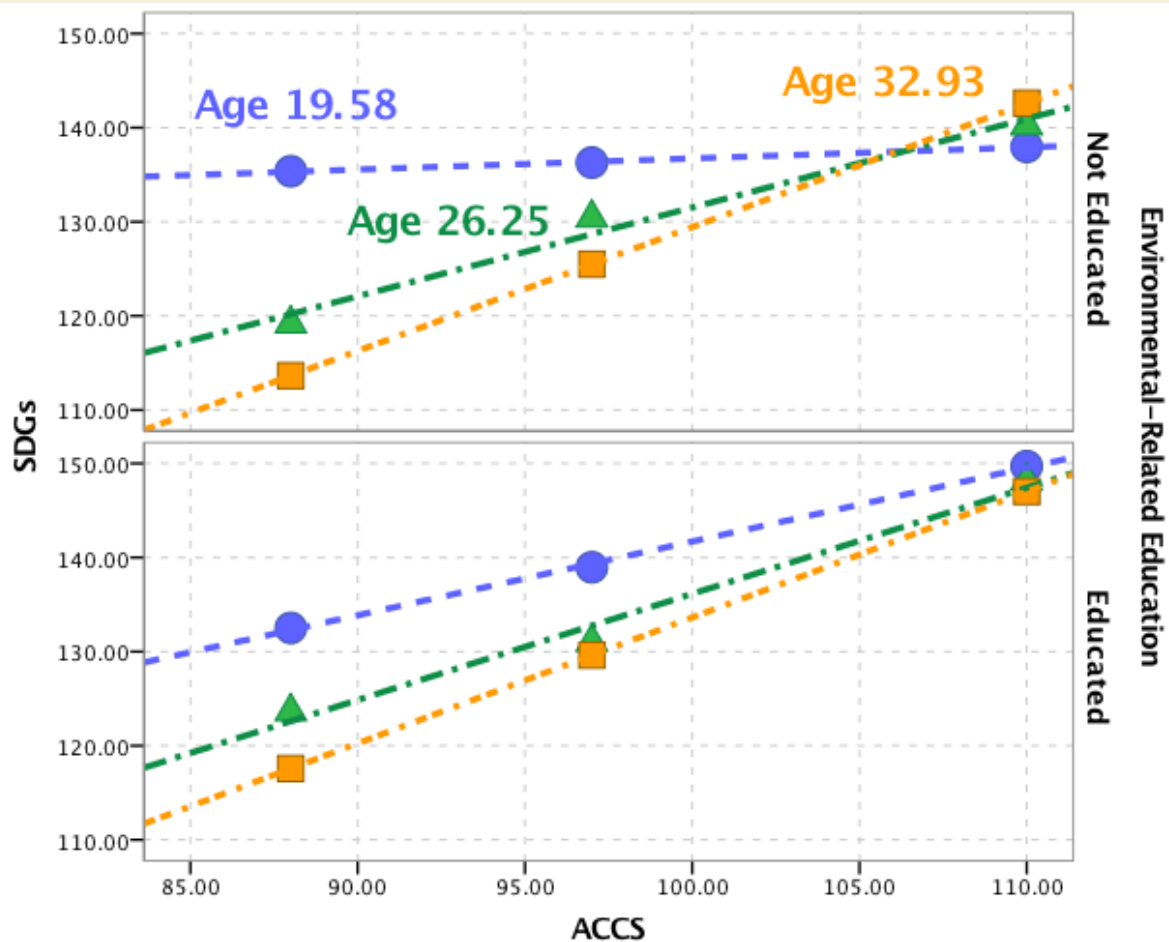


Figure 2. The simple slope plot shows the moderating effects of climate change awareness, E-R education, and age on SDGs.

much impact as awareness of climate change from the SDGs. This leads to the following null hypotheses:

H₂: Ages moderates the influence between climate change awareness and SDGs.

H₃: Environmental-related education (E-Re) and age moderate the influence between climate change awareness and SDGs.

3. Material and Methods

3.1. Data Collection and Sample

The study was conducted meticulously, following the 1975 Declaration of Helsinki. After a thorough review, the ethics committee approved it (Blind***), ensuring

the highest standards of research ethics. Upon enrollment, the participants gave written and verbal informed consent. The student population of higher education between 2022-2023 is 6,864,487 in Türkiye (The Council of Higher Education, 2023). One of the socioeconomic analyses of the regions is the NUTS classifications by Eurostat (Eurostat, 2021). Therefore, NUTS classification and the higher education level of participants were used to determine a sample that reflects Turkey and minimize sampling error. The information provided led to multistage sampling, which showed that samples should be drawn progressively, with increasingly smaller sampling units at each stage. The careful selection of participants ensures the study's representativeness and the minimization of sampling error. Using multistage sampling, the sample size was calculated as 1067, with a 3% margin of error. The participants' higher education level (Associate to Ph.D.) and 12 regions of Türkiye

Table 1. Population and Sample Size

#	NUTS-1 (12 Region)	Population			Sample		
		Associate	Undergraduate	Graduate	Associate	Undergraduate	Graduate
TR1	Istanbul	369389	923413	144882	57	144	22
TR2	West Marmara	34313	50771	8004	5	8	1
		29574	56730	9584	5	9	1
TR3	Aegean	36292	131041	24012	6	20	4
		44485	80707	10594	7	13	1
		53998	92933	15829	8	14	2
TR4	East Marmara	1099531	910201	25647	171	141	4
		68386	137443	29929	11	21	5
TR5	West Anatolia	40705	247333	67010	6	38	11
		36162	88865	23853	6	14	4
TR6	Mediterranean	68649	103313	16275	11	16	3
		34038	62228	12593	5	10	2
		29244	38705	9438	5	6	1
TR7	Central Anatolia	34078	62092	11990	5	10	2
		37830	87766	16184	6	14	3
TR8	West Black Sea	30566	56255	9177	5	9	1
		19167	32566	8567	3	5	1
		42464	39335	8798	7	6	1
TR9	East Black Sea	48348	77862	15146	8	12	2
TRA	North East Anatolia	343108	179866	17383	53	28	3
		18869	29361	5266	3	5	1
TRB	Central East Anatolia	28639	63150	13068	4	10	2
		20683	28170	7375	3	4	1
TRC	South East Anatolia	26393	49096	10924	4	8	2
		19346	37290	6139	3	6	1
		21569	26314	8188	3	4	1
	TOTAL	2635826	3692806	535855	410	574	83

Table 2. Mean, standard deviation (s), point-biserial correlations and Pearson correlations among variables (n=1067)

	\bar{X}	S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Gender	1.51	.500	1														
Age	26.24	6.672	.066	1													
NUTS-1 subregions	4.57	2.496	-.084	-.011	1												
Education Status	4.07	1.120	-.068	-.141**	.522**	1											
Working status	1.47	.500	.195**	.092*	-.561**	-.526**	1										
Long-term settlements	2.75	.505	.161**	.057	.130**	.232**	-.143**	1									
E-Re	.61	.464	-.119**	-.109*	-.076	-.091*	.079	-.175**	1								
Cause	22.98	2.147	.010	-.009	.239**	.207**	-.191**	-.070	.060	1							
Consequences	29.27	4.161	.109*	.181**	.060	.186**	-.066	-.111*	.095*	.519**	1						
Solutions	45.67	4.440	.250**	.004	.237**	.251**	-.217**	-.357**	.171**	.525**	.519**	1					
ACCS	97.94	8.951	.177**	.084	.203**	.261**	-.184**	-.246**	.144**	.742**	.847**	.863**	1				
Knowledge	33.24	6.761	.224**	.183**	.193**	.304**	-.075	-.118**	.079	.280**	.368**	.388**	.507**	1			
Attitude	49.41	9.046	.134**	.171**	.246**	.446**	-.183**	-.099*	-.016	.298**	.307**	.374**	.476**	.852**	1		
Practice	49.25	9.740	.182**	.149**	.337**	.590**	-.274**	-.261**	.107*	.298**	.338**	.440**	.523**	.697**	.799**	1	
SDGs	131.88	12.848	.197**	.182**	.278**	.479**	-.189**	-.173**	.064	.307**	.367**	.434**	.536**	.924**	.953**	.897**	1

* $p < .05$, ** $p < .01$.

ye (NUTS-1) variables were considered as the stages (►Table 1).

After ethical approval, the data were collected from the 17th of November 2023 to the 17th of January 2024. The International Scientific Association (ISCASS) is a non-governmental organization. With the help of ISCASS, 1067 higher education students were reached. Initially, 1067 participants were given verbal and written explanations of the study and education's objectives and requested consent before proceeding. Then, the scales were applied to 1067 participants. Second, 335 higher education students who volunteered received E-R education through online portals from ISCASS. The scales were applied again to 335 higher-education students at the end of the online E-R education.

One thousand sixty-seven (1067) participants ranged from 18 to 48 years old. The mean age of participants was 26.24 years ($s = 6.672$). There were 50.8% ($n = 542$) females and 49.2% ($n = 525$) males. 52.7% ($n = 562$) were not working, and 47.3% ($n = 505$) were employed. Participants describe their places of long-term settlement as 4.2% ($n = 45$) in the village, 12.8% ($n = 137$) in the district, 36.5% ($n = 389$) in a city with a population of 100,000 or less, and 46.5% ($n = 496$) in a city with a population of 100,000 or more. 31.4% ($n = 335$) of participants received E-R education, and 68.6% received no E-R education through online portals.

3.2. Measurement Tools

The research questionnaire was meticulously crafted to gather valuable insights through three distinct sections. The first part focuses on socio-demographic characteristics, providing foundational data essential for understanding the participants. The second part uses the Awareness of Climate Change Scale (ACCS) to help gauge the respondents' awareness and knowledge of climate change. Lastly, the third section employs the SDGs Scale to assess their comprehension of global sustainability efforts. The personal information form encompasses a range of multiple-choice and open-ended questions. These include gender (male/female), age (open-ended), NUTS-1 subregions (open-ended), educational attainment (associate, undergraduate, master's, or PhD), employment status (yes/no), type of long-term residence (village, district, city with a population of 100,000 or fewer, or city with over 100,000), and E-Re (yes/no). Through this comprehensive approach, the questionnaire aims to yield significant findings that can inform future initiatives.

The awareness of climate change scale (accs-22 item)

The Climate Change Awareness Scale (ACCS) serves as an essential tool for gauging public understanding of

climate change (Açıklan et al., 2025). It encompasses three critical sub-dimensions: the causes, consequences, and potential solutions of climate change. Participants evaluate the items on the ACCS using a 5-point Likert scale, where "1" denotes "strongly disagree," "2" signifies "do not agree," "3" stands for "partially agree," "4" represents "agree," and "5" indicates "strongly agree." Scores on the ACCS range from 22 to 110, with higher scores reflecting a greater awareness of climate change issues, while lower scores suggest a diminished awareness. The reliability of the ACCS is noteworthy, with a Cronbach's alpha of .91 reported in prior analyses. In this study, the ACCS achieved an even higher Cronbach's alpha of 0.928, further validating its effectiveness—with subdimensions alphas ranging from 0.89 to 0.93. This underscores the ACCS as a reliable and valuable instrument for assessing climate change awareness among participants.

The sustainable development goals scale (sdgs-38 item)

The SDGs scale was initially developed as a combination of three subscales (Nusrat Afroz & Zul Ilham, 2020). The results indicate the scale includes three subscales (Knowledge toward SDGs - 10 items; Attitudes toward SDGs - 14 items; Practice towards SDGs - 14 items) in total thirty-eight items. The study shows that the scale has an adequate internal consistency coefficient ($\alpha = .91$) for the entire scale, with $\alpha = .84$ for knowledge toward SDGs, $\alpha = .93$ for attitudes toward SDGs, and $\alpha = .74$ for practice toward SDGs. This research rated items on a 5-point Likert-type scale (from 1= strongly disagree to 5 = strongly agree). Higher values indicate that the levels of SDGs are evaluated highly for knowledge, attitudes, and practice. In this study, the Cronbach α for the overall SDGs scale was 0.856 (the range of Cronbach alphas for the subscales: 0.89-0.78).

3.3. Statistical Analysis

The validity and reliability of the scale were evaluated using LISREL 8.80, JAMOVİ 2.2.5, and AMOS 24. Moderation analysis was carried out using R 3.5.3 and SPSS 24.0 following the hypothesis model (►Figure 1). Multiple regression analysis was used to examine the paths. The assumptions for each multiple regression hypothesis were verified. The correlation of each variable to the others was assessed using the point-biserial and Pearson's coefficients of correlation. The significance level in the research was .05.

4. Results

►Table 3 presents correlations among gender, age,

NUTS-1 subregions, education level, working status, long-term settlements, E-Re, and awareness of causes, consequences, solutions, ACCS, sustainable development knowledge, attitudes, practices, and SDGs. Significantly high and positive correlations were found ($p < .01$) between cause-consequences, solution-consequences, solution-cause, knowledge-attitude, practice-attitude, practice-knowledge, ACCS,

and SDGs ($.52 < \rho < .85$) in ► **Table 3**.

The influence of climate change awareness (X) on SDGs (Y) was tested using a linear regression model. The model was statistically significant in the first instance, which concerned the relationship between climate change awareness and SDGs ($F = 49.251$, $df = 6$; 1060 , $p < .01$). As awareness of climate change

Table 3. Results of Moderation Analysis

Dependent Variable								
Y : SDGs								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Step 1:								
Control Variables								
Gender (Female)	11.198** (1.837)	11.764** (2.395)	11.764** (2.395)	11.274** (2.385)	9.510** (2.463)	8.813** (2.468)	10.582** (2.408)	9.592** (2.405)
NUTS-1 subregions	-2.183 (1.189)	-1.613 (3.203)	-5.524 (2.976)	-5.038 (2.402)	-4.019 (2.970)	-3.878 (2.961)	-5.498 (2.946)	-5.724 (2.919)
Education level	13.203** (1.382)	13.036** (1.392)	11.871** (1.312)	11.201** (1.311)	12.637** (1.306)	11.883** (1.329)	12.008** (1.303)	11.074** (1.313)
Working status (Working)	-2.423 (2.512)	-1.979 (2.556)	-2.790 (2.397)	-1.763 (2.402)	-3.055 (2.479)	-4.117 (2.501)	-.278 (2.402)	-1.574 (2.409)
Longest-time settlements	-6.153** (1.623)	-6.975** (1.550)	-8.638** (2.969)	-8.659** (2.937)	-7.832** (2.999)	-8.050* (2.978)	-6.933* (2.999)	-6.795* (2.928)
Step 2:								
Moderator								
W: Age	-.216 (.673)	-2.010** (.771)	-2.310 (.456)	-3.370** (.541)	-1.046 (.707)	-2.692** (.890)	-2.695** (.729)	-4.342** (.871)
Z: E-Re (Educated)		172.098** (55.816)		206.143** (51.284)		243.269** (76.283)		283.874** (78.491)
Step 3:								
Moderator Effect								
$X_i \times W$.014 (.029)	.094** (.033)	.073 (.015)	.106** (.018)	.017 (.015)	.051** (.019)	.025** (.007)	.041** (.009)
$X_i \times Z$		7.665** (2.416)		6.585** (1.722)		5.160** (1.653)		2.796** (.798)
$W \times Z$		6.414** (1.399)		3.194* (.959)		3.961* (1.553)		4.093* (1.619)
$X_i \times W \times Z$		-.290** (.060)		-.099** (.032)		-.083* (.034)		-.040* (.016)
Step 4:								
Independent Variable								
X_1 : Cause	7.947** (2.102)	6.736** (2.011)						
X_2 : Consequences			1.654* (.815)	3.745** (.963)				
X_3 : Solutions					1.783** (.569)	2.137* (.967)		
X_T : ACCS							1.285** (.313)	1.142* (.453)
Constant	84.813** (28.861)	124.169** (33.231)	126.649** (25.477)	201.149** (30.973)	15.198 (27.252)	139.082** (48.867)	61.692** (27.692)	219.168** (46.798)
R^2	.464	.564	.624	.642	.621	.633	.628	.647
F Statistic	18.257** (df=8; 1058)	20.032** (df=12; 1054)	40.515** (df=8; 1058)	29.453** (df=12; 1054)	39.766** (df=8; 1058)	28.073** (df=12; 1054)	41.314** (df=8; 1058)	30.107** (df=12; 1054)

Note. E-Re = Environmental-Related Education, SDGs = Sustainable Development Goals, ACCS = Awareness of Climate Change Scale.

$p < .05$. $p < .01$.

increases, SDGs increase ($\beta = 1.29, p < .01$); thereby, supporting H1. When the control variables were evaluated, gender, education level, and place of long-term settlement were also statistically significant.

Secondly, the influence of climate change awareness (X), age (W), and the interaction effect between climate change awareness and age ($X \times W$) on SDGs (Y) [$X + W + X \times W \rightarrow Y$] was tested using a simple moderation model. In ►Table 3, Model 7 was statistically significant in the second case ($F = 41.31, df = 8; 1058, p < .01$). In Model 7, SDGs scores rise as climate change awareness (X) rises ($\beta = 1.29, p < .01$). Also, as the interaction effect between climate change awareness (X) and age (W) increases, and SDGs (Y) decreases ($\beta = .03, p < .01$). This supports H2.

Thirdly, the influences of climate change awareness (X), age (W), E-Re (Z), and the interaction effect between climate change awareness and age ($X \times W$), climate change awareness and E-Re ($X \times Z$), age and E-Re ($W \times Z$), climate change awareness, age and E-Re ($X \times W \times Z$) on SDGs (Y) [$X + W + X \times W + X \times Z + W \times Z + X \times W \times Z \rightarrow Y$] were tested using a moderation model with a continuous variable and a categorical variable. Model 8 was statistically significant in the third case ($F = 30.11, df = 12; 1054, p < .01$). In Model 8, as climate change awareness (X) increases, the scores for SDGs increase ($\beta = 1.14, p < .05$). Also, as the first interaction effect between climate change awareness (X) and age (W) increases, SDGs (Y) decreases ($\beta = .04, p < .01$). As the second interaction effect between climate change awareness (X) and E-Re (Z) increases, SDGs (Y) increases ($\beta = 2.80, p < .01$). As the third interaction effect between age (W) and E-Re (Z) increases, SDGs (Y) increases ($\beta = 4.09, p < .05$). As the fourth interaction effect between climate change awareness (X), age (W) and E-Re (Z) increases, SDGs (Y) increases ($\beta = -.04, p < .05$). This supports H3. The hypotheses and model results were given the sub-dimensions of ACCS as an independent variable in Appendix 2.

The simple slope plot shows that, if not educated on environmental-related, when ACCS scores increase, SDGs scores are stable at age 19.58 (simple slope = .11, $t = .51, p > .05$). However, when ACCS scores increase, SDGs scores rise sharply at age 32.93 (simple slope = 1.65, $t = 7.11, p < .01$) and also when ACCS scores increase, SDGs scores rise as well at age 26.25 (simple slope = .88, $t = 5.61, p < .01$). With education on environmental-related, when ACCS scores increase, SDGs scores rise sharply at all ages (respec-

tively; simple slope_{19.58} = 1.70, $t = 5.527, p < .01$; simple slope_{26.25} = 1.73, $t = 6.652, p < .01$; simple slope_{32.93} = 1.76, $t = 4.172, p < .01$) (►Figure 2).

5. Discussion

The study first aimed to develop a scale for climate change and then determine the relationship between climate change and SDGs. Following this purpose, the study is organized into two main stages. In the first stage, psychometric measurements for the scale were tested. The developed scale with appropriate values was applied to a different study group afterward, and the models were tested. The climate change awareness scale includes three dimensions: causes, highlighting the problem's root; consequences, emphasizing potential impacts; and solutions, offering mitigation strategies. These dimensions, with five, seven, and ten items, respectively, form a comprehensive understanding of climate change awareness. The study was then developed using three basic models. These models assess climate change's impact on SDGs, age's effect on climate awareness and SDGs, and E-Re and age's influence on climate awareness and SDGs. These three basic models were further expanded into 12 models, each with a unique focus and set of variables, to provide a comprehensive analysis of the relationship between climate change awareness and SDGs.

The results of the present study revealed that all the participants had a very high level of ACCS (97.94 ± 8.95) and a high level of SDGs (131.88 ± 12.85). The model's control variables, gender, education level, and long-term settlement, were statistically significant. Female participants tended to achieve SDGs more than male participants; the results were similar to the literature. Even the diversity of socio-demographic characteristics and cultural contexts of women's reproductive and productive labor are associated with environmental crises and climate changes (Clayton et al., 2023; Pearse, 2017). In addition, when the participant's education level increased, the SDGs score also increased. Since 2014, UNESCO has declared that one of the essential strategies to achieve this goal (SDGs) is education (UNESCO, 2014).

Therefore, research has largely focused on education, highlighting its positive impact on climate change awareness and the SDGs. E-Re was identified as a significant factor in increasing both climate change awareness and SDG scores. E-Re refers to education specifically centered on environmental issues and their connection to sustainable development; its in-

clusion is crucial for understanding education's role in promoting climate change awareness and achieving the SDGs.

Furthermore, the study revealed a pressing need for environmental education for all ages, especially for younger generations. Participants whose long-term settlements were in small/rural places were found to be more sensitive to achieving SDGs than those in capital places. Many reports and research have shown that rural areas have been deprived of vital issues (poverty, resources, etc.) (del Arco et al., 2021; Voola & Kalyanasundaram, 2021). However, most people from rural backgrounds have had environmental respect since their childhood, and losing nature to climate change is not an option or acceptable (Mónus, 2022). This underscores the urgent need for environmental education for all ages, especially for younger generations, making the audience feel the importance and significance of this issue.

Furthermore, previous researches show a positive relationship between higher levels of ageism and awareness about climate change and greater willingness to act (Ayalon et al., 2023; Ayalon & Roy, 2023). Along with this literature, the study also concluded that SDGs increase as students' ages increase when they receive E-Re. Also, according to our results, as the educated students' ages and awareness of climate change increase, their SDG scores increase. Thus, research results reveal that age and E-Re are significant for SDGs. There is one contradictory but noted result compared to the literature. According to the results, age cannot be the only indicator without E-Re because the research shows that awareness of climate change decreases among students who do not receive environmental-related education. The SDG scores increase sharply at age 32.93.

6. Conclusion

As mentioned in the discussion part, the study concluded that as awareness of climate change increases, SDG scores increase, similar to existing findings from different countries (Audu et al., 2014; Taylor & Fransman, 2004). Most countries point out the awareness of climate actions at schools and universities and make a connection to SDG (Kuthe et al., 2019; Lull et al., 2021; Tunji-Olayeni et al., 2021). ASEAN nations focus on the path between SDGs to not only climate change awareness but also environmental awareness (Amin et al., 2022; Nusrat Afroz & Zul Ilham, 2020; Yolida et al., 2023). In general, the results of the research support the idea that climate change awareness affects SDGs. Likewise, the links between climate change and sustainable development are robust,

with Article 7 of the Paris Agreement calling (Dagnachew et al., 2021; Fuso Nerini et al., 2019; Gomez-Echeverri, 2018). This emphasis on the robust links between climate change and sustainable development reassures the audience about the validity of the study's findings, instilling a sense of confidence and security.

Another important finding is that the higher the awareness of climate change and the level of knowledge about climate change, the higher SDGs scores, as highlighted in many studies (Cohen et al., 1998; Lasco et al., 2007; Munasinghe & Swart, 2005; Njoku, 2016; Robinson et al., 2006). In simple words, more knowledgeable participants have higher SDG scores. In this respect, the study findings once more emphasize the importance of education on climate change. This is compatible with related research, which clearly shows that all kinds of educational activities about climate change help individuals develop awareness, attitudes, skills, and understanding, ultimately improving their quality of life (González-Hernández et al., 2022; Lehtonen et al., 2018).

One of the critical research results shows that even if the awareness of climate change among young students who have not received E-Re increases, SDGs do not change, which can be unique compared to the existing literature. Likewise, more than the awareness of climate change and the environment at age 26.25 or even younger is needed for SDGs practice. The SDGs may increase as awareness of climate change increases for the old age without E-Re; on the contrary, unfortunately, the SDGs practices seem to be disregarded for the younger and younger generations without E-Re.

More interestingly, results showed that the E-Re participants had similar behavior and awareness regardless of age. In this respect, E-Re may offer a significantly more permanent route and roadmap to SDG practice. The aged students put more effort into reducing climate change impacts, as they are more sensitive to climate change (Haq et al., 2010). On the contrary, young Europeans reported either comparable or, in some cases, higher levels of climate change awareness compared to the elderly age group (Corner et al., 2015; Pillemer, 2021).

Furthermore, this study has some limitations concerning the sample as it was conducted among specific education levels in Türkiye. Different education levels could be considered for future studies. Also, ER-education content could be changed (e.g., long-term) and become face-to-face with some experiments. With this consideration, interesting results may appear. Another exciting line for future research could be older ages or rural areas. Data could be collected repeatedly (e.g., seasonal), not cross-sectional.

Consequently, our research once more proves that environmental education is essential for all ages. However, education for younger generations is much more critical depending on their awareness and implementation of SDGs. Depending on these results, it can be said that the younger generation tends to take action for climate change and show effort to contribute to sustainable development if they can be supported by environmental-related education, also mentioned by previous research. As expected, it is not easy to generalize due to the relational model of the research. However, young people with a high awareness of climate change and sustainable development may play a more effective role in composing peer networks vis-a-vis NGOs. Last but not least, it can be suggested that stakeholders in E-Re can develop more tailored-based and digital content for different age groups that reflects local and global SDG targets. Lastly, this study contributes to the social implication of awareness of climate change and SDG targets in terms of inclusivity and the role of NGOs.

Research Ethics

The study was conducted with the approval of the ethics committee of Ankara Hacı Bayram Veli University (26.02.2025 date, meeting number 2).

Artificial Intelligence Use

The author(s) declare that no generative artificial intel-

ligence (e.g., ChatGPT, Gemini, Copilot, etc.) was used in any part of this study.

Author Contributions

The author has accepted responsibility for the entire content of this manuscript and approved its submission.

The author solely conducted all stages of this research.

Competing Interests

The authors have no conflicts of interest to declare.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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