# Undergraduates' climate change awareness through physical activity: Self-efficacy as a moderatoris

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**Abstract.** The challenge of climate change is an issue that must be addressed both now and in the future. Physical activities that are environmentally friendly, such as walking and cycling, are not only beneficial for health but also have the potential to raise awareness about climate change. This study aims to analyze the effect of physical activity on climate change awareness among undergraduate students, with self-efficacy as a moderating factor. This research employed a quantitative approach with 116 students as respondents, selected through purposive sampling. The instruments used measured levels of physical activity, climate change awareness, and self-efficacy, and were analyzed using Moderation Regression Analysis (MRA). The research findings indicate that physical activity is positively correlated with climate change awareness ($p = 0.037$; $R^2 = 3.8\%$). Self-efficacy also has a significant positive effect on climate change awareness ($p = 0.012$). However, as a moderating variable, the interaction between physical activity and self-efficacy yields a negative coefficient with a value approaching significance ($p = 0.055$). This suggests that high self-efficacy does not always strengthen the influence of physical activity, it can even weaken it. This study contribute for researchers to understanding the factors that shape climate awareness among students.

## 1 Introduction

Awareness of climate change is becoming a crucial issue in the global environment at this time. This issue arises because, as the Earth's average temperature increases and extreme weather events that impact human life and the environment become more frequent, this issue emerges [1]. This issue has become a global problem because it has a significant impact on human life. Beside environmental impacts, climate change also exacerbates economic and social uncertainty, particularly in developing countries that rely on natural resource-based income [1]. If climate change is not addressed immediately and becomes a top priority, it will have a greater impact later.

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Individual awareness is an important aspect in driving behavioral change toward sustainability amidst the ongoing climate crisis [2]. The conditions of climate change cause a unique kind of anxiety for individuals, which on one hand can stimulate curiosity and motivation to maintain health amidst unpredictable weather [3]. In this regard, physical activity plays an important role because, in addition to being good for the body, it can also provide psychological calm, thus minimizing anxiety caused by climate change [4]. Therefore, building individual awareness becomes a crucial aspect in driving behavioral change toward sustainability in the face of this crisis.

In line with this, in recent years, interest among Indonesians in physical activities has shown an increasing trend, especially for activities carried out outdoors. One of the sports that has seen the most significant growth is running. Throughout 2024, there were 257 running events held across various regions in Indonesia, a figure that represents a surge of more than 60 percent compared to the previous year [5]. This increase is also evident in data from the Garmin Connect app, which recorded 142,975 running activities in December 2024 and soared to 242,627 activities in just five months, in May 2025 [5].

Observing the phenomenon of increasing trends in physical activity is an interesting aspect to study when linked to climate awareness. Physical activity refers to all bodily movements produced by skeletal muscles that require energy to perform [6]. In addition to benefiting physical health, physical activity is also related to quality of life, emotional regulation, and psychological well-being [7]. A more positive outlook on life is generally found in individuals who actively maintain their health through physical activity [4]. Outdoor physical activities also encourage reflection and more environmentally conscious behavior, such as being more aware of air quality and exposure to pollution, compared to activities done indoors [8]. This means that there is a unique relationship between the two variables, where people who regularly engage in physical activity also tend to be more aware of climate issues and the importance of protecting the environment. However, whether this is the case with a different sample remains to be seen.

In connecting these two aspects, a deep understanding is required of the psychological factors that may play a role in the resulting impact. An important internal factor is self-efficacy, namely an individual's belief in their own ability to take action in order to achieve specific goals [9]. According to Bandura's social cognitive theory, self-efficacy can influence how a person processes information, handles difficulties, and behaves in certain situations [9]. In this context, self-efficacy is understood as a specific construct. For example, someone with high self-efficacy is more confident in their ability to maintain outdoor physical activity, making them more likely to expose themselves to the environment and the potential of climate issues [10]. Thus, self-efficacy can moderate the relationship between physical activity and climate change awareness thru its influence on the consistency and quality of engagement in outdoor activities. However, the truth of this still requires further research when it comes to undergraduate students.

Based on the existing background, it is necessary to examine self-efficacy, physical activity, and climate awareness simultaneously to determine whether the trend of increasing physical activity aligns with awareness of climate change. This is relevant considering that the rising trend of public participation in physical activities. However, this potential does not automatically guaranty an increase in concern, so it is necessary to further investigate the relationship between physical activity, self-efficacy, and climate awareness. By studying these three variables together, it can be determined whether the growing interest in physical activity is also accompanied by an increase in climate awareness, as well as how self-efficacy plays a role in strengthening or possibly even hindering this relationship.

This research can serve as a foundation for researchers in understanding the factors that shape climate awareness among students. Through this approach, it is expected to contribute to the development of psychology and sustainable education, as well as to encourage the

emergence of a young generation that is physically healthy and highly aware of their ecological responsibilities. By empirically examining the relationship between physical activity and climate awareness, and by considering the role of self-efficacy as a moderator, this research aims to strengthen both the theoretical and practical foundations in promoting behaviors that actively contribute to environmental preservation among undergraduate students.

## 2 Method

This study uses a quantitative approach with a moderation test design to analyze the relationship between self-efficacy, physical activity, and climate change awareness. In this case, self-efficacy is tested as a moderating variable that either strengthens or weakens the relationship between physical activity as the independent variable and climate change awareness as the dependent variable. This approach was chosen to determine the influence of physical activity on climate change awareness, with self-efficacy as a mediator, and to understand how individuals make conscious decisions and take actions related to environmental issues.

### 2.1 Participants

Participants in this study were selected through purposive sampling, was chosen because this study had specific respondent criteria, namely students aged at least 18 who regularly engage in physical activity. With these criteria, purposive sampling was considered the most appropriate method to ensure that participants were suitable for the research context and able to provide data relevant to physical activity, self-efficacy, and climate change awareness. Resulting in 116 respondents whose questionnaires were collected online. The criteria for respondents in this study included being university students, at least 18 years old, and engaging in regular physical activity. When filling out the questionnaire, participants were provided with informed consent to indicate their willingness to complete the online questionnaire, and the researcher guaranteed that their data would be kept confidential and used solely for research purposes. Based on the questionnaire results, the demographic breakdown by gender was 76 females (65.5%) and 40 males (34.5%).

### 2.2 Research Instrument

The instrument used in this research is a structured questionnaire designed to measure three main variables: physical activity, self-efficacy, and awareness of climate change. The selection of instruments was carried out carefully to produce valid and reliable responses.

To measure physical activity, an adaptation of the International Physical Activity Questionnaire (IPAQ) was used, which has proven to be reliable in assessing the frequency and duration of physical activity. This instrument measures the amount of physical activity among students over the past week [6].

Self-efficacy was measured using the General Self-Efficacy (GSE) scale adapted from Novarianto et al. (2019) [11], by focusing on measuring individuals' general belief in their own ability to handle various situations and accomplish tasks, regardless of context or specific domain. Based on the validity test results for the measuring instrument, all items were at a significance level of $<0.001$ and the Cronbach's $\alpha$ reliability was (0.875). This means that the GSE instrument is valid and highly reliable. The total number of GSE items is 10 items.

Meanwhile, awareness of climate change is measured using the Climate Change Awareness scale, which consists of several statement items related to individuals' knowledge, attitudes, and concern regarding climate change issues, adapted from Adiwena and Bramanwidyantari (2024), with a total of 15 items [12]. The results showed that the validity of all items in the measurement tool was <0.001 and the reliability result (Cronbach's α) was 0.787. This means that the CCA measurement tool is valid and reliable.

All items in the questionnaire were arranged using a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree", to facilitate interpretation and enhance response consistency. The questionnaire was distributed online via an online survey platform.

### 2.3 Data Analysis Techniques

This study employs a non-experimental quantitative approach, so data analysis is conducted using statistical techniques appropriate for answering the research questions and testing the hypotheses. Simple regression analysis is used to examine the relationship between physical activity and climate change awareness. To determine the role of self-efficacy as a moderator, simple moderation regression analysis is used to see to what extent self-efficacy strengthens or weakens physical activity and climate change awareness. All analyses are conducted using the statistical software JASP 0.19.3.0, which enables accurate testing results.

With this method, the analysis will provide an overview not only of the direct influence between variables, but also of how these relationships can be strengthened or weakened by self-efficacy as a complex psychological factor.

## 3 Result

To test the hypotheses formulated in this study, a series of statistical data analyses were conducted. The analysis focused on the relationship between physical activity and awareness of climate change, taking into account the role of self-efficacy as a mediating variable. The results of testing these three variables are presented as follows.

### 3.1 Descriptive Stastitics

To assess the distribution of the data statistically, a descriptive statistical test was conducted. The following is Table 1 of the test results:

**Table 1.** Descriptive test

| | **Climate Change Awareness (CCA)** | **Self-efficacy (SE)** | **Physical Activity (PA)** |
|---|---|---|---|
| Mean | 55.509 | 36.629 | 6508.552 |
| MAD robust | 5.930 | 4.448 | 3765.804 |
| Minimum | 29.000 | 26.000 | 0.000 |
| Maximum | 68.000 | 45.000 | 102400.000 |

Table 1 shows the results of the descriptive test. The average CCA score is 55.509, with a minimum value of 29.000 and a maximum of 68.000. The data distribution around the median is quite stable, as reflected by a robust MAD of 5.930, indicating that the variation among respondents is not too large and tends to be homogeneous. The SE score has an

average of 36.629, with a range between 26.000 and 45.000. The robust MAD value of 4.448 shows that the distribution of self-efficacy among participants is also relatively balanced, without any striking extreme deviations. The physical activity variable shows significant skewness. The mean is recorded at 6,508.552, but the maximum value reaches 102,400, while the minimum value is 0. The robust MAD value of 3,765.804 confirms that the data distribution is very wide and uneven. This skewness indicates there are respondents with very high levels of physical activity compared to the majority of other respondents, which may indicate an unbalanced distribution, possibly due to outliers or the diversity of respondents' lifestyles, for example, the presence of athletes or individuals with extreme activities.

### 3.2 Test the Influence of Physical Activity on Climate Change Awareness

To examine the direct effect of physical activity on awareness of climate change, the results are described in Table 2 below.

**Table 2.** Physical Activity and Climate Chane Awareness

| Predictor Variable | B (Coefficient) | SE (Standard Error) | β (Beta) | t | p-value | $R^2$ (%) |
|---|---|---|---|---|---|---|
| Physical Activity | 0.0001106 | 0.0000525 | 0.194 | 2.108 | 0.037 | 3.8 |

The regression results show that physical activity has a significant effect on climate change awareness, as indicated by a p-value of 0.037 ($p < 0.05$). The regression coefficient of 0.0001106 suggests that each unit increase in physical activity score is accompanied by a 0.00011 point increase in climate awareness score. Although the coefficient is small, this is reasonable because the PA data units are very large (up to tens of thousands). The $R^2$ value is 0.038, or equivalent to 3.8%, meaning that physical activity explains only 3.8% of the variation in climate change awareness. The remainder is influenced by other factors outside this model.

### 3.3 Test the Influence of Physical Activity on Climate Change Awareness

To determine the results of moderation, a simple moderation test was conducted, with self-efficacy as the moderating variable. The results of the test are presented in Table 3 below.

**Table 3.** Moderation Test

| Variable | B (Coefficient) | SE (Standard Error) | β (Beta) | t | p-value | $R^2$ (%) |
|---|---|---|---|---|---|---|
| Physical Activity | 0.0009757 | 0.0004538 | 1.708 | 2.150 | 0.034 | |
| Self-efficacy | 0.420 | 0.164 | 0.285 | 2.557 | 0.012 | |
| PA × SE (Moderation) | -0.00002336 | 0.00001205 | -1.556 | -1.938 | 0.055 | 9.3 |

The analysis results show that both physical activity and self-efficacy have a positive and significant effect on climate change awareness, with significance values of $p = 0.034$ and $p = 0.012$, respectively. This means that the more frequently individuals engage in physical activity and the higher their self-efficacy, the greater their climate awareness tends to be. However, further testing by adding the interaction between physical activity and self-efficacy as a moderating variable indicated that this interaction effect is negative and approaches

significance ($p = 0.055$). This negative coefficient suggests that self-efficacy may actually weaken the positive influence of physical activity on climate awareness. In other words, for individuals with high self-efficacy, the impact of physical activity on climate awareness is not as strong as it is for individuals with lower self-efficacy. This finding can be interpreted as a condition in which a person feels sufficiently confident in their own abilities, making them less inclined to associate physical activity with broader social or environmental issues. Overall, the model explains 9.3% of the variation in climate change awareness ($R^2 = 0.093$), which means that these three variables (physical activity, self-efficacy, and their interaction) contribute to changes in the dependent variable.

## 4 Discussion

Based on the research findings, it is shown that physical activity has a positive influence on climate change awareness among students. This research aligns with previous findings showing that individual participation in physical activity has a positive relationship with beliefs about the personal impact of climate change and the need for new policies [4]. Students who are physically active are generally more aware of the importance of having a good quality of life, one of which is by being mindful of the impact of climate change. In addition, people who are physically active are also more open to information related to sustainability, including the importance of paying attention to activities that impact climate change [10]. This can be explained through the eco-wellness approach, which states that healthy personal behaviors can serve as an entry point for developing a broader attitude toward environmental sustainability [13]. In other words, students who are physically active tend to internalize the value of personal responsibility, which then extends to a concern for the environment.

However, the most interesting and at the same time unexpected result was the discovery of a negative moderating effect of self-efficacy on the relationship between physical activity and climate awareness. This means that among students with high levels of self-efficacy, the relationship between physical activity and climate awareness actually becomes weaker. These findings indicate that, contrary to the common view of self-efficacy's role as always positive [9], the results show that self-efficacy tends to have a negative influence on climate change awareness and does not always strengthen the relationship between physical activity and that awareness. Therefore, it is necessary to reexamine how self-efficacy functions in physical activity and climate change awareness. On the contrary, this result suggests that higher self-efficacy may lead to a sense of complacency with one's current situation and subsequently hinder openness to new information or values related to climate change issues.

This phenomenon can be explained thru the theory of moral licensing, where someone who has done good deeds, such as being active in physical activities, tends to feel they have contributed enough and are therefore less motivated to further strengthen their concern for climate issues or change it into pro-environmental behavior [2]. In addition, having high self-efficacy does not always lead to pro-environmental behavior, especially if their motivation for physical activity is individualistic in nature, such as aiming for personal health or appearance [14]. By engaging in physical activity, students become healthier both mentally and physically, and are able to maintain an ideal body weight [6]. Therefore, it can be said that students who are active in physical activities feel the need to do so not to focus on things outside themselves, but solely to focus on their own health and appearance.

This difference marks the latest contribution to research development, as the notes indicate that self-efficacy cannot be understood as a variable that always positively strengthens the relationship between two behaviors. This study argues that it is important to consider the context of self-efficacy among students, whether their efficacy is focused on

something socially oriented or merely on personal achievement. This is reinforced by Bandura's theory of self-efficacy, which states that an individual with self-efficacy has confidence in their personal abilities, not in social responsibility [9]. In the context of this study, the moderating effect shows a negative coefficient and is close to significance ($p = 0.055$), indicating a tendency for students with high self-efficacy to be more confident in achieving personal health goals, which may reduce the extent to which physical activity promotes awareness of broader environmental issues. However, since these results are not statistically significant, this interpretation needs to be made with caution and reconfirmed thru further research related to this confirmation.

Previous research has shown that self-efficacy can directly predict pro-environmental behavior, as individuals with high self-efficacy tend to be more motivated to act responsibly toward the environment [15]. However, when self-efficacy is tested as a moderator variable, its role can be different. The effect depends on the orientation of self-efficacy, whether it is more directed toward personal goals or broader social values. This methodological difference may explain the variation in research findings, while also confirming the contribution of this study that self-efficacy does not always strengthen the relationship between physical activity and climate change awareness. For students who are more oriented toward academic achievement or personal needs such as health or appearance, high self-efficacy can actually reduce sensitivity to environmental issues, even if they are physically active.

Campaigns related to the importance of understanding climate awareness among university students are not enough if they only encourage physical activities or generally build self-efficacy. More effective interventions are needed, aimed at shaping specific self-efficacy concerning climate change issues. It should be emphasized to students that they also need to have confidence in themselves to seek up-to-date information on climate change, as this is directly related to their future. Overall, the findings of this study add important nuance to the understanding of the relationship between healthy behaviors, psychological traits, and awareness of global issues. This research makes a significant theoretical contribution by highlighting that self-efficacy, as a psychological variable, cannot be understood only in general terms, but must be viewed in terms of its direction and dimension, whether it is oriented towards personal goals or social concern. Practically, these findings are also valuable for designing environmental education programs, so that they not only foster individual self-confidence but also cultivate a more comprehensive collective awareness that is oriented toward sustainability.

## 5 Conclusion

The results suggest that physical activity has a positive influence on climate change awareness among university students. These findings confirm that healthy behaviors not only impact individual well-being but also contribute to the development of concern for environmental issues, especially climate change. However, the moderation results indicate that self-efficacy actually exerts a negative influence, where the relationship between physical activity and climate awareness becomes weaker among students with high levels of self-efficacy. This finding makes an important theoretical contribution, namely that self-efficacy does not always strengthen positive behaviors, especially when its orientation is more individualistic rather than social. Students with high self-efficacy tend to focus more on personal achievements such as health or appearance, without necessarily showing concern for environmental issues. Therefore, self-efficacy should be understood not only in terms of its strength as a predictor of behavior, but also in terms of its orientation. This study enriches the psychology literature by showing that the role of self-efficacy as a moderator is highly dependent on the context of individual awareness. Practically, the results of this research suggest that environmental campaign programs among university students should be

designed more specifically, not only by building general self-confidence or promoting a healthy lifestyle, but also by developing self-efficacy that is directed toward pro-environmental actions and an understanding of climate change as an issue concerning our collective future.

## 6 Implication

The results of this study have important implications for the development of environmental psychology research. Theoretically, this study highlights the need to understand self-efficacy not only as a construct that strengthens positive behavior towards oneself, but also as a psychological variable that can reinforce one's confidence in relation to the natural environment and climate-related issues. For future research, it is important to examine the dimensions of self-efficacy more deeply, including distinguishing between personally-oriented and socially-oriented self-efficacy, as well as exploring the role of intrinsic motivation in shaping environmental awareness. From an educational perspective, it is also important to raise individuals' awareness by providing self-efficacy training that specifically encourages actions that are pro-environment. This can be achieved through campaign activities organized for students or classroom learning.

**Acknowledgements:** The researcher extends heartfelt thanks to all parties who have helped to ensure the success of this study.
**Funding:** This research received funding support from the Faculty of Psychology, State University of Surabaya.
**Data Availability Statement:** The data in this study is confidential and will only be used for research purposes.
**Authors' Contributions Statement:** MJ, ANWH, RAAP, RPS, SJ, and TFN designed the study. MJ, ANWH, RAAP, RPS, SJ, and TFN conducted data analysis and interpretation of results, RAU and AF prepared the background and discussion. All authors were involved in writing the manuscript and approved the final version of the manuscript.
**Competing Interest:** The author declares that they have no conflicts of interest, whether financial, professional, or personal, that could influence the results of this study.

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