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Social inequality and climate change. Student awareness: teachers-to-be and engineers-to-be on the links between social inequality and climate change on the basis of empirical research

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Abstract. The paper presents the results of research into the opinions of university students on the causes and consequences of climate change in the context of social inequalities. The main problem of the research was formulated in the following way: *How do students (future teachers and future engineers) view the links between climate change and social inequalities?* The main aim was to see how students' opinions differed from one another. The authors wanted to find out how different characteristics affect perceptions of the causal relationship between the climate crisis and social inequalities. The majority of students at both universities chose indirect answers, showing that they are not fully convinced of the strong links between the climate crisis and social inequalities. This shows a need for intensive, multi-faceted measures to help students to recognise the relationships between these two aspects.

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1. Introduction

The current climate change is certainly one of the greatest challenges facing humanity (Feulner, 2017; Kakkar et al., 2018). The civilisational transformations initiated by the industrial revolution are exacerbating the climate crisis, causing modern generations to live in an increasingly risky society. Climate change is mainly caused by increased concentrations of greenhouse gases released into the atmosphere as a result of human activity. The reason for the increase in greenhouse gases is their intensive production, including the burning of coal, oil and gas, increased livestock farming, the use of nitrogen fertilisers and fluorinated gases in appliances (e.g. as coolants in air conditioners and fridges) and the destruction of natural carbon dioxide sinks through deforestation and the destruction of natural ecosystems (IPCC, 2013). The impacts of climate change are diverse and complex, ranging from heatwaves, shifts in animal ranges (including species extinction but also the spread of pests and diseases) and climatic zones, melting glaciers, extreme events (hurricanes, floods, fires, prolonged droughts and desertification), to economic and social impacts such as health problems, migration, armed conflicts and human rights abuses (Crowley, 1999; Scafetta, 2010; Kaddo, 2016). While it is easy to link climate change to the rapid technological development, the social causes and consequences of the climate change are less obvious.

As Islam & Winkel (2017) state, inequality has been a persistent theme in the climate change debate, usually in connection with the concept of "social justice" and, as a consequence of the definition of sustainable development, the demand for intra- and intergenerational justice (Brundtland, 1987). It is important to emphasise that in the social context, inequalities can be both a cause and an effect of climate change (Green & Healy, 2022). It is worth stressing that, according to the carbon-centric paradigm, climate change is understood in reductionist terms – as a technical problem of excessive GHG emissions – and the goal of climate policy is to reduce such emissions efficiently (Green & Healy, 2022). In this context, it is the task of decision-makers, activists, politicians, engineers, technicians, teachers and NGOs to raise awareness in this area, to reduce inequalities and to support marginalised, underprivileged groups in their environmental protection activities. Raising awareness, changing the (consumer – Bauer et al., 2012) value system, increasing care for the natural environment and the needs of future generations in countries defined as privileged is also the task of teachers and educators, publicists, people associated with the media and those working in the broadly understood technological sector.

The subject matter literature tends to define social inequalities in two ways: first, as the degree to which the members of a given society differ on some characteristic (e.g., education, status etc.). In this approach, an individual is the subject of inequality. Another definition of inequality identifies it as the differential access of social groups to different goods. In this approach, a social group is the subject of inequality (Sen, 1999; Stewart, 2002; Ferreira et al., 2009; United Nations Development Programme, 2013). In our study, we focused on the second definition: in the context of climate change, some groups of the world's population have become, or may in the future become, subject to inequalities or even exclusion.

Inequality is an inherent feature of the distribution of global material and resource use and its impact on environmental degradation and climate change. Climate change increases the risk of acute events such as storms, droughts and floods, cyclical changes in precipitation, or long-term changes in temperature and sea levels. How do these trends impact people and societies? Most impact assessments and evaluations limit their focus to environmental and hard infrastructure impacts (Chancel, 2021). However, climate change has the potential to directly or indirectly affect a much wider range of sustainable development issues – such as health, food security, employment, income and livelihoods, gender equality, education, housing, poverty and mobility (WHO, 2011). Climate change also globalises and radicalises social inequality; it exacerbates the inequalities between rich and poor, centre and periphery, and at the same time dissolves them in the face of a common threat to humanity. Climate change combines with the inequalities arising from globalisation, decoupling producers and subjects of risk (Beck, 2010).

In the context of climate change, social inequalities can be considered within a country/society as well as between countries/societies (Islam & Winkel, 2017). It is therefore possible to talk about the macro and micro aspects of social inequalities in relation to climate change. The macro level addresses the inequalities between countries, dividing the world's regions into the privileged ("Global North") and the disfavoured ("Global South"). As Lucas Chancel shows in his report (2021), people living in Europe, North America and other countries of the Global North produce a carbon footprint 100 times greater than that of all the world's poor countries combined. In 2019, the world's top 10% of

emitters (771 million people) accounted for about 48% of global CO_2 emissions, while the bottom 50% (3.8 billion people) accounted for just 12% of all emissions. Such inequalities are difficult to address as they require efforts from outside the disfavoured country. The micro level refers to inequalities that affect a single society, nationality and country. This type of inequality appears to be easier to address because all citizens of a given country have the same rights and responsibilities, so citizens should be protected from the inequalities resulting from climate change.

International and national agencies have recognised the role of education in building societies based on values of equity, social justice and sustainability, and have developed strategies and action plans (UNESCO, 2020; OECD, 2024). Properly planned and effectively implemented education makes it possible to influence members of society and build the right hierarchies, values, and attitudes. Thanks to appropriate competences and their elements, such as knowledge and attitudes (values), it is possible to reduce social inequalities in the context of climate change. It is important to remember that these two phenomena are closely linked: on the one hand, climate change can cause inequality (e.g., a privileged place to live), and on the other hand, climate change can result from inequality (e.g., in the context of poverty leading to less concern for the environment). In this context, our aim was to design and carry out research to test the awareness of students – future engineers and teachers – of the links between social inequalities and climate change. To achieve our research objective, we invited students from two universities in Krakow to participate: the former Pedagogical University (PUK during the research; now: University of the National Education Commission) and the AGH University of Krakow (AGH University). The choice of a university that trains teachers and one that trains engineers was justified by the fact that, firstly, these young people will soon be the decision-makers shaping our common future. Secondly, PUK graduates will teach future generations, passing on their knowledge and attitudes. In this context, how they themselves perceive climate change and related inequalities is extremely important. We were interested in whether the views of future teachers on this issue differed from the perceptions of future engineers who will design the common space and infrastructure for future generations.

In summary, it is extremely important to stress that issues related to climate change and social inequality are becoming increasingly prominent in the academic and policy literature, as the two issues are closely linked. Naomi Klein (2015) notes that global capitalism contributes to climate change. She argues that this economic system deepens inequality, and suggests that addressing the climate crisis requires fundamental social change, including tackling inequality. Climate change has the greatest impact on people and communities already struggling with poverty and marginalisation. People with low incomes, those in developing countries and disadvantaged ethnic groups are often more vulnerable to the effects of natural disasters such as floods, hurricanes, and droughts. It is estimated that between 68 and 135 million people could be pushed into extreme poverty by 2030 as a result of climate change (UN, 2015). Furthermore, while the majority of greenhouse gas emissions come from developed countries, the poorest regions of the world, which contribute the least to emissions, suffer the most. For example, people in low-income countries are five times more likely to be forced to move due to climate disasters than those in high-income countries (Parsons et al., 2024). Climate action should definitely go hand in hand with the promotion of social justice.

In our article, we focused on the issue of how the links between social injustice and climate change are perceived by students at two universities in Krakow – the Pedagogical University and the AGH University. These two groups were invited to take part in the study because it is predicted that these representatives of Generation Z will soon decide on the shape of social, environmental and economic life in Poland. The future teachers – the current PUK students – will shape the attitudes, worldview, values and everyday choices of future generations. Moreover, the importance of education in regulating social inequalities is obvious. How future learners perceive the links between inequality and climate change is therefore crucial. In turn, future engineers – AGH University students – will be looking for technological solutions to limit the negative effects of human expansion on the natural environment. It is therefore important to know their views on the interdependence, causes and consequences of the relationship between inequality and climate change. In the following text, we focused on comparing the opinions of future teachers and engineers on the relationship between climate change and social inequalities. After a thorough analysis of the available literature (which is not abundant on this topic), we designed a research tool that we used in a study conducted in a quantitative research paradigm. Our approach allowed us to gather students' opinions, taking into account their views on specific issues related to the causes and effects of

inequality, and to correlate them with their gender, age, professional experience and field of study.

2. Research materials and methods

In our study, we used a method that follows the quantitative paradigm. This allowed us to identify trends and correlations in students' opinions.

2.1. Methodological assumptions of the research

The research was conducted within a quantitative (nomothetic) paradigm. This means that the data obtained were coded and analysed as numerical values. The particular value of quantitative research carried out using the survey method – as in the case of our study – is that it allows a large number of responses to be collected in a relatively short time, and the survey – due to the anonymous character of this method – encourages students to give honest and objective answers.

2.2. Research problem

In the study, the main problem was defined and formulated as the following question: *What are the views of students – future teachers and engineers – on the relationship between climate change and social inequalities?*

In order to answer the research problem as far as possible, the following detailed questions were formulated:

1. What are the opinions of students: future teachers (PUK) on the social causes of climate change in the context of social inequalities?
2. What are the opinions of students: future engineers (AGH University) on the social causes of climate change in the context of social inequalities?
3. What are the opinions of students: future teachers (PUK) on the social consequences of climate change in the context of social inequalities?
4. What are the opinions of students: future engineers (AGH University) on the social consequences of climate change in the context of social inequalities?

2.3. Research method, technique and tool

The survey method was used for the study. As noted by Earl Babbie (2013), a survey study can be conducted for the purpose of exploration, description and explanation. It is most commonly used in research projects where individuals are the unit of analysis. Survey is also the best available method for researchers who want to collect original data to describe a population which is too large to be directly observed (Babbie, 2013). In order to answer all the research questions, we designed an original survey questionnaire. The hard copies of the questionnaire were filled out voluntarily by students of the Pedagogical University of Cracow (PUK) and the AGH University of Krakow (AGH University) during a break in their didactic classes. The empirical data were collected between March and June 2019.

The independent variables and their indicators are presented in Table 1.

2.4. Sampling and sample characteristics

Convenience sampling was applied (Christensen & Johnson, 2011) with the criterion of availability of the respondents and their consent to participate in the survey.

A total of 506 students from two universities in Cracow (AGH University and PUK) participated in the research: future engineers and future teachers. 293 respondents (57.91% of the group) were students from PUK, while 213 respondents came from AGH University (42.09% of the group). The gender composition of the respondents was as follows: 385 were female (76.09%) and 121 were male (23.91%); 465 of the respondents were up to 25 years old (91.90 %), while 38 (7.51%) were over 25 years old; 3 (0.59%) respondents chose the n/a answer. As concerns the study cycle, 391 (77.27%) were in a Bachelor's programme and 115 (22.73%) of them were in a Master's programme studies. The respondents' professional experience was mainly none – 363 (71.74%) respondents stated that they had none; 100 (19.76%) had 1–2 years of experience and 43 (8.50%) had 3 years or more; 298 (58.89%) of the respondents were city dwellers and 198 (39.13%) were village dwellers; 10 (1.98%) respondents answered n/a.

The data obtained from the survey were coded and analysed using SPSS software (Statistical Package for the Social Sciences). Correlations were checked for each independent variable and the data for which $p<0.05$ were identified as statistically significant.

Table 1. Independent variables and their indicators

Independent variable	Indicator*
Gender	Female
	Male
University	Pedagogical University of Krakow (PUK)
	AGH University of Krakow
Age	up to 25 years
	more than 25 years
Level of studies	Bachelor (first cycle)
	Master (second cycle)
Professional experience	none
	1-2 years
	3 years and more
Place of origin	village
	small city
	big city

* – based on the answer provided in the questionnaire
Source: own elaboration

3. Results of the research

Students were asked to what extent they thought social inequalities existing in the world were the cause of climate change. Only 28.15% of the respondents thought that social inequalities were definitely a cause of climate change, and 4,6% of all the students questioned said that social inequalities were a major cause of climate change.

It is worth noting the differences between the responses of the future teachers from PUK and the future engineers from AGH University. AGH University students (future engineers) were significantly less likely than PUK students (future teachers) to declare that social inequalities are not the cause of climate change (no causal relationship). This answer was given by only 20.90% of the AGH University students. As for the PUK students, 43.64% of them declared that social inequalities are not the cause of climate change. There is also a big difference between AGH University and PUK students regarding the following statement: *Social inequalities are definitely the cause of climate change*. This answer was clearly chosen more often by the future engineers (35.32% of AGH University students compared to the 22.91% of PUK students). The statistical analysis showed that there is a strong and statistically significant correlation between the type of university and the answers given by the students ($p<0.05$).

Students were asked to evaluate statements about the causes of climate change in the context of social inequalities. The statements were formulated on the basis of an analysis of the relevant literature.

Respondents were asked to give their opinion on the following statement: Climate change is the result of a small group of privileged/prominent individuals running their own profitable businesses, leading to the degradation of the natural environment. This is also linked to limited development opportunities for disfavoured groups. The students' opinions are presented in Figure 1, broken down by university.

Analysis of the data regarding opinions on this statement shows that there is not much difference between the answers given by students – future teachers and future engineers. It is interesting that most of the respondents from both universities (pedagogical and technical) think that climate change may be a result of the fact that a small group of privileged/prominent individuals run their own profitable businesses, leading to the degradation of the natural environment. This is also linked to limited development opportunities for disfavoured groups (students tend to agree with this statement). Only about 5% of them strongly disagree.

Almost one third of the future teachers surveyed (PUK students) strongly agreed with the statement that developed countries should be held responsible for climate change. This answer was chosen by only slightly more than 13% of the students of the technical university (AGH University). More than a quarter of the future engineers rather disagreed with this statement (for comparison, this answer was chosen by only 8% of the future teachers (PUK

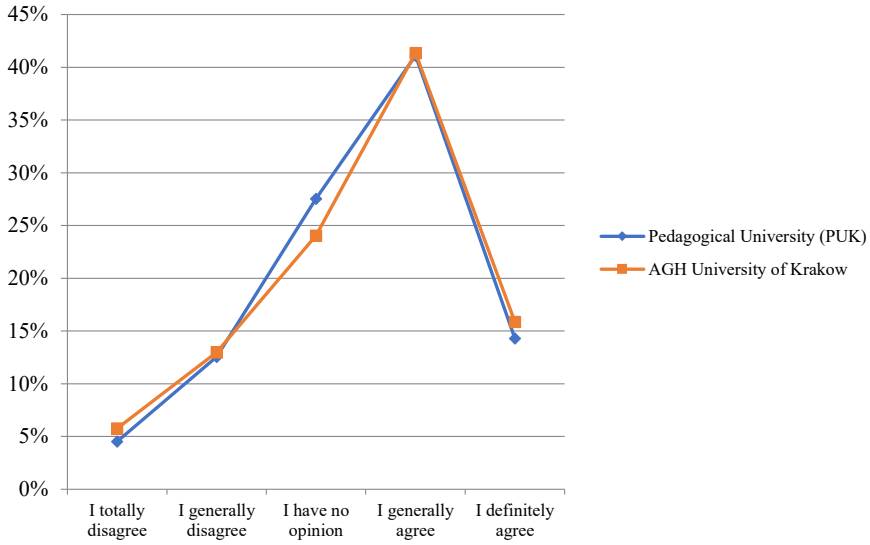

Fig. 1. Differences between students of the Pedagogical University of Krakow and the AGH University of Krakow in their opinions on the statement: *Climate change is the result of a small group of privileged/prominent individuals running their own profitable businesses, leading to the degradation of the natural environment. This is also linked to limited development opportunities for disfavoured groups*

students)). In this case, the responses are statistically significant (correlation between agreement with this statement and the university represented by the respondent; $p<0.05$). Other variables (place of residence, study cycle, gender, professional experience) were not significant for this statement.

Students were also asked to what extent climate change is caused by the destruction of the natural environment by the governments of the world's poorest countries, who sell their natural resources to ensure the survival of their citizens. Figure 2 shows respondents' answers by university type.

Almost one third of the respondents (30.04%) generally agree with the statement that the governments of the world's poorest countries are largely responsible for climate change. Also, 29.42% of the students have no opinion in this regard. About a quarter (22.22%) of the respondents generally disagree with the statement that climate change is caused by the destruction of the natural environment by the governments of the world's poorest countries, who sell their natural resources to ensure the survival of their citizens.

The analysis of the data shows that the answers given by the students – future teachers (PUK) and future engineers (AGH University) are similar. There is a significant difference only in the case of the answer "I generally agree" – about 8 percentage

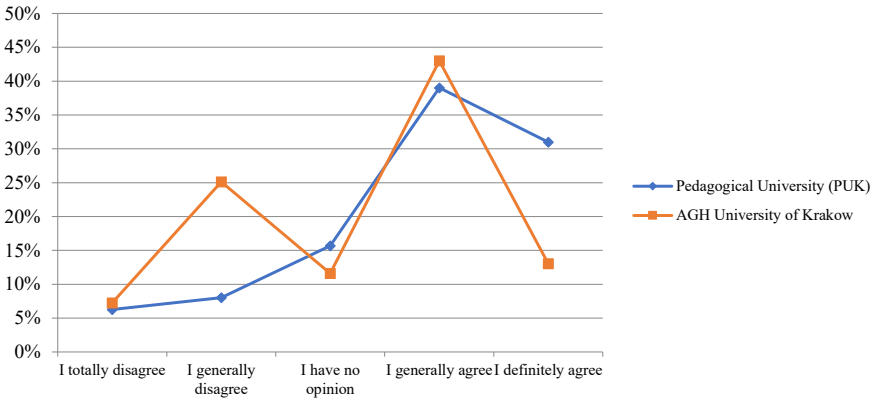

Fig. 2. Differences between students of the Pedagogical University of Krakow and the AGH University of Krakow in their opinions on the statement: *Climate change is caused by the poorest countries where natural environment is destroyed and natural resources are used in an unsustainable way*

points more students from the technical university (AGH University) chose this answer (34.83% for AGH University and 26.67% for PUK).

The analysis showed that there was no statistical significance for this statement for any of the independent variables (gender, age, professional experience, field of study, university, place of residence, study cycle).

Respondents were asked to rate the following statement: in order to slow down adverse climate change, we need to eliminate hunger and poverty.

The analysis has shown that the largest group of respondents from both universities are those who have no opinion on the strategies to stop climate change in the context of its social determinants, such as hunger and poverty. More than a tenth of students – future teachers (PUK) and future engineers (AGH University) – do not agree that in order to slow down adverse climate change, we need to eliminate hunger and poverty. More than one in ten (11.23%) of the students from the pedagogical university (PUK) and 4.5% of students from the technical University (AGH University) strongly agree with this statement and about one fifth of the respondents generally agree with it.

There is a statistical correlation between this statement and the variable: professional experience (Fig. 3).

Pedagogical University students, who are potential future teachers, most often have no opinion on the causes of climate change related to unsustainable production in the world's poorest countries. Almost a third of the respondents from PUK (30.50%) generally agree that climate change is to some extent caused by unsustainable ways of producing goods and providing services

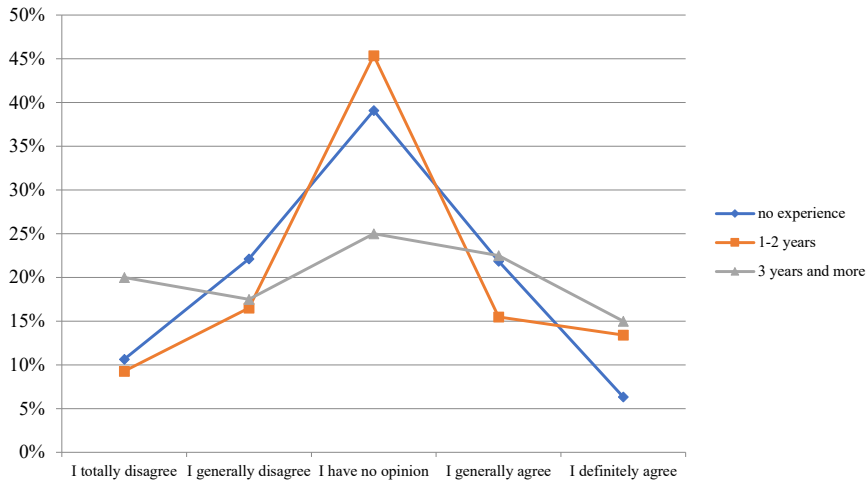

Fig. 3. Students' of the Pedagogical University of Krakow and the students' AGH University of Krakow opinions on the statement: *In order to slow down adverse climate change, we need to eliminate hunger and poverty*

in the poorest countries. This opinion is shared by 40.80% of students from the AGH University, but only 8.51% of PUK students and 10.95% of AGH University students say this with certainty (*I totally agree*). The data analysis shows the statistically significant correlation between the type of university (independent variable) and this answer ($p<0.05$).

There is also a statistically significant relationship between the students' professional experience and the answers given. Table 2 shows the students' opinions on the issue of climate change as a result of unsustainable production (Tab. 2). As study results show, there is a statistically significant correlation between professional experience and the opinion that unsustainable production in poor countries contributes to climate change.

Another statement that students were asked to evaluate was: *Poverty is a factor that exacerbates climate change*. The data analysis showed no statistically significant relationship between the variable: university and the students' answers. However, it is worth noting how the answers of students – future teachers and students – future engineers are distributed (Fig. 4).

Only 6.64% of PUK students and less than 4% of AGH University students strongly disagree with this statement, while 14.34% of PUK students and just over 10% of AGH University students generally disagree. Analysis of the results shows that there is a statistically significant relationship between

Table 2. Students' opinions regarding the statement: *The cause of climate change is unsustainable production in the poorest countries, which degrades the natural environment vs. professional experience*

	Professional experience			
	None %	**1-2 years %**	**3 years and more %**	**Total %**
I totally disagree	4.90%	12.37%	15.38%	7.25%
I generally disagree	17.00%	9.28%	30.77%	16.56%
I have no opinion	32.28%	35.05%	20.51%	31.88%
I generally agree	36.60%	32.99%	23.08%	34.78%
I definitely agree	9.22%	10.31%	10.26%	9.52%
Total	100.00%	100.00%	100.00%	100.00%

Source: own elaboration

Table 3. Students' opinions regarding the statement: *Poverty is a factor which aggravates climate change (e.g. unsustainable exploitation of natural resources, unsustainable production...)* vs. professional experience

	Professional experience			
	None %	**1-2 years %**	**3 years and more %**	**Total %**
I totally disagree	4.57%	4.12%	17.50%	5.54%
I generally disagree	13.71%	9.28%	12.50%	12.73%
I have no opinion	24.57%	37.11%	25.00%	27.10%
I generally agree	40.29%	31.96%	25.00%	37.37%
I totally agree	16.86%	17.53%	20.00%	17.25%
Total	100.00%	100.00%	100.00%	100.00%

Source: own elaboration

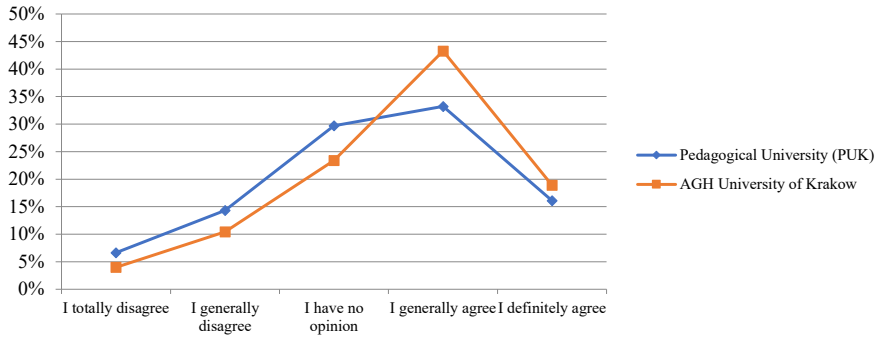

Fig. 4. Differences between students of the Pedagogical University of Krakow and the AGH University of Krakow in their opinions on the statement: *Poverty is a factor that exacerbates climate change (e.g. unsustainable exploitation of natural resources, unsustainable production...)*

students' professional experience and the answers given (Tab. 3).

In the second part of our questionnaire, we investigated the students' views on the impact of climate change in the context of social inequalities.

The largest group of students, both future teachers and engineers, think that social inequalities are only partly the result of climate change (climate change causes social inequalities). It is worrying that almost a third (30.04%) of future teachers and a fifth of students of technical faculties (future engineers) think that *Social inequalities are not the result of climate change*. A further 28.62% of trainee teachers and as many as 36.10% of engineering students believe that social inequalities are only slightly caused by climate change. This means that a large group of the students at both universities, future teachers and future engineers, are unaware of the extent to which climate change is causing and exacerbating existing social inequalities.

Students were also asked to indicate the extent to which they thought armed conflicts and threats to state sovereignty were caused by climate change (Tab. 4).

Slightly more than a quarter (26.90%) of students – future teachers and almost a third (29.11%) of students – future engineers believe that climate change is not at all a trigger for armed conflict. About a third (33.45% at PUK, 33.33% at AGH University) of the students at both universities believe that conflicts are only marginally caused by climate change. A small group of students (5.52% of the future teachers and 2.82% of the future engineers) think that climate change is a trigger for armed conflict (there is a strong correlation between these two phenomena). Almost 40% of the students – future engineers and 30% of the students – future teachers think that climate change is not a threat to the sovereignty of states. Distributions of the answers: *Climate change has a slight effect* and *has a direct effect* are similar among both groups of students.

The analysis of the results of the Chi-square test shows that the answers to this question depend on the university of the respondent. The relationship is shown in Figure 5.

Students' answers regarding the threat to state sovereignty posed by climate change depend on the study cycle in which they are currently enrolled. Almost a third of students – 33.93% at Bachelor's level and 33.04% at Master's level – believe that there is no threat to state sovereignty as a result of climate change. 31.11% of Bachelor's and 26.09% of Master's students answered that there is a slight possibility of a threat to state sovereignty as a result of climate change. 23.14% of Bachelor's students and 30.43% of Master's students answered that there is no direct impact on state sovereignty as a result of climate change. According to 10.03% of Bachelor's students and 4.35% of Master's students, climate change has a major impact on the threat to state sovereignty. Finally, 1.80% of Bachelor's students and 6.09% of Master's students responded that climate change is one of the main factors driving the threat to state sovereignty.

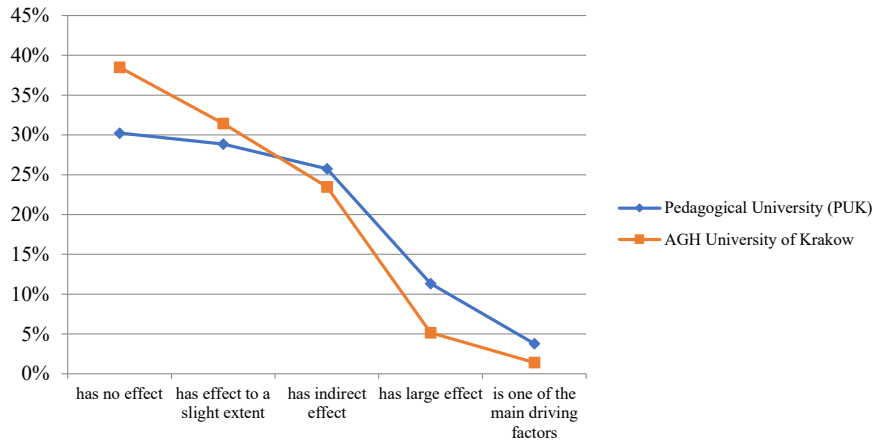

Fig. 5. Students' of the Pedagogical University of Krakow and the students' AGH University of Krakow opinions on armed conflicts as the effect of climate change.

Chi-square tests for: Threat to state sovereignty as an effect of climate change vs. university shows that 0% of cells (0) have an expected count of less than 5. The minimum expected count is 5.92

Table 4. Threat to state sovereignty as the effect of climate change vs. university

	University		
	Pedagogical University %	AGH %	Total &
has no effect	30.24%	38.50%	33.73%
has effect to a slight extent	28.87%	31.46%	29.96%
has indirect effect	25.77%	23.47%	24.80%
has large effect	11.34%	5.16%	8.73%
is one of the main driving factors	3.78%	1.41%	2.78%
Total	100.00%	100.00%	100.00%

Source: own elaboration

Students taking part in the study were also asked to indicate the extent to which they thought climate change could pose a risk to life, health and property.

According to the analysis, almost twice as many students – future teachers – believe that climate change is one of the main factors causing risk to life, health and property. Most respondents from both universities believe that climate change has a major impact on threats to life (42.41% of future teachers and 36.15% of future engineers). Slightly less than 5% of the students from the pedagogical university and about 5% of the students from the technical university do not see a causal relationship between climate change and threats to life, health and property.

Students were also asked to give their opinion on the extent to which migration is a consequence of climate change (Tab. 5). It should be noted that migration has been a highly emotional issue in Europe for several years. It is interesting to see how the relationship between migration and climate change is perceived by future teachers and engineers.

More than one in ten (11.85%) of the students at the pedagogical university and slightly more than 7% (7.08%) of the students at the technical university think that migration is not caused by climate change. A further 17.07% of the future teachers and 19.81% of the future engineers think that climate change has only a minor impact on migration. A third of PUK students (34.15%) and as many as 44.34% of AGH University students believe that climate change has a direct impact on migration. Almost 30% of the future teachers and about a quarter of the future engineers stated that climate change has a major impact on human migration. The answers regarding the relationship between migration and climate change are statistically related. This relationship is shown in Table 6.

The analysis of the data obtained shows that there is a correlation between the students' answers regarding territorial conflicts as a result of climate change, and the university and gender of the respondents.

About one fifth (on average 20.40%) of the students from the Pedagogical University of Krakow and from the AGH University of Krakow believe that armed conflicts are not the result of climate change. The following statements were chosen by different numbers of students: about 28% of students – future teachers and about 10 percentage points less of students – future engineers think that climate change can indirectly trigger armed conflicts. About one fifth (21.92%) of the students from the pedagogical university believe that climate change has a great impact on armed conflicts while only 12.68% of the students from the technical university share the same opinion. Only 3.76% of AGH University students and 8.22% of PUK students perceive a strong causal relationship between climate change and armed conflict.

Chi-square tests on the topic show that 0% of the cells (0) have an expected count of less than 5. The minimum expected count is 13.50. The data analysis shows that women were more likely than men to say that climate change has a major impact on resource conflicts. On the other hand, men were more likely than women to say that there is no causal relationship between climate change and resource conflicts (Tab. 7).

Students were also asked to give their opinion on a very general statement about climate change reducing the quality of life in many regions of the world. The analysis showed that students' responses varied according to university and gender.

According to the analysis, 21.03% of the students – future teachers and 11.74% of the students – future engineers perceive a strong causal relationship

Table 5. Risk to life, health and property as the effect of climate change vs. university

	University		
	Pedagogical University %	AGH %	Total %
Has no effect	4.48%	7.04%	5.57%
Has effect to a slight extent	7.24%	11.74%	9.15%
Has indirect effect	18.97%	31.46%	24.25%
Has large effect	42.41%	36.15%	39.76%
Is one of the main driving factors	26.90%	13.62%	21.27%
Total	100.00%	100.00%	100.00%

Source: own elaboration

Table 6. Migrations as a result of climate change vs. university

	Gender		
	Female %	Male %	Total %
has no effect	10.29%	8.33%	9.82%
has effect to a slight extent	18.21%	18.33%	18.24%
has indirect effect	35.09%	49.17%	38.48%
has large effect	29.02%	16.67%	26.05%
is one of the main driving factors	7.39%	7.50%	7.41%
Total	100.00%	100.00%	100.00%

Source: own elaboration

Table 7. Resource conflicts as a result of climate change vs. gender of the respondents

	Gender		
	Female %	Male %	Total %
has no effect	7.07%	17.36%	9.54%
has effect to a slight extent	14.66%	18.18%	15.51%
has indirect effect	34.03%	36.36%	34.59%
has large effect	31.94%	19.83%	29.03%
is one of the main driving factors	12.30%	8.26%	11.33%
Total	100.00%	100.00%	100.00%

Source: own elaboration

between climate change and a reduced quality of life. Students from the technical university were more likely (37.09% compared to 27.24% PUK students) to say that quality of life is only indirectly related to the current climate change. About a third (32.80%) of both women and men said that climate change has a major impact on reducing the quality of life.

Responses to this question differ between women and men, mainly with respect to the opinion that climate change has only a minor impact on the decline in quality of life (fewer women than men chose this answer, the difference being around 12 percentage points). More women think that climate change is one of the main factors resulting in reduced quality of life (almost 20% of women and around 9% of men chose this answer) (Fig. 6).

Respondents were also asked how they thought climate change was affecting the increase in social inequalities. It is worrying that almost 20% of students from the pedagogical university and more than 20% of the students from the technical university do not see a causal relationship between these two phenomena. Only 16.26% of the future teachers and 13.62% of the future engineers see a strong impact of climate change on the increase in existing social inequalities. About a third of the respondents from both universities think that climate change has only an indirect effect on increasing inequalities (Fig. 7).

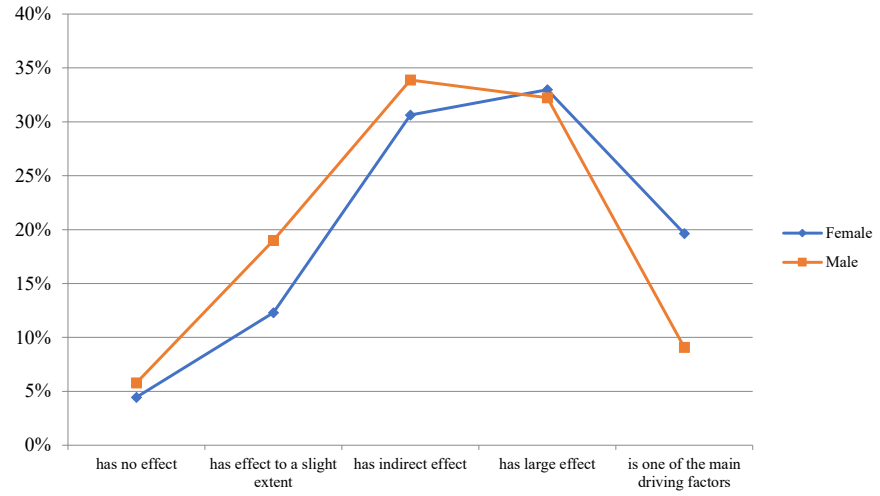

Fig. 6. Reduced quality of life in many regions of the world as the effect of climate change vs. gender

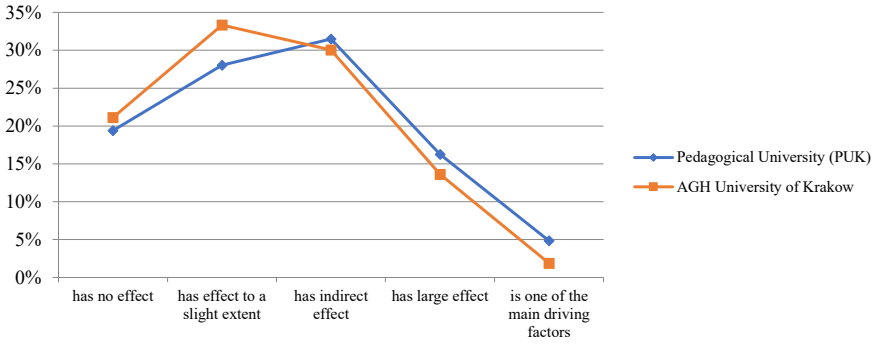

Fig. 7. Students' views on the impact of climate change on increasing social inequalities

4. Discussion and conclusions

The study examined students' opinions on the relationship between social inequalities and climate change, focusing on teachers-to-be (from the Pedagogical University of Krakow, PUK) and engineers-to-be (from the AGH University of Krakow). The findings reveal some significant differences in how these two groups perceive the role of social inequalities in contributing to climate change, as well as the impact of climate change on social inequalities. The two phenomena discussed in this paper – climate change and social inequalities – are strongly correlated, although the relationship is not obvious. The research presented above aimed to determine the extent to which future engineers and teachers – people who will soon be decision-makers shaping the economic, social and environmental life of our country and, in a wider dimension, Europe – are aware of the interdependence between climate change and social inequalities.

As the analysis shows, it is very worrying that few young people are aware of the causal relationship between the phenomena discussed. Meanwhile, numerous studies show that there is a strong correlation between inequalities (in many dimensions) and climate change (Smith et al., 2014; Harlan et al., 2015; Paavola, 2017; Ngcamu, 2023). Scientific research on the causes of climate change consistently points to human activities as the main driver of recent global warming. The main contributors are the emissions of greenhouse gases, particularly carbon dioxide (CO_2), methane (CH_4)

and nitrous oxide (N_2O), which trap heat in the Earth's atmosphere. These emissions come mainly from the burning of fossil fuels (coal, oil, and natural gas) for energy, transport and industry, as well as from deforestation and agricultural practices.

It is extremely important to study the awareness of this issue among students who will soon be shaping the economic, social and natural environment.

The social consequences of climate change are also an extremely important issue. The scientific literature raises the following issues in relation to the impact of climate change on social inequalities: (a) Vulnerability of marginalised groups: climate change tends to amplify pre-existing social inequalities (Otto et al., 2017; Parsons et al., 2024); (b) Health inequities: climate-related health impacts, including respiratory diseases and malnutrition, disproportionately affect disadvantaged communities (Parsons et al., 2024); (c) Livelihoods and poverty: climate change undermines the livelihoods of the poorest, particularly in regions that depend on agriculture and natural resources. This in turn deepens cycles of poverty, as the most vulnerable groups are often those least equipped to adapt or recover (Birkmann et al., 2022).

Many studies emphasise the need for equitable climate policies that address the needs of the most vulnerable. Climate justice frameworks argue that while wealthier nations and populations are the primary contributors to greenhouse gas emissions, the most severe impacts are felt by low-income and marginalised communities worldwide (Birkmann et al., 2022). In terms of perceptions of social inequalities as a cause of climate change, only 28.15% of respondents believe that social inequalities are definitely a cause of climate change, while 4.6% consider them to be a major cause. AGH University students were less likely (20.9%) than PUK students (43.64%) to reject the idea that social inequalities are not related to climate change. A higher percentage of AGH University students (35.32%) than PUK students (22.91%) agreed that social inequalities are definitely related to climate change. As our study shows, in the context of business interests and environmental degradation, most respondents from both universities agreed that climate change is partly caused by a small group of privileged individuals running profitable businesses that degrade the environment, while about 5% strongly disagreed with this view. Another important issue in our study was students' perceptions of the responsibility of developed countries for climate change. Almost a third of PUK students (30%) thought that developed countries should be held responsible for climate change, compared to only 13% of AGH University students. A significant proportion of AGH University students (over 25%) disagreed with this view. Regarding the role of poor countries in climate change, around 30% of respondents generally agreed that the governments of the poorest countries contribute to climate change by selling natural resources, with slightly more AGH University students (34.83%) agreeing than PUK students (26.67%). In addition, a large proportion of respondents (especially those with professional experience) had no opinion on the link between hunger, poverty and climate change mitigation strategies. More PUK students (11.23%) than AGH University students (4.5%) strongly agreed that eliminating hunger and poverty is key to tackling climate change. The case of unsustainable production in poor countries shows that around 40.80% of AGH University students and 30.50% of PUK students agreed that unsustainable production in poor countries contributes to climate change, but only a small proportion of students from both universities strongly agreed.

Many respondents (30.04% of PUK students and 20% of AGH University students) thought that social inequalities were not caused by climate change, while another third thought that they were only slightly affected by it. This reflects a general lack of awareness of the link between climate change and worsening social inequalities.

When asked about the impact of climate change on armed conflict and sovereignty, our research shows that a significant proportion of students believe that climate change has little impact on triggering armed conflict or threatening state sovereignty. However, a minority (5.52% of PUK students and 2.82% of AGH University students) believed that climate change was a direct cause of conflict.

Another issue we addressed in the study was the risks to life, health, and property associated with climate change. The majority of respondents believed that climate change posed a significant threat to life, health, and property, with slightly more students from PUK (42.41%) than AGH University (36.15%) perceiving this risk as a major one.

In the context of migration and climate change, migration was perceived by a significant proportion of students as being affected by climate change, with 44.34% of AGH University students and 34.15% of PUK students acknowledging a direct impact.

We also asked students about their views on the impact on quality of life. Around 21% of PUK

students and 11.74% of AGH University students saw a strong link between climate change and a reduced quality of life, with AGH University students more likely to see an indirect relationship.

In our study, we treated gender as a variable that may correlate with opinions on the relationship between climate change and social inequality. The study shows that women were more likely than men to perceive a strong link between climate change and resource conflicts, while men were more likely to deny any causal relationship. Women were also more likely to see climate change as a major factor in reducing quality of life.

In conclusion, the study reveals significant differences between future teachers and engineers in their perceptions of the link between social inequalities and climate change. AGH University students were more sceptical about the link, while PUK students tended to see developed countries and poverty as contributing factors. Gender and professional experience also played a role in shaping these perceptions. The findings suggest a need for more cross-disciplinary education on the complex relationships between climate change and social inequalities.

It should be remembered that sustainable development in all its aspects cannot be achieved without social equality for all people (*Transforming*…, 2015).

Gender equality is particularly important in this context, as it affects all people around the world. As Gay-Antaki (2020) notes, research on gender in climate-related programmes suggests that the small amounts of money allocated to gender and climate change initiatives, their quick expiration dates, and the narrow understanding of gender do not allow for substantial interventions to begin to address gender or climate vulnerabilities. In order to address gender inequalities in the context of climate action, the 'W+' project was launched. The W+ Standard seeks to capitalise on the focus on carbon markets and the current interest of the private sector in questions of gender equality (Arora-Jonsson & Gurung, 2023). It should be emphasised that inequalities related to the consumption of carbon as an energy source are currently a very big problem in Poland: so far, coal has been a relatively cheap and readily available resource, while the current situation deepens inequalities regardless of gender as the poorest cannot afford more environmentally-friendly energy sources. This is a very serious problem and a great challenge for Poland's social policy and economy.

Socio-economic inequalities drive emission-intensive consumption and production, facilitate the obstruction of climate policy by wealthy elites, undermine public support for climate policy, and weaken the social foundations of collective action (Green & Healy, 2022). Surprisingly, many of the students in our study had no opinion on these issues. In a context of economic inequality, conspicuous consumption by the wealthy drives society-wide increases in consumption-related GHG emissions (Wiedmann et al., 2020).

Education is of great importance in mitigating climate change in the context of social inequalities; educating underrepresented and minority students in science, technology, engineering and mathematics (STEM) is particularly important as it can both reduce inequalities and limit harmful practices that lead to human-induced climate change (Skowronek et al., 2022). Skowronek and co-authors (2022) emphasise that infusing technical education with the social sciences, arts, ethics, and economics prepares future leaders to participate creatively in solving identifiable barriers to a sustainable society. Therefore, it is particularly important for future teachers to be aware that properly planned and implemented education in this area can have a positive impact on climate change. It is necessary to transform education towards teaching-learning based on empathy, mutual care – with respect for humanistic values, but using the knowledge and skills available thanks to STEM.

Climate change is also a factor that increases social inequalities: it is estimated that climate change could push more than 130 million more people into extreme poverty by 2030 alone (Hallegatte et al., 2016). Meanwhile, according to the analysis of our research, as many as 30.04% of students - future teachers and 20% of future engineers do not believe that climate change can lead to a deepening of social inequality. It is therefore necessary to plan activities in the form of educational programmes/ projects and social campaigns that will make people aware that social inequalities will increase if climate change is not mitigated. As Costella and co-authors note (2023), social protection policies could play an important role in addressing the socio-economic impacts of climate change, given their long-standing and central role in managing poverty and income risks.

Without strong adaptation and mitigation measures, climate change is projected to further exacerbate vulnerabilities, threaten human health and security at risk, and impede sustainable development.

At its most fundamental, climate change affects people, and responses depend on people to be successful. Thus, the social dimensions of

climate change, the interplay between climate as a phenomenon, related policies and society – including the role of people as victims and agents of climate change – are critical to successful climate policy. To date, however, the human variable of the climate equation has too often been absent or weak (WHO, 2011).

We deliberately invited young people from two different faculties and – in the future – two different professions to participate in our study. Although our research was exploratory and we did not formulate any hypotheses, we expected the answers to differ according to the university, the knowledge possessed and the different experiences gained, among other things, during the student internship. We also included other variables, such as gender, place of origin or professional experience, which made it easier to understand the differences that emerged during the analyses. However, the detailed analysis of the data collected shows that the opinions of the students from the Pedagogical University and from the AGH University of Krakow differ only slightly. When asked about the direct social causes and consequences of climate change, students gave answers that showed that they did not see a correlation/relationship between these two phenomena. The detailed questions that followed, dealing with specific causes and effects of social change in the context of inequality, showed that students were able to see these relationships. The majority of students from both universities chose indirect answers, which showed that they were not fully convinced of the strong links between the climate crisis and social inequalities ("I have no opinion"; "has an indirect effect", etc.). This means that both future teachers and future engineers lack sufficient knowledge. Therefore, we need intensive, multi-faceted means of helping students and other community members to see the links between climate change and social inequalities. Such activities can help to address the adverse climate change on the one hand and facilitate action to promote social justice on the other.

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