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The importance of the Sustainable Development Goals to students of environmental and sustainability studies—a global survey in 41 countries

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To fight the global problems of humanity, the United Nations has adopted 17 Sustainable Development Goals (SDGs). To achieve these goals, it is necessary that future decision-makers and stakeholders in society consider these goals to be important. Therefore, in this study, we examined how important students in 41 countries directly related to the environmental sector rated each of the 17 SDGs. Based on the analysis of these ratings, it was possible to categorize the SDGs into three higher-level factors that reflect the three pillars of sustainability (social, economic, environmental). These three pillars are considered to be of varying importance in different countries. We also correlated the ratings of these higher-level factors with country-specific indicators, such as the Human Development Index. The correlations between the indicators and the higher-level factors revealed that in countries with higher indices, the SDGs are rated as less important compared to in countries with lower indices. These results provide stakeholders with important guidance on how the SDGs should be promoted in their country.

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Introduction

Currently, humanity is facing major environmental, social and economic problems worldwide. To address these global issues on an international cross-border level and to create a more sustainable and better future for all, the United Nations adopted the 17 Sustainable Development Goals (SDGs) in 2015 (United Nations, 2015). Each of the SDGs has indicators that are used to measure progress towards achieving the goals (United Nations, 2017). The individual goals do not stand alone but rather influence each other and are closely linked (Bali Swain and Yang-Wallentin, 2020; Nilsson et al., 2016; Pham-Truffert et al., 2020; Pradhan et al., 2017); each goal addresses environmental, social and economic problems (Elder and Olsen, 2019).

It is particularly important how the SDGs are perceived, accepted and evaluated by people worldwide. In this context, there have been several surveys conducted in recent years, some with varying results. While awareness of the SDGs has increased globally compared to their predecessor, i.e., the Millennium Development Goals (GlobeScan, 2016), 63% of the respondents in a survey of 28 European countries said they had never heard of the SDGs. Globally, awareness of the SDGs is approximately 50% (Theresa et al., 2020); however, only 1% of people say they are very well informed about the SDGs (Lampert and Papadongonas, 2016). There are also regional differences in the assessment of the individual goals. Globally, 'climate action', 'good health' and 'well-being and quality education' are considered particularly important (Theresa et al., 2020). In another survey, 'zero hunger', 'clean water and sanitation' and 'no poverty' were selected as the most important SDGs (Lampert and Papadongonas, 2016). Young people in particular are more likely to have heard of the SDGs, and for them, quality education is particularly important (Youth Speak Survey, 2020). In general, people around the world have a high level of acceptance about the content of the SDGs (Ipsos, 2015).

The education system has an important role in raising awareness of the SDGs and in teaching skills and values that lead to more sustainable behaviour. Therefore, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has developed learning objectives for the SDGs to support teachers and learners (UNESCO, 2017). Tertiary educational institutions are particularly important in this regard, as they educate the next generation of decision-makers who will have a critical impact on the future of the planet (Yuriev and Sierra-Barón, 2020). Universities, through their education and influence, contribute directly to the achievement of a whole range of SDGs (Kioupi and Voulvoulis, 2020). In recent years, there has been a strong increase in sustainability programmes at universities, with a particular focus on student attitudes (Rodríguez-García et al., 2019); however, there is wide divergence between programmes (O'Byrne et al., 2015). Despite the recent surge of sustainability in higher education, students generally have limited knowledge of the SDGs (Zamora-Polo et al., 2019). Higher education institutes, such as universities, have a special responsibility worldwide because they shape future leaders (Alshuwaikhat and Abubakar, 2008; Bellou et al., 2017), decision-makers (Alshuwaikhat and Abubakar, 2008; Lozano et al., 2013), professionals (Kioupi and Voulvoulis, 2020) and intellectuals in various academic fields (Lozano, 2006).

In addition to educating the next generation of decision-makers, which is most likely the most important factor, universities also make an important contribution to achieving the SDGs through research, public engagement or university policy (Kestin et al., 2017). They can influence politicians and industry leaders with their clear and unbiased information (Stephens et al., 2008) and reach a wide audience in the general population (Kioupi and Voulvoulis, 2020).

While elite positions in society can be reached independently of having a university education, universities provide knowledge and technical skills that significantly increase the likelihood that a person will achieve such a socially relevant position (Frank and Meyer, 2007; Vicente-Molina et al., 2013). Therefore, students, as potential future decision-makers of society, contribute greatly to the achievement of the SDGs and have an impact on the major problems of humanity and thus on the future of the planet. Until now, however, there has been a lack of valid international research that examines the perspective of students in the natural and sustainable sciences on the various SDGs. This study is an attempt to reduce the international research gap and examine the views of environmental students in different countries regarding the SDGs. The aim is to determine how important students in each country consider the SDGs to be. In this context, statistical methods will be used to check whether the individual SDGs can be assigned to higher-order groups on the basis of the students' evaluation. To identify patterns and differences between the countries, these higher-ranking groups were compared among the individual countries and correlated with country-specific indicators. The results are intended to provide guidance for action for today's decision-makers in individual countries.

Therefore, in our study, we asked more than 4000 university students in 41 countries whose course of study is directly related to sustainability to rate the 17 SDGs on a scale of 1–5 (important to unimportant). In the first step of the analysis, an exploratory factor analysis was used to investigate the extent to which the SDGs can be categorized into higher-level factors based on the participants' ratings. In a second step, we examined how these higher ranking factors differed among the 41 countries studied. In the final step, we analysed the relationship between these higher-ranking factors and various country-specific indicators (GDP per capita, the Human Development Index, the Education Index, the Environment Performance Index and the SDG Index).

Methods

Data collection procedure. The survey was conducted using an online questionnaire. To guarantee a high level of data protection and the anonymity of the participants, the survey software that is also applied for evaluation at Goethe University in Frankfurt was used. Students were shown the labels and descriptions of each SDG (Table 1) and asked to rate them on a scale of 1 to 5 (unimportant to important). The survey was conducted in one of the official languages of the respective countries. The translation of the questionnaires was performed by a native-speaking translator and always checked by an additional person. The translations of the SDGs were taken from the official website of the UN (United Nations, 2016). If no translation was available, the SDGs were translated by a translator following the same principle. The English version of the questionnaire can be found in Supplementary Fig. 1. To collect the data, professors and scientists worldwide were contacted and asked for their help. The scientists were asked to distribute the questionnaire among their students. An English cover letter was provided to participants and described the content and background of the study. In addition, a short introductory text at the beginning of the questionnaire explained the research project to the participants. Only people from natural science courses directly related to sustainability (e.g., biology, environmental sciences, ecology and conservation, natural resources management, etc.) were contacted.

A total of 4305 students (34.3% male, 63.6% female, 0.8% divers, 1.2% no answer) participated in the survey. The participants were on average 22.59 (±0.495) years old and in the 4.29th (±2.744) semester of study. The number of participants

Table 1 Results of the explorative factor analysis.

Label	Description	Factors		
		Factor 1 (social)	Factor 2 (economic)	Factor 3 (environmental)
Zero hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	0.786		
No poverty	End poverty in all its forms everywhere	0.732		
Good health and well-being	Ensure healthy lives and promote well-being for all at all ages	0.645		
Gender equality	Achieve gender equality and empower all women and girls	0.579		
Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all	0.572		
Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	0.500		
Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation		0.787	
Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all		0.661	
Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient, and sustainable		0.650	
Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development		0.592	
Reduced inequalities	Reduce income inequality within and among countries		0.497	
Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all		0.484	
Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	0.411	0.461	
Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development			0.801
Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss			0.797
Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy			0.726
Responsible consumption and production	Ensure sustainable consumption and production patterns		0.478	0.533

The values shown are the factor loadings after the varimax rotation. Factor loadings < 0.4 are not shown. Cross-loadings < 0.4 appear only for two SDGs. Label and the description were part of the questionnaire. Factor 1 represents the social pillar, Factor 2 represents the economic pillar, and Factor 3 represents the environmental pillar of sustainability.

broken down by country is shown in Supplementary Table 2. The survey period was September 2020–July 2021.

The study was reviewed by the ethics committee of the science didactic institutes and departments of the Goethe University Frankfurt am Main under approval number 15-WLSD-2104. If a university required a local ethics vote, that vote was also conducted prior to the survey.

Analysis. An exploratory factor analysis was conducted to examine the relationship between the individual SDGs and to assign the SDGs to higher ranking factors based on the students' ratings. This is a structure-simplifying procedure that is used to assign individual variables or items to higher-order factors and thus simplify the interpretation of the data (Yong and Pearce, 2013). In simple terms, a factor analysis generates a correlation matrix (*R*-matrix) for all items used. Items that correlate particularly well and separate themselves from other item clusters are assigned to a higher ranking factor (Field, 2013). The rotation method chosen was varimax, which is considered the most reliable orthogonal rotation method (Fabrigar et al., 1999). To check whether the data were at all suitable for this type of analysis, Bartlett's test of sphericity and the Kaiser–Meyer–Olkin measure of sampling adequacy were performed (Dziuban and Shirkey, 1974). The number of factors was determined by the Kaiser criterion, which takes into account all factors that have an eigenvalue larger than 1 (Kaiser, 1960). To examine whether the values of the three higher-level factors found by the factor analysis differed within countries or whether the factors were perceived to be of similar importance, the (two-tailed) Friedman test was used (Field, 2013). For significant results, a pairwise comparison was performed using the (two-tailed) Dunn–Bonferroni test (Dunn, 1964). The effect size was calculated using the following formula: $r = \frac{Z}{\sqrt{N}}$ (Fritz et al., 2012).

To investigate whether there is a linear relationship between the factors found through factor analysis and the indices of each country (e.g., the Human Development Index and the Education Index), the Spearman rank correlation was calculated. The Spearman rank correlation was selected because the data were ordinally scaled and not normally distributed (Field, 2013; Schober et al., 2018).

Selected indices. The following five country-specific indices were selected:

- Gross domestic product per capita (GDP per capita, 2021): GDP per capita is a value calculated by organizations such as the international monetary fund (International Monetary Fund, 2021). It is often used as an indicator of the standard of living, even though some weaknesses in this interpretation are currently known (Goossens, 2007).
- Human Development Index (HDI from 2020): The HDI is an indicator of the United Nations (Conceição et al., 2020) that consists of life expectancy, the average number of years of schooling, and the standard of living (United Nations Development Programme, 2020b).
- Education Index (EI from 2020): The EI is a United Nations indicator that consists of the number of years of schooling that an adult person has attended on average and the expected years of schooling that a child will attend (United Nations Development Programme, 2020a).
- Environment Performance Index (EPI from 2020): The EPI is an index that assesses environmental health and ecosystem vitality using 32 performance indicators (Wendling et al., 2020).
- SDG Index (SDGI from 2021): The SDGI is an indicator of the Bertelsmann Foundation that attempts to calculate the progress of the SDGs in percent based on various indicators. For example, if a country has an SDGI of 85.9, then approximately 86% of the SDGs have been achieved by that country (Sachs et al., 2021).

Results

Both the Bartlett test ($p < 0.001$) and the KMO criterion (KMO = 0.924) confirmed the applicability of an exploratory factor analysis for the 17 SDGs. The analysis revealed three factors with an eigenvalue > 1, indicating that the SDGs can be attributed to three higher-order factors (social, economic, environmental), which together can explain 53.48% of the variance. Overall, there was a clear assignment of items to the factors, and only a few cross-loadings were observed (Table 1).

The comparison of the three sustainability factors within the tested countries showed that the countries rated the individual dimensions of the SDGs differently. For example, in some countries, all three sustainability factors were rated as being equally important (Fig. 1a); thus, there was no significant difference between the factors. In a number of countries, the environmental component was rated higher than the economic component, but no difference was found between the social and environmental components or between the social and economic components (Fig. 1b). In the third group, the economic factor was rated as slightly less important than the environmental and social factors (Fig. 1c). In some countries, the environmental factor was rated significantly higher than the other factors (Fig. 1d). For better clarity, the individual significance levels are not marked in Fig. 1 but can be found along with the effect sizes in Supplementary Table 1.

The three higher-level sustainability factors show significant correlations with all five selected country-specific global development indices ($p < 0.001$). The correlations are shown in Table 2.

All correlations are in the high range according to the common interpretation (Field, 2013). It is noteworthy that there is a negative correlation for all the global development indices examined. It follows that students in countries with higher indices rate the SDGs as less important than do students in countries with lower indices. For all the global development indices tested, a higher score means a higher standard. In other words, students in countries with, for example, a higher standard of education or higher income per person consider the SDGs to be less important compared to their counterparts.

The correlations between the three sustainability factors found and the individual indices are shown in Fig. 2. The importance score refers to the mean values of the individual sustainability factors for the different countries. The dashed lines represent the linear trend.

Discussion

The results of this study provide important information on how students in the environmental field worldwide perceive and evaluate the 17 SDGs. Based on the rating of the importance of the individual SDGs, it was possible to assign them to three higher-level factors in the factor analysis. Although each of the 17 SDGs contains all three pillars of sustainability (social, economic and environmental (Purvis et al., 2019)) and the different levels of sustainability build on each other (Sachs, 2012; United Nations, 2015), it has also been shown in previous studies that people assign the SDGs to individual pillars to varying degrees (Bain et al., 2019; Dalampira and Nastis, 2020; Elder and Olsen, 2019). Reviewing the three higher-level factors, it can be assumed that our data also reflect such a classification. When considering only the labels and short descriptions, Factor 1 includes the SDGs that are primarily considered social, Factor 2 includes the SDGs that are considered economic, and Factor 3 includes the SDGs that are

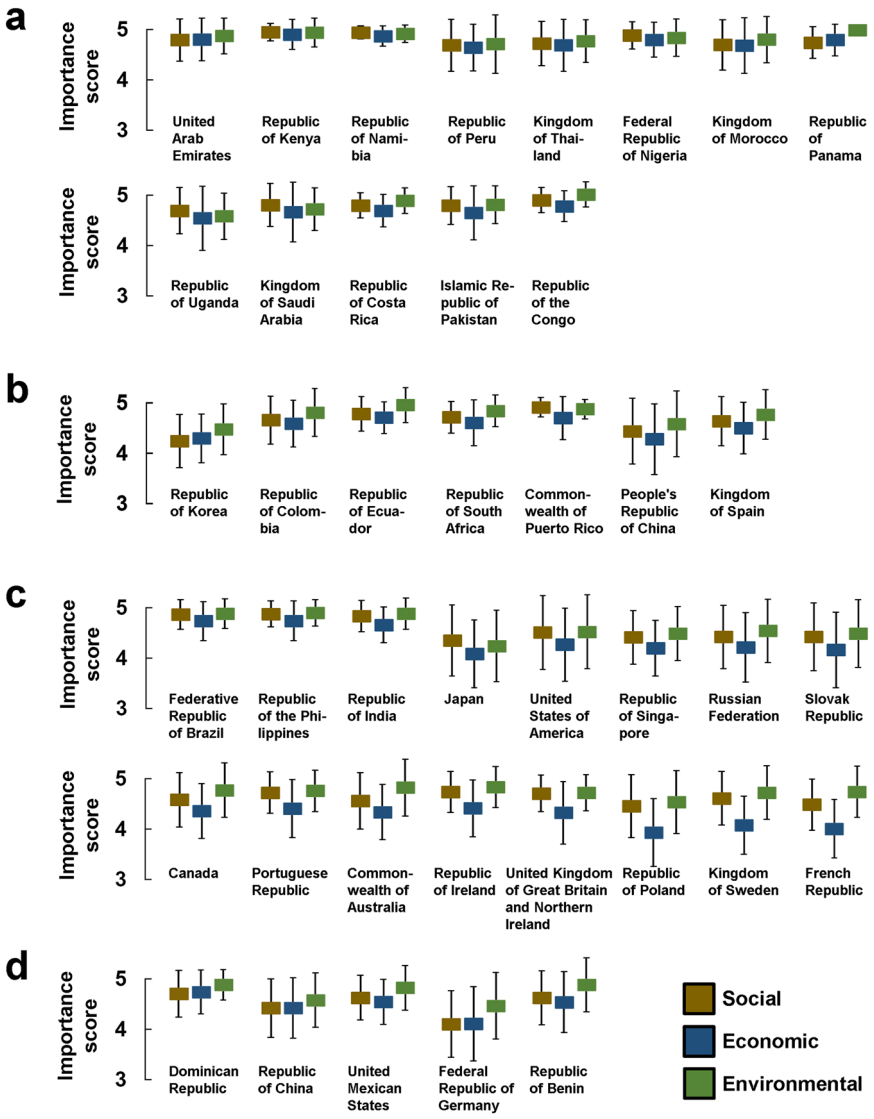

Fig. 1 Illustration of the three factors of the SDGs (social, economic, environmental) for each of the surveyed countries. In group (**a**), there are no significant differences between the three factors within the countries. In group (**b**), the environmental factor is rated higher than the economic factor but not higher than the social factor. In group (**c**), the economic factor is rated lower than the other two factors. In group (**d**), the environmental factor is rated significantly higher than both the economic and environmental factors. For clarity, the significance levels are not marked with asterisks in the figure. Exact significance levels and effect sizes can be found in Supplementary Table 1. The boxes represent the mean of the components; the error bars represent the standard deviation.

Table 2 Spearman correlations between the three discovered higher-level factors of the factor analysis and the five selected global development indices.

	Factor 1 (social)	Factor 2 (economic)	Factor 3 (environmental)
Gross domestic product (GDP) per Capita Person	−0.551	−0.661	−0.533
Human Development Index (HDI)	−0.626	−0.694	−0.611
Education Index (EI)	−0.614	−0.691	−0.592
Environment Performance Index (EPI)	−0.591	−0.670	−0.525
SDG Index (SDGI)	−0.620	−0.712	−0.577

All correlations are significant ($p < 0.001$).

considered environmental (Elder and Olsen, 2019). While in previous studies, respondents were often asked directly to assign the SDGs to the three pillars of sustainability, in this study, the classification was solely based on the different ratings of the importance of each SDG.

The clear separation of the SDGs into these three groups and the low cross-loading values suggest that environmental students worldwide make this categorization and assign different importance to the SDGs in the three groups, potentially subconsciously. It can be concluded that the students consider ecological,

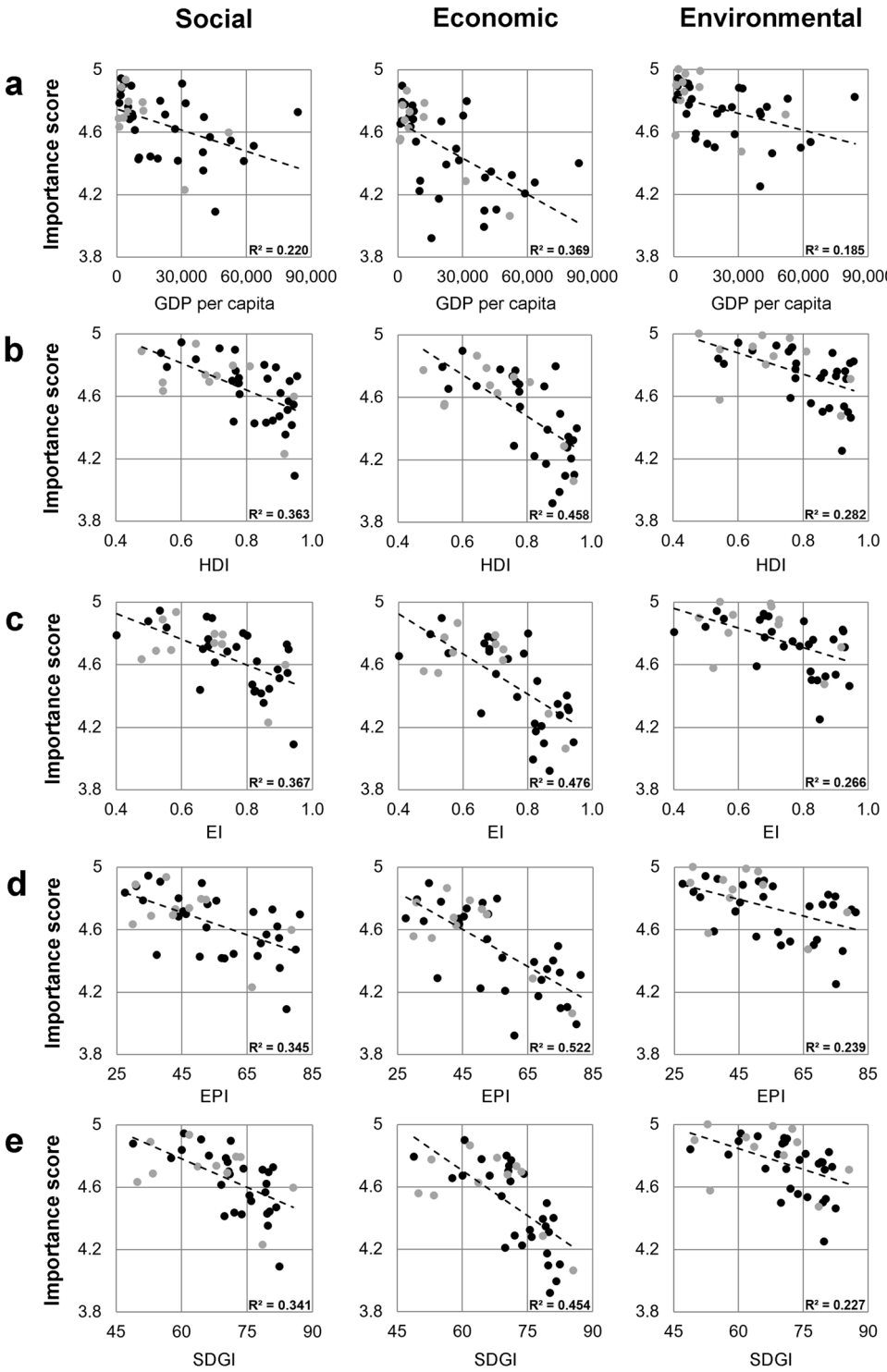

Fig. 2 The mean values of the countries of the assessed importance for the three sustainability factors (social, economic, environmental) plotted against the global development indices examined. Each point represents one country. Countries with fewer than 50 respondents are shown in grey, and countries with more than 50 respondents are shown in black. **a** Gross domestic product per capita in US dollars, **b** Human Development Index, **c** Education Index, **d** Environment Performance Index, and **e** SDG Index.

economic and social challenges to be of varying importance. This finding provides an essential starting point for decision-makers in tertiary education institutions. In addition to the current increasing number of courses with a focus on sustainability (O'Byrne et al., 2015; Rodríguez-García et al., 2019), more emphasis should be placed on the interconnectedness of the individual layers of the various SDGs. For each SDG, attention should be given to highlighting social, environmental and economic components and to underlining the close relationship between these pillars. In this way, the importance of all three components of each SDG can be taken into account for current issues. Fisheries, for example, have important elements of the social and economic components, in addition to the environmental component, and all of these elements are closely linked

(Asche et al., 2018). These connections should be addressed and highlighted in environmental education courses.

When comparing these three factors within the countries, different patterns emerge. In approximately two-thirds of the countries, the three factors are not rated as equally important. A noticeable pattern, which is particularly evident in a number of industrialized countries, is that the gap between the economic factor and the other two factors is particularly large. This could well be explained to some extent by the attitudes of people in industrialized countries; i.e., environmental issues, such as fighting climate change, are seen as particularly important aims in North America and Europe (Theresa et al., 2020). When considering problems in developing counties, people in Europe often rate issues belonging to the social component (such as peace and security) as particularly important (European Commission. Directorate General for International Cooperation and Development. et al., 2016). This potentially leads to the assessment that the environmental and social factors are particularly important, while the economic SDGs are perceived as less important, as they do not fall into either category.

Another pattern that repeatedly emerges is that the environmental component is rated as being more important than one or both of the other components. In no country was the environmental component rated significantly worse than the two other factors. These results are very positive, as environmental problems are currently more relevant than ever before. The boundaries of our planet are being increasingly exhausted, and there is an urgent need for action at the global level (Steffen et al., 2015). The high rating of environmental factors also shows a particularly positive trend in all countries. In the past, many governments and experts prioritized economic growth and considered environmental damage as a trade-off (Elder and Olsen, 2019). The common approach has been to accept pollution as a consequence of economic growth and to deal with the related environmental problems that arise later (Azadi et al., 2011). This view is not reflected in our study of environmental students. In the current study, environmental concerns are considered to be at least as important, and in some countries even more important, than social and economic factors.

The differences identified between countries can serve as a possible guide to action for local decision-makers who can incorporate specific promotion of the importance of different SDGs into the curriculum. In this way, country-specific actions can be implemented that specifically address the economic, ecological or environmental awareness of each of the SDGs. These results can also be seen as a call to those countries in which the gap between the three factors is particularly large. Especially in these countries, political or educational actions, such as emphasizing the global importance of the economic SDGs in the educational context, would be particularly important.

The comparison of the country-specific indicators with the rating of the importance of the higher-level factors shows a similar picture for all indicators. In countries with higher indices (higher GDP per capita, higher health index, etc.), the SDGs are generally rated as being less important than in countries with lower indices. In this context, it does not matter whether the SDGs are perceived as social, economic or environmental. This result is surprising, since in previous international studies, it was often found that people in wealthier countries, i.e., countries with a higher GDP per capita, have a more positive attitude towards, for example, environmental problems, than do people in countries with a lower GDP per capita (Franzen, 2003; Franzen and Meyer, 2010; Franzen and Vogl, 2013). The research of and theory put forth by Inglehart is often used as a basis for explanation. He found that in countries where postmaterialist values dominate, people have a more positive attitude towards environmental protection than they do in countries with more materialist values. Thus, postmaterialist values are more likely to be found in advanced industrial societies (Inglehart, 1995). However, postmaterialist values do not necessarily lead to higher support for the SDGs (Guan et al., 2019). Our study also supports this assumption. The results show that, on average, people in societies with higher indices (usually industrialized societies) rate the SDGs as being less important than do people in countries with lower indices. This provides important insights for politicians, stakeholders and decision-makers; i.e., in wealthier countries that have already made great progress in implementing the SDGs, the relevance of the SDGs must be communicated at different levels. Particular attention must be paid to higher educational institutions. The fact that the SDGs are rated lower on average in wealthier countries with a higher Education Index outcome shows that it is especially in these countries that there is a need to improve the related knowledge and that the focus of higher education institutions should be placed specifically on content related to the SDGs. In this context, it is not sufficient to teach only basic scientific knowledge (Frick et al., 2004); rather, other factors, such as attitudes (Gifford and Sussman, 2012) or values (Steg and Groot, 2012), should also be a particular focus of education. The importance of the SDGs should be considered not only for specific countries but also in an international and global context. Thus, these topics could be integrated into the curricula of universities and schools to enable students, as future decision-makers in society, to act as multipliers and pass on the relevance and importance of the SDGs in society.

Limitations

Although the study was conducted with great care, some limitations must be addressed. For example, the study surveyed a very select group of students in environmental and sustainability science courses. It can be assumed that people in these courses are more interested in environmental issues than the general population. However, because a similar group of students was surveyed in each country, cross-country comparison is possible. Nevertheless, it must be assumed that the results cannot be generalized to other courses of study or to the general population. Further international studies are necessary to investigate relationships in other groups.

Another limitation of the study is that the survey was conducted by e-mail on a voluntary basis. This could possibly lead to self-selection; i.e., people who were already interested in the topic of the SDGs were more likely to participate in the survey.

It should also be mentioned that the sample size differs in part between the individual countries. While in some countries, several hundred people could be surveyed, in other countries, only a sample size in the two-digit range was possible. This result could potentially have had an influence on the comparison between the countries.

When evaluating the individual SDGs, it cannot be ruled out that the students did not rate each SGD independently but rather related their importance to each other. As a result, some SDGs may have been rated differently than they would have been without such a direct comparison. However, since this effect was equally possible in all countries, the results remain comparable, and the conclusions remain valid.

Conclusion

The current research was able to show that the importance of the SDGs, regardless of the pillar of sustainability (social, economic, environmental), is considered important by students in environmental and sustainability science courses in different countries. However, there are variations between the countries in how

important the individual pillars for sustainability are considered to be. This result offers the opportunity to specifically promote individual pillars for sustainability in those countries in which a pillar was perceived as being less important. Another important finding of the study is that especially in countries with high global development indices, the SDGs are rated as less important compared to the ratings in countries with lower global development indices. Therefore, our research is a call to countries with higher indices, where the SDGs have already been implemented to a higher extent, to actively improve the view and acceptance of students regarding the SDGs. This can help to further achieve the SDGs both in individual countries and at the global level.

Data availability

The raw data supporting the conclusions of this article will be made available by the authors to any qualified researcher.

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Author contributions

Conceptualization: MWK and PWD; data collection: MWK; methodology: MWK and PWD; validation, formal analysis, investigation: MWK and PWD; figures: PWD and MWK; writing—original: MWK; writing—review and editing: MWK and PWD, funding acquisition: PWD. All authors contributed to the article and approved the submitted version.

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Competing interests

The authors declare no competing interests.

Ethical approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of the science didactic institutes and Departments of the Goethe University Frankfurt am Main under approval number 15-WLSD-2104.

Informed consent

Participants were informed in writing before the start of the online survey about the voluntary character of participation, data protection and the aims of the study. After this information, participation in the study was considered informed consent. Participants could withdraw from the study at any time by closing the browser. It is not possible to identify individuals from the anonymously obtained data, and only persons of legal age were surveyed.

Additional information

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