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Attitudes towards environment and technology: preliminary investigation of associations

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Completed Research

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Abstract

The development of science and technology (ST) should respond to the needs of today's world, which is unfortunately heading towards a climate catastrophe. Many people do indeed use ST to protect the environment. However, for many, technological progress, economic growth is prioritized over environmental concerns. The presented study tracks the mutual relation of these attitudes. Log-linear analysis was conducted using secondary data obtained from the World Values Survey. The study sample includes all European countries that participated in the survey and Canada, China, Turkey, United States of America. The research considers four types of attitudes: Synergy of attitudes, Green attitudes, Red attitudes and Rejection of attitudes. The results explain the relationship between classification into a particular type of attitudes and variables such as gender, age, education level. The study is addressed to practitioners, policy-makers, educators interested in better understanding the needs of future participants in educational activities for environment protection.

Keywords

Adult Education, Attitudes towards environment, Education for Sustainable Development, ICT4D, Log-linear analysis.

Introduction

Science and technology (ST) are changing our world, whether we like it or not. Some studies argue that the rapid development of technology has a negative impact on human well-being (Twenge et al., 2018) and should be slowed down. Others suggest that developments in science and technology, especially those based on information and communication technologies (ICT), are essential in helping to solve the many problems we face (Scarrà & Piccaluga, 2020). The attitudes and beliefs of users of these systems are reflected in the research that has been conducted. Indeed, research confirms that some of them regard technology use as an enforced necessity seeing the negative impacts of technological progress, while others are eager to test and implement any technological innovation into their daily lives seeing it in bright colors.

The findings suggest that the negative impact of ST development manifests itself in many areas of our lives. It has affected our sleeping habits. A new lifestyle has developed among many people who actively use new technologies, especially among those born in the age of advanced science and technology. Surfing the Internet in the evening and at night, texting on social networks, and playing games reduce the daily sleep time and sleep quality. Research shows that the heavy use of social networks leads to increased feelings of loneliness (Matthew & Reich, 2016) and increased diagnoses of depression and anxiety (Twenge & Campbell, 2018). In recent years, mass media and social networking activities have increased the reach of disinformation and fake news. It was particularly evident during pandemics (Tagliabue et al., 2020). At that time, disinformation was used to steer public perceptions of risk. The growing technological exclusion of certain social groups is also an undeniable problem (Czaja & Urbaniec, 2019; Seifert, 2020).

On the other hand, the positive impact of ST development is manifested by the innovative technological solutions implementation facilitating the satisfactory functioning of man in today's world. The use of

systems that automatically recognize critical situations reinforces a sense of security, including for older people at risk of sudden illness incidents (Kirchbuchner et al., 2015). The development of science and technology, especially those based on artificial intelligence (AI), Virtual Reality (VR), or robotics, is improving the quality of medical and healthcare services (Garg, 2021). The evolution of high technology has a significant impact on knowledge transfer and human capital development, contributing to the high socio-professional competencies improvement leading to job and personal life satisfaction (Kowal et al., 2017). But what is extremely important is that advanced technologies using cyber-physical solutions, blockchain, AI, or others, can become the answer to the environmental problems that are deepening and threatening humanity. Tackling progressive climate change is becoming a priority driving the work of many researchers or specialists involved in information and communication technology for development (ICT4D) (Kreps et al., 2018, Rothe & Van Audenhove, 2020).

The next section of the paper will include: the second part – the presentation of the current study and research questions, the third part – the establishment of the research methodology, the fourth part – presentation of conducted analyses' results, the fifth part - focus on the discussion, sixth part - a summary of the research findings, the final section is the presentation of references.

Current study

The perception of negative and positive sides of advanced technology is related to the attitudes and beliefs of future users, on whom the effective implementation of ICT4D solutions depends the most. The scale of feelings towards modern technology can be broad. On the one hand, we can deal with technophilia, "defined as attraction, the enthusiasm of the human individual determined by the activities which involve the use of advanced technologies. It is expressed by easy adaptation to the social changes brought by technological innovations. The term technophilia is used to highlight how technology can evoke strong futuristic positive feelings" (Osiceanu, 2015:1138). By contrast, on the other, there is the phenomenon of technophobia. "Technophobia is defined as an irrational fear or anxiety caused by side effects of advanced technologies. The definition involves two components: first, the fear of side effects of technological development on society and the environment; and second, the fear of using technological devices such as computers and advanced technology" (Osiceanu, 2015:1139). Between these two extremes, however, there are intermediate attitudes. Their knowledge and their understanding should be crucial when implementing ICT4D projects.

Ongoing research on people's attitudes indicates that they can be variable over time (Aronson et al., 2016). As they are one of the key factors influencing the success or failure of project activities (Heeks & Alemayehu, 2009; Ashraf et al., 2014), we should rely on the results of recent research on social attitudes when planning to start a new project. Given these considerations, the presented study aims to deepen the knowledge about the most current social attitudes towards two intersecting fields. The first concerns environmental protection, and the second is the perception of the impact of science and technology on people's lives. The study was conducted based on the following research questions: (1) *Have the attitudes of selected nationalities towards the problem of prioritizing environmental protection changed in the last decade?*; (2) *Have attitudes of selected nationalities towards the sense of the impact of science and technology on people's lives changed in the last decade?*; (3) *What other factors are related to the analytically emerged factor 'attitude type'?*

The analysis consisted of three stages. Firstly, a unique national index was determined. This index reflected the declared attitudes towards the environment, science, and technology. Next, four types of attitudes were identified. Then, the knowledge of each attitudes type was deepened by considering categorical variables such as gender, age, education level. This study used log-linear analysis, a statistical method that allows a more accurate assessment of interactions and relationships between variables.

Method

Procedure

The research was conducted using secondary data analysis. Data came from the World Values Survey (WVS) Wave 6 (Inglehart et al., 2014) and Wave 7 (Haerpfer et al., 2022). Data were collected during a face-to-face interview at the respondent's residence place. Responses were recorded on a paper questionnaire or a computer-assisted personal interview (CAPI).

The attitudes towards environmental protection were assessed on the basis of the answers to the question:

V81/Q111. "Here are two statements people sometimes make when discussing the environment and economic growth. Which of them comes closer to your own point of view?" respondents had a choice of three closed answers: "1. Protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs; 2. Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent; 3. Other answer".

The attitudes towards science and technology were assessed on the basis of the answers to the three question:

"Now, I would like to read some statements and ask how much you agree or disagree with each of these statements. For these questions, a 1 means that you "completely disagree" and a 10 means that you "completely agree." V192/Q158. Science and technology are making our lives healthier, easier, and more comfortable. V193/Q159. Because of science and technology, there will be more opportunities for the next generation. V197/Q163. All things considered, would you say that the world is better off, or worse off, because of science and technology? Please tell me which comes closest to your view on this scale: 1 means that "the world is a lot worse off," and 10 means that "the world is a lot better off." (Code one number)".

Participants

The analysis uses data from selected national societies. As the study is part of a project carried out in Europe, the research focus was on this area. The study sample includes all European countries that participated in the survey and Canada, China, Turkey and United States of America, countries of interest to the project team. A complete comparison of the two waves was difficult because the survey was conducted by two institutions (the World Values Survey Association and the European Values Study), which used non-identical questionnaires. For this reason, countries where questions about science and technology were not asked in wave 7 were excluded from the analysis. The WVS Wave 6 sample analyzed size included 20 052 cases, of which China 2300 (11.5%), Cyprus 1000 (5.0%), Estonia 1533 (7.6%), Germany 2046 (10.2%), Netherlands 1902 (9.5%), Poland 966 (4.8%), Romania 1503 (7.5%), Slovenia 1069 (5.3%), Spain 1189 (5.9%), Sweden 1206 (6.0%), Turkey 1605 (8.0%), Ukraine 1500 (7.5%), United States of America 2232 (11.1%) cases. The WVS Wave 7 sample analyzed size was 20 389 cases, of which Andorra 1004 (4.9%), Canada 4018 (19.7%), China 3036 (14.9%), Cyprus 1000 (4.9%), Germany 1528 (7.5%), Greece 1200 (5.9%), Romania 1257 (6.2%), Serbia 1046 (5.1%), Turkey 2415 (11.8%), Ukraine 1289 (6.3%), United States of America 2596 (12.7%) cases.

Data analysis

In the WVS study, responses to three questionnaire questions (three factors/variables) allow assessing the respondents' attitudes towards feelings of influence of technology on our lives. To reduce the number of independent variables into manageable one called latent variable representing those attitudes, the principal component analysis (PCA) was employed. This method explores the extent of the respondents' response variation in the items.

In the next step, selected variables determining individual characteristics of respondents of WVS Wave 7 were included in the log-linear analysis (Allen, 2017). They were: gender, age, level of education. According to the WVS7 survey, gender was a dichotomous variable (male, female), age was classified into six intervals (16-24, 25-34; 35-44, 45-54; 55-64; 65 and more years), level of education into three groups (lower, middle, higher), types of attitudes revealed in the first step of analyses. All analyses were performed using IBM SPSS Statistics, version 27.

Results

Table 1 presents the results of PCA over three components measuring respondents' attitudes towards feelings of influence of science and technology on people's life. The analyses were performed separately for the two last sessions of WVS.

These components analysis, with an eigenvalue cut-off of 1.0, suggests that one factor explained 69% of the data measuring respondents' attitudes towards science and technology. The factor includes three items

("Science and technology are making our lives healthier, easier, and more comfortable", component 1 with loading 0.88(wave 6)/0.87(wave 7), "Because of science and technology, there will be more opportunities for the next generation", component 2 with loading 0.87/0.86, "The world is better off, or worse off, because of science and technology", component 3 with loading 0.73/0.76).

	WVS 2010-2012, Wave 6			WVS 2017-2020, Wave 7		
Agreement on technology influence (1=completely disagree, 10=completely agree)	n	M (SD)	Item loading	n	M (SD)	Item loading
Q1. IT make our lives better	19212	7.57 (2.13)	1.0	20154	7.59 (2.17)	1.0
Q2. IT give more opportunities	19129	7.80 (2.06)	1.0	20097	7.68 (2.13)	1.0
Q3. IT make world better	19268	7.44 (2.05)	1.0	20077	7.44 (2.16)	1.0
	Initial eigenvalue	% of variance explained		Initial eigenvalue	% of variance explained	
Component 1	2.07	68.99		2.09	69.56	
Component 2	0.64	21.17		0.58	19.37	
Component 3	0.30	9.84		0.33	11.07	
Total		100.00			100.00	

Table 1. Results of PCA over three components measuring respondents' attitudes

Next, the standardized mean values for each country was calculated and compared, both for WVS wave 6 and 7 (see Figure 1). The results indicate that in 2010-2012 the highest belief that science and technology would improve people's life was in China, Poland, Estonia, Turkey, Ukraine, and Sweden. However, for Poles, Ukrainians economic growth was more important than environment protection, while Swedes, Chinese, Turks, and Estonians were more concerned about protecting the environment. On the other hand, Cyprus, Slovenia, the United States of America, Romania, and Spain were not only more concerned about economic growth but also did not highly believe that science and technology would improve their lives.

Following the procedure suggested by Koch and Fritz (2020), the analyses in the next step have focused on the national populations. As it aimed to identify factors related to the analytically emerged factor 'attitude type' this part of the study focuses on the most recent survey results. Based on the WVS Wave 7 the four groups of these populations were determined: (1) Synergy of attitudes - people give priority to protecting the environment and are concerned that science and technology will improve the quality of their lives; (2) Green attitudes - people give priority to protecting the environment but do not believe that science and technology will significantly improve the quality of their lives; (3) Red attitudes - people do not give priority to protecting the environment but are concerned that science and technology will improve the quality of their lives; (4) Rejecting attitudes - people do not give priority to protecting the environment and do not believe that science and technology will improve the quality of their lives either. These four groups were identified on the basis of the individual PCA factor and standardized scores for Q111 question responses. For pro-environmental attitudes, the values below zero (responding to the mean value) classified to a given subgroup. For pro-technology attitudes, the values above zero classified to a given subgroup (see Figure 2).

The results of wave 7 of the WVS indicate a high pro-environmental attitudes in the respective national populations. The dominant support for environment protection is declared in Andorra (34.6% synergy of attitudes and 39.8% green attitudes), China (56.8% synergy of attitudes and 12.0% green attitudes), Germany (37.1% synergy of attitudes and 29.4% green attitudes), and Canada (31.1% synergy of attitudes and 30.2% green attitudes). The high level of pro-environmental attitudes but with less concern for the positive role of science and technology in people's life is noticed in Turkey (28.1% synergy of attitudes and 29.4% green attitudes), Greece (30.9% synergy of attitudes and 25.8% green attitudes), United States (30.7% synergy of attitudes and 22.5% green attitudes), Cyprus (24.2% synergy of attitudes and 28.1% green attitudes) and Ukraine (29.0% synergy of attitudes and 22.1% green attitudes). More than a quarter of the

population prioritizes economic growth over environmental protection and the belief that science and technology will improve the quality of people's life present by residents of Romania (33.5% red attitudes),

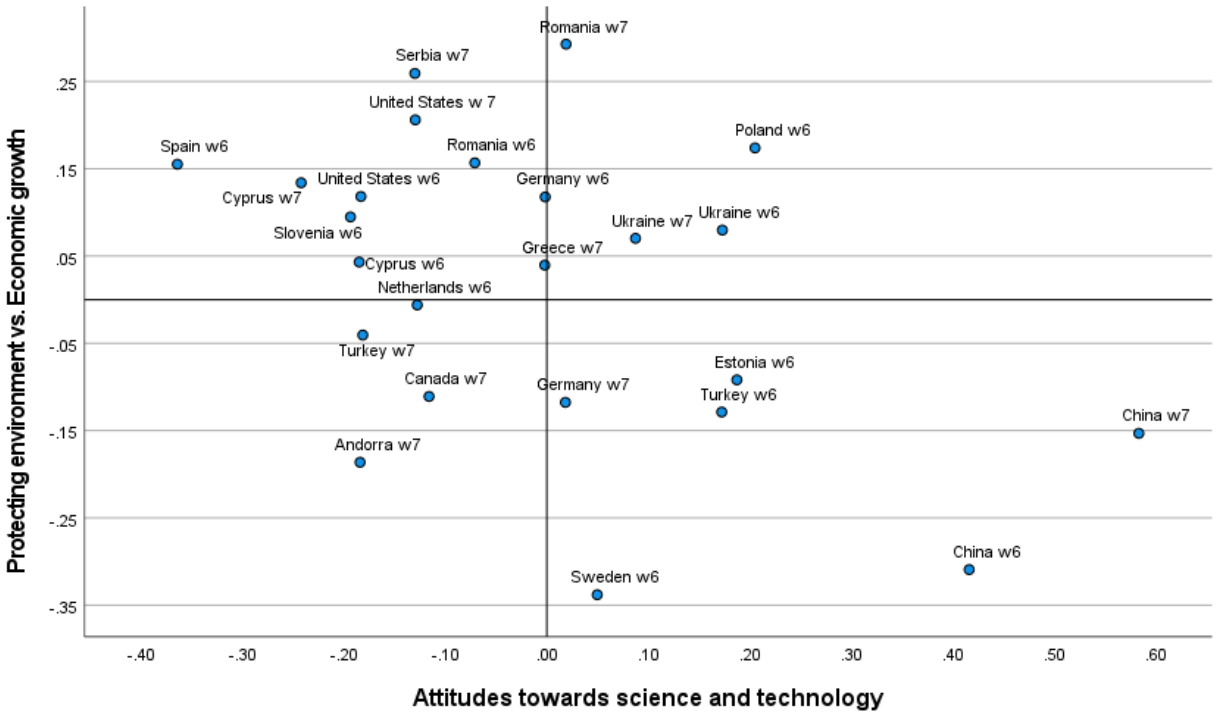

Figure 1. Country standardized values of environmental and technology attitudes for WVS Wave 6 (n = 18 889) and Wave 7 (n = 19 606). Author's own elaboration

Ukraine (28.9% red attitudes), Serbia (27.5% red attitudes), China (25.2% red attitudes). The lowest level of pro-environmental attitudes and less concern about the positive role of science and technology in people's life is noticed in Cyprus (28.5% rejecting attitudes), the United States (27.7% rejecting attitudes), Romania (26.3% rejecting attitudes), and Serbia (25.4% rejecting attitudes).

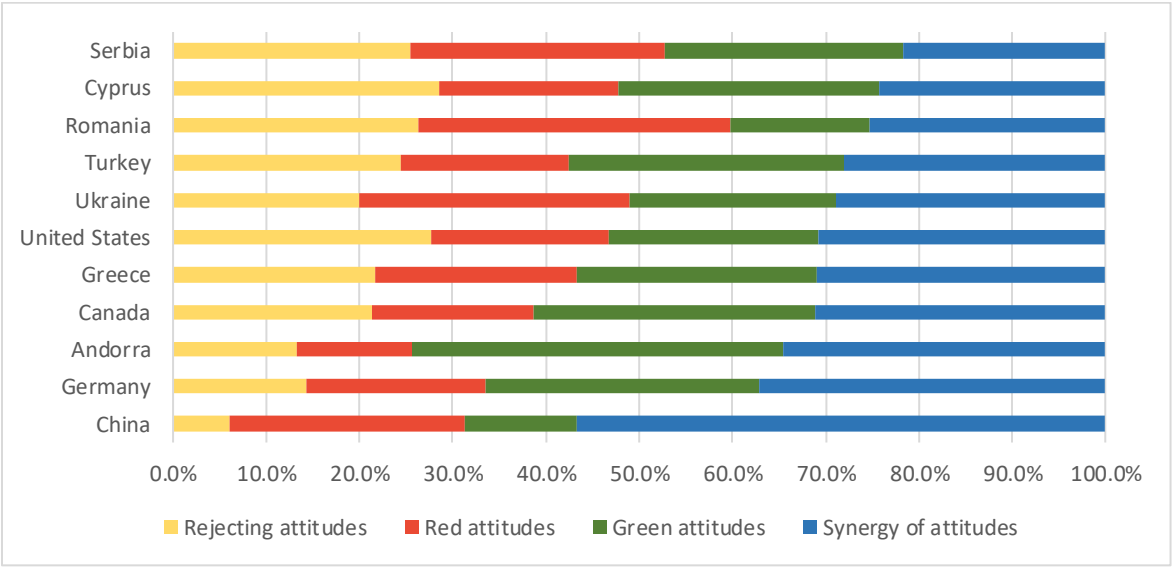

Figure 2. Types of environmental and technology attitudes for WVS Wave 7 (n = 19 543). Author's own elaboration

To further investigate the characteristics of the different types of attitudes, a log-linear analysis was carried out in the next step. Four categorical variables were entered into the model: type of attitudes (four intervals), gender (two intervals), age (six intervals) and highest educational level (three intervals). The saturated model was supported by all four three-way interactions, two-way associations, and main effects. A significant association was found between age and education level, attitude type and education level, gender and education, gender and age, attitude type and age, and gender and attitude type, so these variables were included in the log-linear model. It means that not only the main variables condition the classification into a group representing a given type of attitude, but also the association between these variables. Table 2 shows the results of the individual associations and interactions. Fourth-order interactions, not reported in Table 2, were found to be statistically insignificant (p = .604). The log-linear analysis revealed poor fitness of third ordered log-linear models ($\chi 2 = 272.62$, $p < .001$) and the rejection of the saturated model.

Effects	Degree of freedom	Partial likelihood-ratio, Chi-square	*p*-value
Main effects			
Type of attitudes	3	911.39	<.001
Education	2	776.99	<.001
Age	5	687.77	<.001
Gender	1	13.32	<.001
Associations			
Education*Age	10	871.23	<.001
Type*Education	6	171.99	<.001
Gender*Education	2	100.29	<.001
Gender*Age	5	83.71	<.001
Type *Age	15	73.24	<.001
Gender*Type	3	47.09	<.001
Interactions			
Gender*Education*Age	10	112.68	<.001
Type*Education*Age	30	72.57	<.001
Gender*Type*Age	15	28.69	.018
Gender*Type* Education	6	28.66	<.001

Table 2. The saturated model partial associations

In the next steps all four three-way interactions were removed from the saturated model (Gender*Type* Education $\chi^2 = 28.66$, p = <.001, Gender*Type*Age $\chi^2 = 28.69$, p = . 018, Gender*Education*Age $\chi^2 = 112.68$, $p < .001$, Type*Education*Age $\chi^2 = 72.57$, p = <.001), revealing small change in chi-square value (27.36) and non-significant ($p = .604$). It confirms that the final unsaturated model is optimal and fitted to the original data, then accepted. The main effects values indicate that the strongest predictors of the model outcome are type of attitudes ($\chi^2 = 911.39$), followed by education ($\chi^2 = 776.99$) and age ($\chi^2 = 687.77$). Gender contribute least to the model ($\chi^2 = 13.32$).

Regarding main effects for particular types of environmental and technology attitudes (see Figure 3), a higher proportion of the pro-environment attitudes were declared by people with higher level of education (62.6%: 37.6% synergy of attitudes and 25.0% green attitudes), compared to those with middle (56.3%) and lower level of education (56.6%). A higher proportion of the pro-technology attitudes were declared by those with higher level of education (58.3%: 37.6% synergy of attitudes and 20.7% red attitudes), compared to people with lower (57.6%) and middle level of education (50.3%).

In case of gender pro-environmental attitudes were declared to a greater extent by women (59.8%: 33.1% synergy of attitudes and 26.7% green attitudes) than men (57.8%: 34.9% synergy of attitudes and 22.9% green attitudes). Regarding particular types of environmental and technology attitudes, a higher proportion of men declared the pro-technology attitudes (synergy of attitudes 50.1%, red attitudes 51.7%), while a higher proportion of women declared the pro-environmental attitude types (green attitudes 55.2%, rejecting attitudes 52.2%).

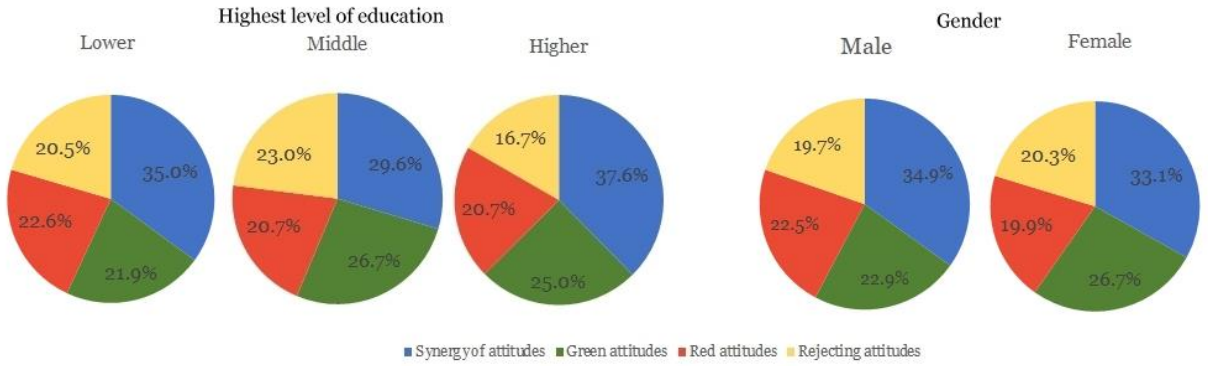

Figure 3. Particular types of environmental and technology attitudes. Author's own elaboration

Regarding the effects of age (Figure 4) pro-environmental attitudes decreased with age. They were declared to a greater extent by young people aged 16-24 (64.1%) compared those aged 25-34 (61.5%), 35-44 (59,1%), 45-54 (57,4%), 55-64 (57,0%), 65 and more (54,9%). The opposite direction was indicated by pro-technology attitudes, they were declared to a greater extent by people aged 65 and more (57,1%) compared those aged 45-54 (56,2%), 55-64 (55,5%), 16-24 (55.4%), 35-44 (54,5%), 25-34 (52.7%).

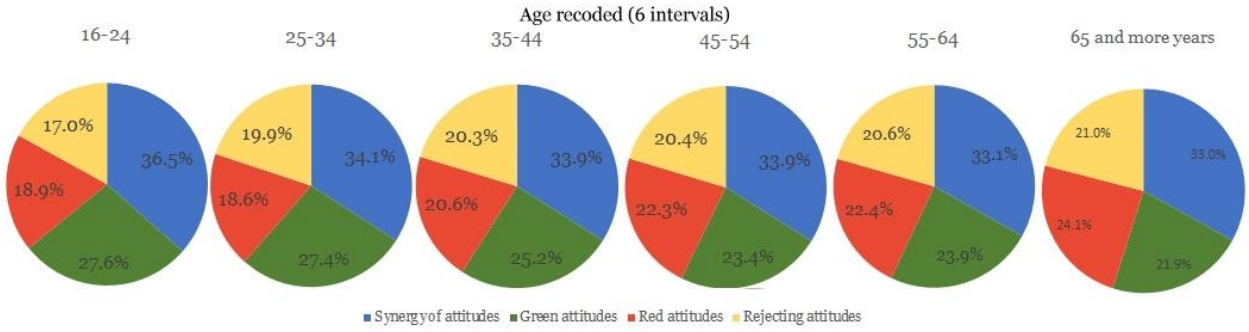

Figure 4. Particular types of environmental and technology attitudes. Author's own elaboration

Discussion and conclusions

The presented study uncovers current trends of changing environmental attitudes in interaction with attitudes towards technology, analyzed for selected nationalities. A better understanding of societal attitudes allows for a more efficient and effective design of educational actions to shape pro-environmental behavior that could slow down the rate of adverse climate change. Given today's advanced technology, the solutions developed should make the most of its advantages. However, without the active involvement of users, even the most interesting ICT4D-based project may fail (Marais, 2011). The rationale presented was the start of this study. In a first step, the country index was created to determine the attitudes of WVS survey respondents towards environmental issues and the impact of science and technology on people's lives. Based on the method proposed by Koch and Fritz (2020), four groups of attitudes emerged.

The average values of the environmental attitude indicators comparison shows high pro-environmental attitudes in the respective national populations. Similar trends can be observed in studies of pro-environmental policies such as preference for fossil fuel taxes (Caferra et al., 2021), energy-efficient behavioral intention (Marquart-Pyatt et al., 2019), perceived climate responsibility, or personal climate action (Pohjolainen et al., 2021). People are increasingly inclined to see environmental concern as a important issue, which can support their motivation to take action against climate change, including the development of appropriate pro-environmental behavior.

Concerning the development of new technologies, the trend is the opposite. The average values of indicators of attitudes towards science and technology comparison shows a decrease in confidence in their

effectiveness. Most societies are not convinced that modern technologies can contribute to a better and more comfortable life as much as they did 10 years ago. Similar results can be percived in other studies, which show an increase in fears of new technologies developing too rapidly (Edelman Trust Barometer, 2021) or of technology being used to manipulate society (Tagliabue et al., 2020). The findings of this study are in line with research that shows an increase in concerns about online safety. Emerging cyber-attacks, identity theft (Walsh et al., 2019), and the growing problem of online criticism are resulting in less motivation to use the apps flooding the market. Among them are some that could reinforce pro-environmental behavior.

Type 1: Synergy of attitudes

The first group of attitudes that emerged from the analysis gathers preferences for both environmental concern and high confidence in science and technology. When planning ICT4D-based pro-environmental educational activities for this group, we can expect the considerable involvement of future users. We can assume that these activities will be addressed to a greater extent to young and middle-aged, high and low-educated recipients. These conclusions are confirmed by studies that show that women, who shoulder most of the household chores, are increasingly using the Internet to fulfil them (paying bills remotely, shopping online). It leads to reduced fear of new technology and increased confidence in it. More and more women are starting to actively use new technologies. In addition, people with secondary education tend to have higher skills, including labor market-enforced digital skills (Qin et al., 2021). Representatives of this group can also benefit considerably from the support of social networks in developing digital skills and more incentives, invitations to use new technologies (Asmar et al., 2020).

Type 2: Green attitudes

The second group of attitudes that emerged from the analysis gathers preferences regarding concern for the environment, but less confidence in science and technology. When planning educational activities for this group, more emphasis should be placed on strengthening incentives towards interest in ICT4D solutions, presenting the advantages and benefits of its' use. We can assume that activities will be addressed to a greater extent to young and middle-aged, high and middle-educated women. According to Graça's team research (2018), women are more likely than men to show empathy towards their surroundings, be it towards people, animals, or the environment. Women are more concerned about the environment, they are also more involved in environmental activities, and they are more concerned about the difficulties or suffering of others, including animals. It is easier to engage them by pointing to emotional rather than rational factors.

Type 3: Red attitudes

The third group of attitudes that emerged from the analysis gathers a preference for prioritizing economic growth over environmental concerns but greater confidence in science and technology. For this group, the role of incentives and the attractiveness of ICT4D-based solutions will be significant. We can assume that these actions will target middle-aged men with low education to a greater extent. According to studies by McCright and Dunlap (2011) or Krange et al. (2018), men are more likely than women to deny climate change and global warming. Economic factors have a significant impact on environmental behavior. This group may seek to avoid educational activities on environmental issues that they perceive as a threat to their quality of life or economic stability (Kollmuss & Agyeman, 2002).

Type 4: Rejecting attitudes

The fourth group of attitudes that emerged from the analysis gathers a preference for prioritizing economic growth over environmental concerns and lower confidence in science and technology. When planning educational activities for this group, more emphasis should be placed on strengthening incentives towards interest in ICT4D solutions, presenting their advantages and benefits of its use but also putting emphasis on incentives. We can assume that these activities will be directed to a greater extent to older, low and middle-educated women. Voulvoulis and Burgman's research (2019) indicates that the convergence of environmental science-technology has the effect of lowering trust not only in science itself but also in new technologies, as inconsistent messages provided by the media create confusion, especially in the case of the

commercialization of science. Digital exclusion can also be a problem, so when designing ICT solutions, exceptional attention should be paid to the needs of the target group and the organization of ICT 4D-based activities in such a way that they are accessible and user-friendly for future users.

The study provides an initial characterization of attitudes towards the two overlapping areas that need to be considered when designing environmental actions based on new technologies, particularly advanced ones based on artificial intelligence (AI), Virtual Reality (VR), or robotics. The findings are addressed to practitioners, policy-makers, educators interested in better understanding the needs of future participants of planned educational actions. Findings contribute to the existing studies on changing attitudes towards environmental protection among society and initiate interest and future debate on how to implement ICT4D-based educational activities. The study novelty lies in the timeliness of the research and the contribution to the development of peculiarly sensitive research field. The study limitations relate to the extent to which the WVS data are used. Due to the needs of the conducted project, the scope of the research was mainly limited to European countries. It would be valuable to extend the analysis to non-European countries participating in the WVS and conducting a factor analysis considering nationality in future research.

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